Chapter 3

International practices regarding gas pricing

The actual natural gas price experienced by end users in any market is virtually impossible to discern except in a state-planned economy (but there the state is unlikely to hand over the information anyway). Whereas spot prices for U.S. natural gas at the Henry Hub, UK gas at the National Balancing Point (NBP), and Japanese LNG coming from Indonesia are readily available, the actual prices paid by consumers would bear little resemblance to the available spot prices because realized prices are a invariably a blend of numerous supply agreements ranging from one day to 25 years in duration. In Asian markets, most gas is procured through long term contracts, whereas price indices like Henry Hub refer to the spot price. Actual volatility experienced by Asian companies is likely to be much lower than is suggested by the spot prices.

Every economy tries some kind of stabilization of prices. It is virtually impossible to figure out an economy-wide average price for each country. This chapter broadly describes the highly evolved pricing models adopted by the US and the UK, as well as Japan which is totally dependent on imports and in China which has a mix of domestic and imported natural gas like India.

3.1: Marketing of Gas as a commodity

Unlike other internationally traded commodity markets, natural gas has disparate regional benchmark prices. The dominant mechanism for the international gas trade, however, remains oil indexation, which originated in Europe in the 1960s and spread to Asia. A contrasting mechanism based on hub pricing and traded markets developed in the United States and has spread to continental Europe via the UK. Today, Europe is witnessing an unprecedented collision between these two pricing mechanisms and gas industry cultures.

According to the International Energy Agency, one of the most essential questions related to global energy supplies and security is whether the traditional link between oil and gas prices will survive. While Europe is currently the battleground, the implications stretch beyond European borders because regional gas markets once isolated are now interconnected through the rising trade in liquefied natural gas. If the spot market model gains the upper hand in Europe, Asia will be the last remaining stronghold of oil indexed pricing, possibly making it unsustainable.

Pricing typically transcends from a cost plus approach (i.e. the acquisition cost of the gas plus a mark-up for non-gas logistics costs and a return on capital) or on the basis of the market value of the gas in competition with other fuels to indexation approach, normally crude or a basket of crudes. Yet another approach witnessed is the industry driven demand and supply based model duly supported by a large number of buyers and sellers. This to an extent is possible where long term contracts are discouraged (European Commission)

to enable new entrants perceive the market as conducive for entry. The flip side is that this leads to volatility of prices.

In a presentation made to the Energy Information Administration, Washington, James T. Jensen[37] from Jensen Associates presented the findings of a survey conducted in 2009 in which the International Gas Union attempted to catalogue the various gas pricing systems currently in operation across different countries. Throughout the world, it listed eight different systems, three of which are utilized for cross border trade. These three are:

1) Gas-to-Gas Competition - Gas priced in open free market trade (North America & UK). Gas prices are independent of oil prices.

2) Oil Price Indexation - Prices are set by formula under long-term contracts (Europe & Asia).

3) Bilateral Monopoly - the dominant pricing mechanism in the former Soviet Union, Central and Eastern Europe; and China where one seller and one buyer decide prices through mutual negotiations based on their bargaining power.

The other five categories apply to internal markets and most commonly are used to subsidize domestic consumers of gas.

Determinants of pricing include number of suppliers (domestic and import), transporters, marketers, storage capacity, development of spot markets,

[37] Jensen, James T., Jensen Associates (August 23, 2012), *International Gas Pricing – A Challenge to Economic Modeling,* A presentation to the Energy Information Administration Washington.

trading hubs, duly supported by legislations towards unbundling to retain independence in transportation and marketing.

3.2: Natural Gas Pricing in USA

The restructuring of the US gas industry by the various FERC[38] Orders has created a highly liquid and transparent market for both gas as a commodity and for natural gas transportation infrastructure.

The system has developed around a number of 'hubs' where pipeline interconnections bring gas flows together from different sources and re-distribute it to different market regions. Natural gas can be traded or priced at almost any location in North America.

In North America there are 38 different hubs (29 in US and 9 in Canada). Trading hubs, whether a producing area hub located near a gas supply basin or a market area hub located near a market centre, are characterized by numerous market participants and access to services, such as balancing and title transfer, organized by the hub operator.

The most important liquid hubs in North America are Henry Hub, located at the Gulf of Mexico in Louisiana (US), and NIT hub located in the western Canadian Sedimentary Basin in Alberta (Canada). Both these hubs are located in the largest producing areas of their respective countries and serve different markets. Prices at other hubs typically are referenced as a differential with Henry Hub or NIT.

[38] FERC = Federal Energy Regulatory Commission. The Federal Energy Regulatory Commission is an independent agency that regulates the interstate transmission of electricity, natural gas, and oil in USA.

The national quotations for physical gas trading utilize Henry Hub as a reference point, much as the oil pipeline junction at Cushing, Oklahoma (US) has become the reference point for the WTI (West Texas Intermediate) oil price quotation system. The Henry Hub is the reference point for trading in physicals and in papers, being the underlying asset of the New York Mercantile Exchange (NYMEX) futures. The Henry Hub futures quotations have the advantage of complete transparency, since they are traded on an exchange.

In contrast to North America, natural gas pricing at Continental European hubs does not provide a true indication of the supply-demand balance because the Continental European market comprises a complicated structure of long-term and short-term contracts. Therefore, Continental hub pricing is not a function of total supply and demand but a function of something quite different; arbitrage of all kinds, between different contract pricing structures, between contract and spot prices, between hubs, between UK and the Continent. In fact, the market in Continental Europe is an ideal stage for arbitrage. Continental Europe utilizes a multiplicity of supply prices and these contrast starkly with the USA where there exists the Henry Hub price and all other prices are derived from it. Portfolio optimization on the Continent falls upon the gas procurement managers who evaluate and select from among the existing supply options.

3.3: Natural Gas Pricing in U.K.

The regulator of the gas industry in U.K. is the Office of Gas Supply (Ofgas), which regulates tariffs and the industry structure. Other institutions with

regulatory authority over the industry include the Office of Fair Trading and the Monopolies and Mergers Commission, together with the competition watchdogs, and the Department of Trade and Industry - the sectoral ministry. Tariffs for market customers are regulated by Ofgas on the basis of the following price cap formula[39]:

Price cap = RPI - X + GPI - Z + E + K,

Where RPI is the retail price index, X is the productivity improvement factor, currently set at 5.

GPI is the gas price index, constructed by Ofgas to reflect British Gas's average cost of gas.

Z is the efficiency factor of GPI, currently set at 1. E is the energy efficiency expenditure factor.

K is a correction factor that allows over- or under recovery of costs in any particular year to be corrected in later years.

Tariffs cannot be changed more than twice a year without the approval of Ofgas. Tariffs for transportation and storage are also regulated by Ofgas. Tariffs are first calculated to generate revenues that cover BGT's[40] total costs and return on assets. Then tariffs are subject to following price cap formula:

$$M_t = [1 + (RPI_t - X) / 100] P_{t-1} - K,$$

Where M_t is the maximum revenue per therm[41] transported by BGT.

RPI_t is the retail price index. X is the productivity improvement factor, currently set at 5.

P_{t-1} is the maximum revenue per therm that BGT was allowed to earn in the previous year.

K is a correction factor that allows over- or under recovery of costs in any particular year to be corrected in later years.

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[39] Juris, Andrej (1998), *Market Development in the U.K. Natural Gas Industry,* World Bank
[40] BGT = British Gas Transco, now known as National Grid U.K.
[41] Therm = 100,000 BTU

While this formula came into effect on October 1, 1994, when BGT introduced a new structure for transportation and storage charges, today the UK gas market is in fact a series of quite different markets, requiring careful empirical examination in order to make sense of their articulation and the process of price formation. At the present time, four different markets can be distinguished: the retail market and three different "wholesale markets": the long-term bilateral contract market, the over-the-counter (OTC)[42] market and the on-the-day commodity market (OCM). Originally, spot transactions were for gas injected at the Bacton entry point on the Norfolk coast; however, shortly after, delivery conditions were standardized and centered on the newly established National Balancing Point (NBP, 1996) – a virtual hub. OTC and OCM markets interact both with each other and with the International Commodity Exchange (ICE; former International Petroleum Exchange) futures market. Moreover both the long–term contract market and OTC market could themselves be seen more as containers for a series of different sub-markets (e.g. long-term contracts between the upstream and wholesalers or between upstream companies).

US and UK markets are highly evolved where financial gas markets exist and contracts are traded primarily for managing price risk and these are not necessarily for physical delivery. Participants in the financial gas market come from all segments of the gas industry. Because transactions in this market involve the transfer of risks among these participants, intermediation plays an important role. The main intermediaries are traders and financial institutions, such as banks and organized exchanges. Financial gas contracts are highly

[42] OTC is a term used to describe trades which are customised confidentially between the parties concerned – in contrast to open-market trades which are standardised and priced transparently.

variable because of the heterogeneity of needs of market participants. The most common types of contract are forward contracts, swaps, futures contracts and options.

3.4: Natural Gas Pricing in China

Tariffs in China are currently based on a cost-plus approach. Except for the two pilot programmes in Guangdong and Guangxi regions, the wholesale pricing regime for domestic natural gas is based on three elements[43], *i.e.*:

- ex-plant (wellhead) price;
- pipeline transportation tariff; and
- end-user price, including fertilizer producer, industrial users (direct supply), city gas (industry or not industry as such).

The ex-plant (wellhead) price is proposed by the project developer and adjusted by the central government. It is based principally on the production cost of natural gas (wellhead cost plus purification fee, including financing cost and tax such as municipal construction fee and education cost fee) plus the appropriate margin for the producer. This price is a baseline, and producer and buyer can negotiate up to 10% above it. While this methodology allows for a common approach for domestic fields and for more expensive fields to be developed as long as the costs can be passed through, it also creates one price for each field: this complicates the regulatory handling of the pricing system when the number of producing fields increases.

[43] Corbeau, Anne-Sophie and others, OECD/IEA (2012), *Gas Pricing and Regulation: China's Challenges and IEA Experience*

The pipeline transportation price is also set by the central government. Before 1984, a flat pipeline tariff was applied. After 1984, new prices were adopted for new pipelines. Transportation prices differ, and are determined on the basis of the pipeline cost (construction and operation) plus the appropriate margin (internal return rate of 12%) with a variation by transport distance from each gas source to each city gate. Therefore, the transport tariff depends on the different consuming regions, and also the diameter and length of the pipelines. The IRR is allowed for all pipelines by the government at a current rate of 12%, which seems to be above OECD averages.

The high IRR is accompanied by very short depreciation periods of ten years or so, while the technical lifetime would be about 40 to 60 years. This has the potential to increase pipeline tariffs even more so, and to allow high profit in transportation of natural gas. According to market players, the high IRR is required to compensate for losses at the production, imports and sales side, where capped prices usually lie below the real production and sales costs. This pricing structure is very similar to that which prevailed in the United States between 1954 and the early 1980s, with capped well-head prices for gas and guaranteed IRRs (of around 12 %) for interstate pipelines. This cross-subsidization (from transportation tariff to well-head price) hinders wholesale markets as it generally leads to a competitive advantage of the integrated companies against non-integrated exploration and/or supply companies without their own transportation capacities.

City gate prices are allowed to differ not only on account of the source of gas supply and transportation cost but also on account of final use of gas, like

residential, commercial, industrial or fertilizer. In fact, even the ex-plant and transport tariffs are fixed on the basis of end use of gas.

Pricing reform is already being piloted by the National Development and Reform Commission in Guangdong and Guangxi provinces and extending its trials to other provinces has been proposed. This reform takes a backwards calculation approach based on oil price indexation, similar to approach taken by many OECD European countries.

Some areas needing improvement include: i) Market dominance and preventing competition using pipeline infrastructure in particular, as this remains a key barrier to development of more-efficient gas markets; ii) Storage needs to be augmented fast; iii) TPA needs to be introduced; iv) establishing a spot market; and v) unbundling.

3.5: Natural Gas Pricing in Japan

Japan Custom Cleared (JCC) is the average price of customs-cleared crude oil imports into Japan (formerly the average of the top twenty crude oils by volume) as reported in the customs statistics; nicknamed "Japanese Crude Cocktail." It is a commonly used index in long term LNG contracts and has replaced the Government selling price of crude oil as standard index.

The Japanese approach to oil-linkage has largely been adopted by North-east Asian nations also. It utilizes a simple formula which is linked to the JCC. It is in the linear form of: **P=C+S*JCC.**

Where P is the Price in $/MMBTU, C is a constant expressed in $/MMBTU and S is the "Slope", a dimensionless number applied to JCC in $/Barrel for incorporating oil indexation.

Because of the constant C, gas prices do not rise proportionally with oil prices as do European prices. A typical formula would be P=$0.80+0.1485*JCC. In this case, when JCC=$100/Barrel, P=$15.65 per MMBTU.

Because oil prices have gone through wide swings over time, "s curves" (sometimes caps and/or floors) were introduced at one point in Asian contracts. *S curves* reduce the slope at upper and lower "pivot points"; they thus have the effect of protecting the buyer at high oil prices and the seller at low oil prices but as oil prices began to move to much higher levels in 2004/ 2005, *s curves* increasingly put the seller at a disadvantage. With the tight Asian LNG markets towards the end of the decade, producers were successful in removing most of them.

Asian natural gas storage capacity is generally limited given the absence of production fields. Large scale LNG storage has been discouraged due to safety concerns, high energy costs, and space constraints. Liberalization and hub development are still continuing in many OECD European countries. Besides this aspect of the development stage of the market, experience from OECD countries shows that liberalization takes time, usually a decade (and often more), before reaching any quantifiable results. Japan, despite having established gas industries for decades, is still far from having liberalized gas markets.

3.6: Comparison of various models of pricing of natural gas

There are major structural differences between markets in the US, the UK, China and Japan. These arise due to fundamental differences in the key drivers of pricing in each market – the ever-changing mix of supply,

consumption, and storage. With history as a guide, the one certain thing is that these markets will never become static. Continuous movement and increasing interdependence will drive each country to refine its own unique regulatory approach to managing markets. Price shocks will no doubt continue, and each shock will inevitably create winners and losers.

The least regulated markets of the U.S. and the UK have seen greater natural gas price volatility. Yet excess volatility in the natural gas market may not, in the end, be cause for alarm. Price volatility is both a necessary and permanent part of a liquid market, as concluded in a 2003 study by the American Gas Foundation[44]. It may be that, to paraphrase President Franklin Roosevelt, the only thing we have to fear is fear of volatility – not volatility itself. If a free and open market lets buyers, sellers, and traders innovate and use market-based tools to cope with price fluctuations, the net economic costs may be trivial.

The recent report presented by the Rangarajan Committee[45] has looked at the various pricing models for natural gas available internationally before recommending a formula for pricing of domestic natural gas in India. The Committee has recommended that the netback import price may be averaged with the average of Henry Hub, NBP and Japanese natural gas import price to arrive at the price for domestic gas. Their recommendations are under consideration of the Government of India.

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[44] Whitman, Austin F., M.J. Bradley & Associates LLC (January 26, 2011), *Natural Gas Price Volatility – Lessons from Other Markets,* Report for the American Clean Skies Foundation and the Task Force on Ensuring Stable Natural Gas Markets

[45] Rangarajan, C. (December 2012), *Report of the Committee On the Production Sharing Contract Mechanism in Petroleum Industry,* Economic Advisory Council to the Prime Minister, India