



Research Article

# Gas and LNG pricing and trading hub in East Asia: An introduction

Shi Xunpeng<sup>a,b,\*</sup>

<sup>a</sup> Australia-China Relations Institute, University of Technology Sydney, 15 Broadway, NSW, 2007, Australia

<sup>b</sup> Energy Studies Institute, National University of Singapore, 29 Heng Mui Keng Terrace, Block A, #10-01, 119620, Singapore

Received 6 October 2016; accepted 23 December 2016

Available online 21 February 2017

## Abstract

This paper summarizes the four papers in the special issues on ‘Gas and LNG pricing and trading hub in East Asia’. The papers examine lessons and experience from European hub development, other commodity, the Japanese history on developing of futures markets and inter-fuel substitution in East Asia. The papers finds that liquid futures market is the key to formulate benchmark prices while a well-developed spot market is the foundation; political will and strong leadership are required to overcome the power of incumbents and to restructure the gas market that impede the the development of competitive markets; and East Asia needs to develop its indigenous gas or LNG trading hubs even in low oil prices period and its developing market allows easier changes in new contracts than in existing ones. This hub development requires governments to go through tough domestic market reforms, including liberalization and cooperation with each other and with gas exporters.

© 2017 Sichuan Petroleum Administration. Production and hosting by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

**Keywords:** Natural gas; Hubs; East Asia

## 1. East Asia's gas and LNG pricing and trading hub issues

Oil indexation has played a positive role in the early stage development of the natural gas industry. However, as of now, oil indexation faces many criticisms, which include failure to reflect gas market fundamentals. In East Asia, LNG and gas prices are often linked to JCC oil import prices since LNG was first introduced in Japan as an alternative source of energy to reduce the high dependence on oil. This oil linkage guaranteed that gas was competitive with oil. Such an oil indexation pricing mechanism was used to gain market share from oil in the early days for gas market development globally [1]. Although oil indexed gas prices reflected the market fundamentals of the 1970s–1990s in continental Europe and Asian LNG, fundamentals in both these regions have changed significantly by the end of the 2000s, but gas

pricing mechanisms failed to reflect the changes in fundamentals [2].

The transition to hub-based pricing has been well advanced in northwest Europe and North America but has just emerged in East Asia. North American gas prices reflect gas supply-demand balances through gas-on-gas competition while European prices are linked both to oil prices and hub prices. Most LNG exports to East Asia, including some spot trades, are however still oil indexed [3]. The share of oil indexed imports (including both LNG and pipeline gas) in East Asia was 83.7% of the total imports, against the global average of 48.7% in 2015; 59% of consumption in Asia was oil indexed while gas-on-gas competitive pricing only accounted for 14%, mainly in India [4].

In recent years, there were substantial gaps in prices between the major hub based spot prices in North America and Europe, and oil indexed long-term contract prices in East Asia due to high oil prices [5]. In response, in East Asia, the world's primary destination for LNG, pricing LNG using an oil index kept LNG prices high and thus drove consumers to use more reasonably priced coal.

\* Australia-China Relations Institute, University of Technology Sydney, 123 Broadway, NSW, 2007, Australia.

E-mail address: [xunpeng.shi@gmail.com](mailto:xunpeng.shi@gmail.com).

Peer review under responsibility of Sichuan Petroleum Administration.

East Asia is preparing to change its dominant oil indexed long-term contracts to more flexible hub (spot) indexed contracts for its LNG and pipeline gas imports. Since 2010, the continued prevalence of oil-indexation has had the most adverse effect on Japan, the world's largest LNG importer. Japan implemented several strategies to challenge traditional LNG pricing mechanisms in the region. These included an increase in the share of spot and short-term purchases, sourcing new supplies from the United States under alternative pricing arrangements and driving regional buyer cooperation [6].

In order to make such a transition successful, a local benchmark price is needed. This benchmark price will have to be generated through gas-on-gas competition either within a major domestic market, such as China or Japan, or between major markets, such as the East Asian LNG markets. In both case, establishment of a gas trading hub is required.

The traditional way to create such a trading hub is within a national market where market liberalization and other competition policies allow a gas-on-gas competition to reveal market equilibrium prices. Such a national hub roadmap faces several challenges in East Asia. First, most East Asian gas markets, except the Singapore gas market, are not mature, or are mature but not liberalized and thus are not yet ready to host such a competitive national trading hub. China and Japan have unveiled their plan for market liberalization, but the region is less tolerant to the decade long process of domestic gas market liberalization.

The regional LNG hub approach is thus proposed as the alternative, even though a regional LNG trading hub is a novel idea. This approach creates LNG-on-LNG competition through removal of restrictions on current LNG trade, mainly on the destination clauses. Since it does not require national market liberalization, it can conceivably be achieved quickly. Given the significance of East Asia in the world's LNG market, the trade changes in East Asia will have significant impact on the regional and global LNG markets.

In general, understanding the impact of hub creation, hub indexation and contract flexibility (hereafter contract changes) in East Asian gas on regional gas market is a current need of national policy formulation in East Asia. However, the impact of such changes is not well understood. More specifically, since there is no gas trading hub in East Asia, an examination of ways to create such a hub is an immediate question faced by policy makers and the industry.

## 2. The special issue on gas hubs

Given the emerging status of gas trading hubs in East Asia, and Singapore's efforts to host a trading hub that can offer benchmark prices for East Asian LNG trade, Energy Studies Institute (ESI) at the National University of Singapore set up projects to study key issues on gas/LNG trading hub and associated market development in East Asia. Key research issues studied include: (1) history of gas market development in East Asia and prospects; (2) lessons for establishment of gas hubs from other commodity markets and gas hubs in Europe and (3) the roles governments play in the development of these

benchmark prices around the world. Dedicated studies were conducted for hubs in commodities such as coal, oil, and iron ore, for the European hub creation experience and for coal-gas substitution.

In addition to these projects, two international workshops were held to facilitate dialogue among multiple stakeholders, including buyers, sellers and traders, academia, industry and government officers. The key takeaways from the ensuing discussions were included in the research report.

In this special issue, we present four research papers from the ESI research projects and the related workshops. The first paper is about the European hub development experience (hereafter the European hub paper). This case study was conducted mainly for two reasons: first, the European gas market is in the process of transition and thus drawing on the experience is relevant; and second, due to its developing status, there are always new issues that have not been studied and thus the additional study can create value added to the literature. This paper offers a comprehensive analytical framework that enables hub development and draw implication for East Asia.

The second paper analyses development of hub based pricing in three widely traded and most important commodities, namely crude oil, iron ore and coal, to determine key components and the role of governance in the formation of market accepted hub based prices (hereafter the commodity paper). The choice of the three key commodities is based on their importance and different stages of development in market based pricing. While East Asia is new to gas trading hub, it has experienced stages of market formation in these three commodities. For example, Singapore is a global trading hub for oil and iron ore. Indonesia has an unsuccessful experience in providing benchmark price for coal, in spite of its status as the world's largest thermal coal exporter. The iron ore market is of particular interest because the market completed transition from long-term contract trade to spot indexed trade only a decade ago and the development of Singapore as a trading hub despite having no indigenous supply and demand.

The third paper studies the experience of the Dojima Rice Exchange (DRE) (hereafter the DRE paper). The experience of the DRE, the world's first futures markets, is a useful reference for East Asia in terms of developing gas futures markets: it is located in the same region, has had similar challenges of product standardization, and represents a typical case that better illustrates the development of commodity markets from scratch. In various stages of its existence, the DRE managed to overcome a range of market problems, and was able to make commodity futures trading efficient. In other stages, it failed to cope with the challenges, which led to significant discrepancies between futures and spot prices, and increased vulnerability faced by market participants. The shift of economic power from Osaka to Tokyo significantly weakened the DRE but its closure was caused by government decision. Due to the uniqueness of East Asian history, traditions and culture, the DRE case may offer some lessons for modern East Asia.

The fourth paper is about coal and natural gas substitution in East Asia (here after the substitution paper). Future development of natural gas market in Asia is of much concern. Since the top three LNG importers in the world: Japan, South Korea and China take up 55.5% of the world's total traded LNG in 2015, the potential of substitution between natural gas and other energy sources in some countries may have great regional and global impact. These different outlooks will also affect the hub initiative and associated contract changes in the long run.

### 3. Summary of findings

#### 3.1. *The European hub paper*

Findings from the European experience suggest that market liberalization and transition of gas pricing mechanism are required to establish such competitive markets while political will, appropriate regulations and good governance are necessary to safeguard the competition environment.

Market liberalization is a necessary measure to create the demand for wholesale trade, which in turn is the key incentive and fundamental role of a trading hub. The transition to hub pricing and consequently increased flexibility in the long term gas contracts will create demand for hub trading and increase liquidity of the price benchmark.

The European hub paper shows that strong political will is needed to fight with the power of those incumbents that will suffer from the liberalization process. The creation of hub indexation poses significant challenges to incumbents, who might be against the liberalization. Therefore, legislation was used in Europe to force incumbents to release infrastructure capacity and gas market shares to new entrants and thus to increase market competitiveness. For example, the delegatization of “destination clause” provides the legal foundation for importers to request destination free and the opening-up of Germany's end-user market through legal decisions kicked off the change in attitude towards traded gas markets.

Natural factors, such as presence of domestic production and culture, might have contributed to the hub development and facilitated gas pricing transition.

As the experience of gas hubs located across continental Europe demonstrates, they contribute to flourishing trade, but are preconditioned by the comprehensive process of gas market liberalization, and no single best model of gas hub development exists. Nevertheless, transparency and connectivity are necessary features of a benchmark trading hub that is accepted by market players. The successful development of a liquid wholesale gas market requires the following efforts: clear rules and mechanisms that address the choice of a transmission system model, the design of the balancing rules, and presence of transparency requirements. When there are multiple candidates for benchmark hub, the first mover will have advantage, as the case of TTF hub prices in the Netherlands.

It also suggests that regulation of financial market players is important for the sustainable development of gas hubs as financial players, although necessary to develop futures market, may distort the gas markets.

#### 3.2. *The commodity paper*

The commodity paper concludes that the role of governance is important but vary in the process of transition to market based pricing. It finds that large volumes of physical trade often underscore the price creation at trading ports. Since prices from many physical trade cannot be observed, price reporting agencies (PRAs) is important in impartial and efficient price and trade information dissemination.

Financial market that appears after the spot market improve the robustness of pricing mechanisms through the injection of forward looking price signals from the financial layers. In these financial markets, although benchmark prices may still be location-bound to key demand or supply centres (by specifying specific delivery locations), the corresponding price become an international price.

The commodity paper suggests different roles of government at different stages of hub development. At the initial stage, governance could play an important role in building relevant soft and physical infrastructure that will reap the first mover advantage in hub building. First mover advantage is crucial in establishing benchmark prices, but will need continuous reinvention to be continuously relevant. However, when market develops, government will be less required amid of concern of distorting markets. In the stabilized market, governances should maintain stable rules and regulation and monitor for future changes.

#### 3.3. *Dojima Rice Exchange paper*

The DRE paper proposes a general design of a LNG futures exchange which offers commodity standardization based on the terms of the futures contract via either physical or cash settlement and analyzes the experience of DRE as the first futures market for commodities in Asia. It argues that the Asian LNG trading hub needs a bottom-up approach that is different from existing North American and European ones to designing its futures exchange due to the lack of a regional infrastructure connectivity and dominance of LNG trade.

The DRE papers concludes that a well-functioning futures market can meet a wide range of expectations from the market participants by facilitating communication, transportation, financing, storage, price formation, and uncertainty bearing; financial players such as hedgers and speculators are equally important to the exchange itself. The diverse interests of market players are balanced by the contracts with standardized products. While the participation of financial institutions is necessary, it has to be properly regulated.

The DRE case study provides a number of implications for the LNG futures market development. These include market fundamentals, the division of role between the market and the government, financial institutions, commodity standardization, government predictability, and the ability to regulate the volatility of spot and futures trading.

The experience of the DRE demonstrates that market fundamentals, regulations, macroeconomic context, geopolitical events, and natural factors like weather conditions all affect

the successes and failures of the futures exchange. Market fundamentals are the essential factor for the establishment of a successful spot market, which is essential for the development of a futures market. Regulations, although useful, could not create markets without the market fundamentals. There is a division of roles between government and the exchange: while a mature legal and financial system is required for a thriving future markets, the self-regulation of market is also important. However, the government can easily shut down even a mature market through anti-market measures.

### 3.4. *The substitution paper*

In the substitution paper, a log linear trans-log production function model is established to investigate inter-fuel elasticity of substitution between coal, oil, natural gas and electricity in China, Japan and South Korea. The results show that elasticity estimates of both coal-gas substitution and coal-electricity substitution to be positive over 1985–2012, suggesting that these two energy inputs are substitutes at least to some extent. It also reveals that relatively higher substitution possibilities between coal and natural gas, and less opportunities to substitute coal with other fuels in China. Furthermore, the model results suggest the elasticities of coal-gas substitution in China are much larger than that in Japan and South Korea, indicating there is higher possibilities of coal-gas substitution in China.

One point that has not been stated, but implied in the substitution paper, is that a lower price of natural gas will stimulate gas consumption through substitution and thus is of gas sellers' long term interest. The larger elasticities of coal-gas substitution in China than that in Japan and South Korea and the outlook for growing energy demand in China indicates that China is the key determining factor for gas sector development in East Asia. Therefore, much of the new pricing mechanisms and contract terms could be tested from the new demand from China.

## 4. Policy implications

All the four papers offer policy implication for East Asia regarding development of gas hubs and its associated pricing transition. These can be summarized as market development, the role of government and lessons for East Asia.

### 4.1. *Market development*

A liquid futures market is the key to formulate benchmark prices while a well-developed spot market is the foundation of a successful futures market. Market fundamentals are essential for the development of successful spot and associated futures markets. Competitive markets are necessary for functional gas hubs and a highly liquid hub is the one that is widely accepted by the market.

Financial market players, may cause market turbulence, and but is a necessary part of the hub development. Spot trading is necessary but not sufficient for a benchmark hub and

the liquidity in the futures is the key factor of success for a benchmark hub. However, “commoditization” of LNG global trade, a consequence of hub development in the long run, will lead to commodity cycles that are common in commodities markets.

Since market fundamentals are more or less naturally determined, the government can advance the hub creation by creating competitive markets through liberalization and regulations. Yet, policy makers have to anticipate and prepare for the volatility of spot and futures trading when making decision to replacing oil indexation with hub indexation. Government should enforce appropriate regulation to prevent financial players from manipulating the market to their advantage.

### 4.2. *Roles of government*

Political will and strong leadership are needed to overcome the power of incumbents and to restructure the gas market. Government through its legislation and regulations, plays a critical role in development of gas hubs. Government roles include safeguarding the competition environment, maintaining law and order and creating the gas market liquidity.

Despite the necessity of government policy, the government is not the creator of hub as markets are not created by policy or regulation, but are created by trade and traders. The boundaries between policy intervention and markets' own rules have to be properly defined and the government regulation should be predictable. Therefore, government roles are needed but should be selective. Nevertheless, as shown in the case of DRE, the government can also shut down a mature market through anti-market measures.

The role of government policy is different at different stages of market development. While government policy is critical at the initial stages, as the market develops, market prefers public policy to adopt a “hands-off” approach. However, continuing efforts at removing potential market distortions is desirable across the various stages of market development.

### 4.3. *Lessons to for East Asia*

East Asia needs to develop its indigenous gas or LNG trading hubs. Since the intra-regional pipeline connection is largely non-existent in East Asia, it is the LNG spot cargo trading that is likely to become the basis for the regional gas futures market in the near future.

Although the pathway to such gas trading hubs might be more difficult than others due to factors such as a lack of indigenous production and inter-connectivity, vertically integrated industry structure, the traditional preference of supply security, and unclear political signals, a growing market creates an opportunity to start new terms with new contracts without being influenced by vested interests.

To create functional hubs and transition to hub indexation, East Asian governments need to liberalize gas and electricity markets, transit to from oil indexation to hub indexation,

readjust government roles to boost competition, improve flexibility in LNG markets, and integrate gas and LNG markets. Separation of transportation from commercial activities, implementation of Third Party Access to pipeline and LNG terminals, and liberalization of gas prices are priority areas.

Regional cooperation among consumers and between consumers and producers should be enhanced. Despite the dynamics and challenges, collaborative efforts between exporters and importers to change the pricing mechanisms are necessary and possible as gas trading hubs could be beneficial for gas importers and gas exporters by providing the right price signal that will improve the efficiency of gas utilization. Regional gas market integration would also be useful to increase the total liquidity in the LNG and gas market. If the market is efficient, the East Asian prices will reflect the region's own fundamentals and is fair to both buyers and sellers. As an immediate solution, suppliers and consumers can cooperate to eliminate

destination restrictions on LNG trade as a freer trade of LNG will contribute to formation of regional LNG market prices before gas-on-gas hubs emerges.

## References

- [1] IEA. Developing a natural gas trading hub in Asia: obstacles and opportunities. Paris: International Energy Agency; 2013.
- [2] Stern J. International gas pricing in Europe and Asia: a crisis of fundamentals. *Energy Policy* 2014;64:43–8.
- [3] Aguilera RF, Inchauspe J, Ripple RD. The Asia Pacific natural gas market: large enough for all? *Energy Policy* 2014;65:1–6.
- [4] IGU. Wholesale gas price survey – 2016 edition. Norway: International Gas Union; 2016.
- [5] Shi X, Variam HMP. Gas and LNG trading hubs, hub indexation and destination flexibility in East Asia. *Energy Policy* 2016;96:587–96.
- [6] Vivoda V. Natural gas in Asia: trade, markets and regional institutions. *Energy Policy* 2014;74:80–90.