

Research Article

# Development of Europe's gas hubs: Implications for East Asia

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## Abstract

Gas trading hubs have been initially developed in the US in 1980s, UK in 1990s, more recently in European in the 2000s and mulled in East Asia now. Due to its freshness and diversification in nationality, governance and culture, the European hub experience can offer valuable lessons for East Asia. This paper seeks to advance understanding of gas hub development in Europe and provide lessons for East Asia. The European experience highlights that market liberalization and transition of gas pricing mechanism are necessary in creating the competitive markets that are needed for functional gas hubs. Political will and regulations further safeguard the competition environment needed for hub development. Natural factors, such as significant domestic production and culture could have a significant impact on the hub development and transition of pricing mechanism. In East Asia, the path to gas trading hubs might be more difficult than in Europe but a growing market creates an opportunity to start new terms with new contracts. Nevertheless, East Asian needs to work hard to development its indigenous gas or LNG trading hubs.

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## 1. Introduction

With the development of independent natural gas markets, the oil indexed pricing mechanisms for natural gas are increasingly challenged [1,2]. As alternatives, the gas-on-gas competitive pricing mechanisms through gas trading hubs have become increasingly popular in Europe, although they took a few decade time to reach their current status [2]. The gas trading hub model was first developed in the United States (US) in 1980s – with its Henry Hub (HH) as the leading example – and the United Kingdom (UK) being the first in the Europe in 1990s and then by Continental Europe in 2000s.

Despite differences in their performance and national contexts, European hub development experiences provide important lessons for building gas hubs in East Asia. In the

past few years when the oil was about \$80 per barrel and when the gap between Asia's oil indexed LNG prices and US and European hub prices are beyond cost of arbitrage, Asian buyers have looked to move away from oil indexed to hub-indexed LNG imports [3]. It is also believed that the creation of a gas hub would consolidate regional demand and thus increase the ability of East Asia to bargain from a position of strength for lower gas prices [4].

Even though hub-indexed prices in Europe and North America have been indirectly used by Asia gas buyers<sup>1</sup> [5], there are concerns that Henry Hub prices may not reflect the market fundamentals in East Asia as perfect arbitrage is not possible, and the unique characteristics of regional supply and demand 'de-couple' regional commodity market prices from global prices [6]. Factors such as geographical risks and

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<sup>1</sup> LNG buyers have used contracts indexed to the Gulf Coast's Henry Hub natural gas price benchmark to hedge their price exposure in Asia, and buyers are demanding new terms for renewal of contracts.

foreign exchange risks as a result of using pricing benchmarks from outside the region will encourage the development of East Asian benchmark prices.

This paper investigates the European experience and draws lessons for East Asia in developing its domestic competitive gas markets and gas hubs. Questions to be answered are: What learning points from the European experience can be applied towards creating a gas hub in East Asia? What role did governments play in the development of the competitive markets and hubs? Were there common regulatory mechanisms and key infrastructure put in place to facilitate the development of the markets and hubs? What the likely scenario for hub development in East Asia based on the EU experience?

This major contribution of this paper is to offer a comprehensive analytical framework that enables hub development and draw implication for East Asia. Most studies on gas hubs in Europe focus on pricing and price correlation [7–9]. The previous studies on gas hubs in Europe examine either specific country case studies [4,10], or technical details, such as balancing issues [11,12], flexibility and tariff issues [13], pricing discovery [14], or determinants of gas prices and the role of market integration [15]. There are also a few studies on the pricing patterns in a competitive market [16,17], on the impact of different pricing mechanisms [3], and other studies that deal with the impact of European integration on gas markets [8,9,18,19]. The issues of spot markets and trading hubs have been intensively discussed in the Chinese literature [4,10,20–23]. The consensus is that China needs to build a spot gas market that can offer benchmark prices for China and even Asia and the Pacific. While the European experience in hub development may be mentioned in some studies, none of them have dedicated to study the European case in details. None of these studies have summarized the European hub experience from an East Asian perspective.

The paper proceeds as follow: Section 2 introduces the methodology used in this study. Section 3 presents a brief overview of the development of gas hubs in Europe. Section 4 summarizes key lessons learned from the European case study. Section 5 discusses the implications of hub development in East Asia through a comparative study. The last section concludes the paper.

## 2. Methodology

This research was conducted through desk study, fieldwork to Europe and interviews conducted in China, Japan and Singapore. The experience and arguments in the literature were reviewed and analysed, and comparative studies between the Europe and East Asia were conducted. The European views and debates were collected through field interviews conducted in the UK, France, Germany and the Netherlands during 24 June to 3 July 2015. The institutions interviewed include gas/LNG traders, Exchanges, hub operators, information providers, academic researchers, IEA, and industrial players. Further discussion and debates was conducted during a workshop held on 28–30 August 2015 in Singapore.

## 3. Overview of gas hub development in Europe

Gas hubs in Europe originated in the UK in 1996 and proliferated throughout Continental Europe beginning in the 2000s, but the level of development has been uneven. The National Balancing Point (NBP) is Europe's first gas trading hub, having been established in the UK in 1996. Following the lead of the UK, gas trading hubs mushroomed across the EU throughout the 2000s. The first continental gas trading hub is the Belgium Zeebrugge (ZEE), which emerged after the construction and start of the Interconnector pipeline in October 1998 linking it to the UK NBP market.

Europe is more interested in building a virtual trading hub (rather than a physical one) as it has more flexible trade arrangements and is more open to participants, in particular, financial players [2]. Most European hubs are virtual hubs, with the exception of Zeebrugge in Belgium. Zeebrugge is a physical hub, where the Interconnector meets the Belgian distribution system [1]. The physical hub requests traders to bring their gas there and thus discourages the interests of many traders.

The level of development is quite different among the active hubs in Europe. Northwest Europe has the most advanced hubs, followed by Central Europe, while gas hubs are still at their early stage in Southern Europe. According to a European Commission Report, as of 2013, the share of gas hub trading varied significantly among these regions. In Northwest Europe, it accounted for 80% of all natural gas consumed. In Central Europe, the number was lower and stood at around 50%. Southern Europe, however, had only about 15% of its gas consumption based on gas-to-gas competition. Southeast Europe is 100% dependent on oil-indexed contracts [24].

While some European gas hubs represent cases of successful experience, others have failed to be mature and even ceased to exist. The UK's NBP, the Netherlands' Title Transfer Facilities (TTF), and Germany's Net Connect Germany (NCG) are the examples of successful hubs. Based on the assessed performance of European gas hubs in 2014 and 2015 (Fig. 1), the two most developed European hubs are the British NBP and the Dutch TTF. The assessment also give high scores to the two German hubs and the two Belgian hubs (Zeebrugge and virtual hub ZTP) in the latest assessment. The two Belgian hubs recorded significant improvement. German Gaspool and the Net Connect Germany (NCG) are the latecomers to hub-based trading, but are already known for their quick growth rates of trading volumes (liquidity). While the other hubs are less active. The PEGs, CEGH, PSV and GTF also relatively good.

Assessed by churn rate,<sup>2</sup> a popular indicator of hub performance, the difference among hubs is more significant. According to Heather [25], in 2014, both NBP and TTF has a churn rate of more than 20, well above the minimum of 15 which is reportedly required by Gazprom as the requirement

<sup>2</sup> "Churn rate" refers to the ratio between traded volume and physical gas throughout and is a widely used indicator for spot market liquidity.

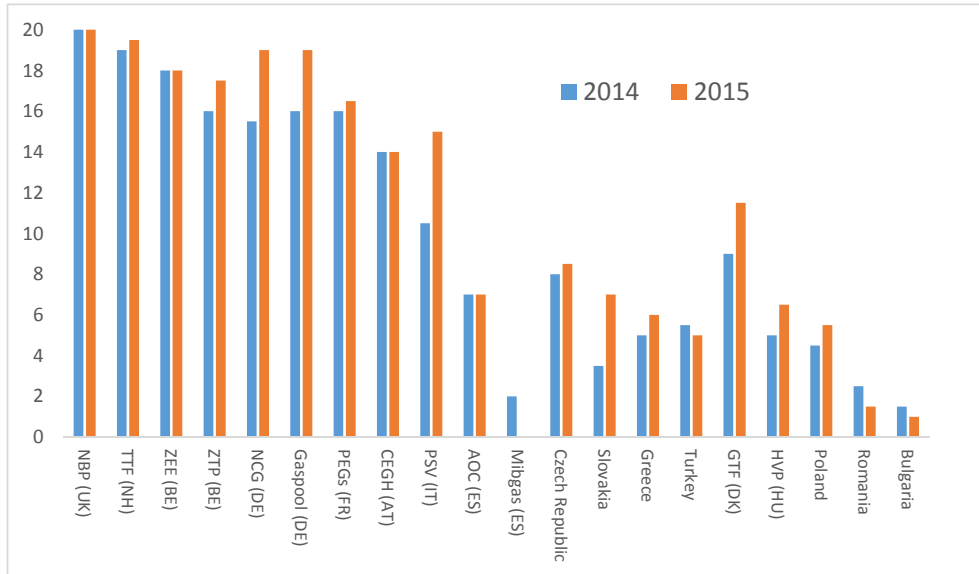


Fig. 1. Scores of individual European hub assessments. Source: EFET, 2015. Review of gas hub assessments, published on 7 January 2015.

for a credible (liquid) hub. In contrast, the German, Australian and Belgian hubs had a churn rate of 3–5 while the rest hubs only had a churn rate of less than 2. The French and Italian hubs have performed poorly (Fig. 2). In the European continental gas markets, TTF is the only pricing benchmark, while other hubs are priced as spreads with TTF prices. Although ZEE has good performance, it does not offer a benchmark because its prices are dependent on those of NBP.

Although many hubs are more or less successful, only two of them, NBP and TTF, are benchmark hubs. Although the Netherlands' TTF is developed after NBP, it became the benchmark to which prices in European end-consumer contracts are pegged. TTF has developed quickly and steadily in the past few years, and is considered a success story. NBP had

a good start and was successful but was overtaken by TTF by annual traded volume in 2014 [26]. In July 2015, TTF overtook NBP as the most liquid gas hub in Europe based on monthly trades [27].

TTF's ascent to the top of gas trading hubs has brought by some chances. When Germany renegotiated its long term contracts with Gazprom in 2009, Gazprom did not agree with Germany's hub prices because Gazprom argued that Germany's hub prices could be manipulated by the German utilities, which are the major owners of German gas hubs. For the same consideration, the German hubs were not accepted even by the domestic counterparts. According to interviews with an expert, NBP prices, as the most liquid market at that time, were also not accepted by Gazprom and the German parties because

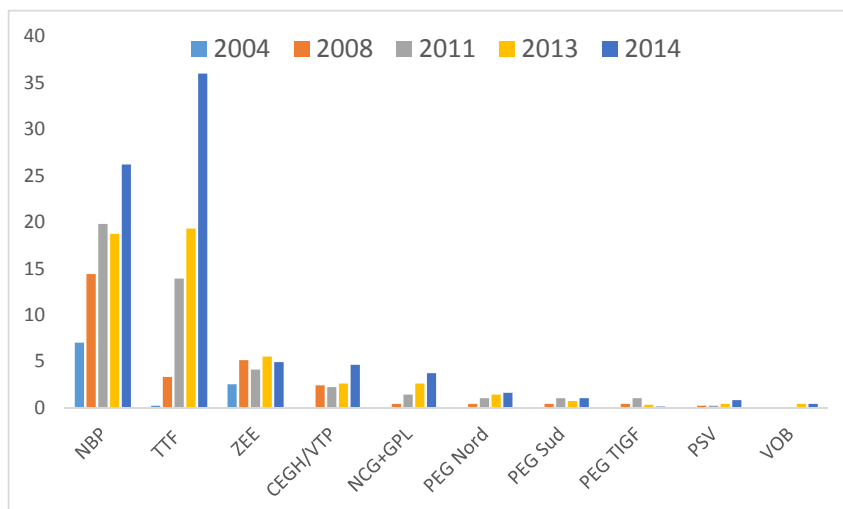


Fig. 2. Net churn rate of European hubs, 2004–2014. Note: The net churn considers trade volume only and exclude swaps volume. Source: [25].

NBP is priced in Pence and thus creates exchange risks for continental companies. Instead, TTF prices are acceptable to both Russia-German parties as reference prices for the Russia-German contracts despite of its considerably low churn rate of 3.3 at that time [25] because TTF was the most developed trading hub in Continental Europe after ZEE<sup>3</sup> and TTF is priced in Euro. Furthermore, TTF prices are neutral to both parties: German companies were not significant in TTF, and thus could not manipulate the TTF prices. After the TTF is used in the long term contract, companies started to hedge in TTF which further boosted its liquidity. Nowadays, since TTF has been developed, other European hub owners have no interest to make their hubs better because they think market liquidity is not enough.

Despite the successful development of various hubs, there is no cross-country regional hub yet. As of 2012, none of these European hubs are transnational, all are national (the United Kingdom, the Netherlands, or Italy), or sub-national (France, Germany) and there were over 30 entry-exit zones in the EU [18]. Although the boundaries of the market areas do not necessarily coincide with the boundaries of a member-state, one member country often has one market area and one operator is appointed as the area's Transmission System Operator (TSO). However, with the development of infrastructure and the rolling out of market liberalization, gas prices in different European wholesale markets are converging.

Different performance in Europe's hubs reflects challenges of uniform application of the EU-wide framework of liberalization and provide lessons for developing existing and future gas hubs in Europe and future hubs in East Asia.

#### 4. Key factors for successful hub development

The experience of numerous European gas hubs demonstrates that there are a few essential factors for gas hub development. Unbundling of vertically integration gas companies creates the necessary market players. Market liberalization and pricing transition create the need of trade and the liquidity. Hub and transition of gas pricing formation are interconnected. On the one hand, a key outcome of the pricing transition is the emergence of gas trading hubs, which produce the benchmark prices as alternatives to oil indexed prices. On the other hand, hub creation is a key enabling factor for the pricing transition as hubs can facilitate trade, and enable competitive markets to function [2].

In addition, the liberalization and pricing transition requires political determination, and changes of cultures, regulations and governance practices. Strong political will is needed to fight with the power of those incumbents that will suffer from the market liberalization and pricing transition. Legislative changes are often required to force incumbents to release infrastructure capacity and gas market shares. While governance is needed, domestic production will facilitate pricing

transition and trading tradition is beneficial in accepting gas hub pricing model.

##### 4.1. Market liberalization and competition

The comprehensive process of gas market liberalization is a precondition for hub development. These could be demonstrated by three reasons. First, market liberalization is necessary to create the competitive environment. The lack of market competition is a major barrier for hub development. In Italy and France, the hubs were not developed well due to a lack of government will to liberalize their gas markets. A liquid hub was delayed in Italy due to the failure of creating a competition in middle and downstream sectors to the extent seen in the Northwest European liberalised market in the 2000s [28]. It was argued that there was no real desire for an effective commercial and liquid PSV gas hub in Italy until very recently [25]. For example, despite the Italian government is enforcing antitrust ceiling and gas releases, ENI is still the dominant player who owns storage, a majority of production and import infrastructure [28], and did not trade at the PSV at all until recently [25]. Similarly, while the Belgian gas market was developing in line with the EU liberalization directives, the lack of competition at early stages of ZEE's development resulted in delayed implementation of reforms.

Second, market liberalization is a necessary measure to create the demand for wholesale trade, which in turns is the key incentive and fundamental role of a hub [12]. In a monopolistic industry, the integrated company can manage most of the injections and withdrawals, and balance the export shocks in supply or demand, through adjustments within its portfolio of contracts, and thus has no demand for trade. In contrast, deregulation in the gas sector creates fragmentation and thus demand for trade. Liberalization of final gas pricing prevents costs to be passed on to consumers, thus creates the need of trade and competition. Unbundling encourages market participants to utilize hubs in order to balance their contracts, manage their portfolio risks and even speculate, and thus increase liquidity of the markets. The establishment of NBP followed national gas market liberalization with the privatization of the British Gas Corporation (1986) and implementation of the Gas Act (1995), which effectively introduced competition. Liberalization of gas markets in the EU achieved a milestone that supplier dominated gas markets have been rebalanced to better meet consumers' needs. This is a relatively recent achievement because as recent as 2005–2006 observers criticized market arrangements where pipeline owners and traders used to be the same companies capable of manipulating the market [29]. These worries were addressed by the 3rd Energy Package.

Additionally, liberalization of national electricity markets also plays a major role in gas hub development, as utilities are major gas consumers who are less likely to participate in wholesale gas trading if they can pass costs to consumers.

The importance of liberalization on hub development is testified by the experience of TTF. Unlike NBP, TTF and its development did not take off until 2009, when a number of

<sup>3</sup> ZEE is priced in pence and thus has the same currency conversion risk as the NBP.

necessary market changes were implemented. First, in July 2009, the TSO standardized traded natural gas effectively erased the difference between high and low calorific gases. Second, in April 2011, the TSO implemented “Market Based Balancing,” a real time balancing regime [30,31]. Third, suppliers of the Dutch gas market including GasTerra, Exxon and Shell, have actively supported hub-based trading. As a result of these comprehensive liberalization measures, TTF trade volumes skyrocketed from 2009 to 2011, rising at about 62% annually. By 2012, TTF could be referred to as a mature market [31].

The process of liberalization involves organizational restructuring of concerned industries, and implementation of a regulatory reform program. Miriello and Polo [12] proposed an evolutionary path for the wholesale natural gas market: development of wholesale trade for balancing need in a fragmented market, a second source of gas supply as an alternative to long term gas in the liquid market, and traded financial instruments to manage risks. The key factors of success are liberalized wholesale markets and final prices, the unbundling of vertically integrated gas companies, open and transparent third party access (TPA), through the introduction of a common network code, proper competition legislation, and hands-off government policy [2]. The workable third part access and transparent hub prices make consumers, in particular, large consumers, access to various suppliers and thus the competition for large consumers become fierce [32].

#### *4.2. Pricing transition for long term contracts sustains competition and generates liquidity*

The transition to hub pricing is another important factor to create demand for hub trading and increase liquidity of gas hubs. After liberalization, the local hub prices may be significantly lower than the oil indexed import prices at least at some times.<sup>4</sup> For example, a combination of unexpected availability of new LNG on the markets and reduced demand due to global financial crisis created the significant price discrepancy between the oil indexed long term contract prices and the spot prices [1] and motivated the European gas pricing transition. With this price difference, and the freedom to choose their suppliers by consumers in a liberalized market, the traditional utilities that signed oil-linked long terms contract were often bypassed and consequently suffered financial loss as well as failure to meet the minimum take-or-pay levels. The price gap and retailing market liberalization lead to unsustainable financial exposure of the midstream utilities which have to seek arbitration and negotiated price reductions in their long-term gas contracts [33].

Supply surplus is a key market condition that enables the pricing transition. On the one hand, the surplus will create a lower spot prices than oil indexed prices. The price difference

and liberalization caused financial loss to incumbents, who could not survive and have to resort to renegotiation of their long term contracts. In North America, the Henry Hub gas trading hub was adopted in the late 1980s when interstate gas trades became less difficult than before, supply became abundant and production became competitive [34]. The development of continental European hubs only effectively started from 2009, when a surplus of LNG supply catalysed hub liquidity and development [25]. In the few years after 2009, the European market was over supplied by the unexpected availability of new LNG due to the US shale gas boom, soaring oil prices, depressed demand due to the global financial crisis, and the commissioning of new LNG liquefaction terminals in Qatar, Yemen, Russia and Indonesia [32].

On the other hand, the surplus shifts the bargaining power to buyers and make the transition possible. The pricing transition was made possible by the shift to a consumer-dominated market and reconfiguration of market players which gradually led to the formation of a ‘hybrid price’ market since the mid-2000s. Since most of the failure of take-or-pay happened with Gazprom, the European utilities have renegotiated their contracts with Gazprom by reducing prices and level of take-or-pay by 2012 [32]. Gazprom is a strong support of oil indexation and did not accept hub prices initially, but instead gave discounts to bring the oil indexation prices close to hub prices [25]. However, in September 2015, Gazprom Export conducted gas auctions for the first time, symbolizing its acceptance of a partial move away from the traditional long-term oil indexed contracts towards a market (hub) pricing mechanisms given the current over supplied market situation [35].

The transition to spot marking is not an easy job in the business sector. The breakdown of long term oil indexed contracts is a dramatic change to the mode of commercial practice and creates winners and losers. The transition of gas pricing formation in Europe was achieved by the re-negotiation of some long-term oil indexed contracts by introducing spot indexation and more flexibility on the take-or-pay quantities that occurred from 2010 onwards [1] and increased use of shorter-term contracts (IGU, 2011). Some of the changes of long term contracts are completed through arbitration, which is not desirable for business partnership. Due to the fact of significant financial loss from the importer side, arbitration was often successful. Since the financial loss in European gas companies is too heavy to be sustained, arbitration was the only chance for the European utilities to survive.

#### *4.3. Political will and regulations*

The liberalization and pricing transition has been very costly for many participants, in particular, the incumbents. Market liberalization means that the incumbent monopolistic companies had to give up their vertical integration, market power and market share. The dominant integrated gas companies such as in UK (British Gas) and the Netherlands (GasTerra), were unbundled and forced to relinquish their market share to make room for new players. The liberalization of the retail gas sector caused a progressive loss of monopoly

<sup>4</sup> Such low spot prices, however, will not be always the case because spot prices could be higher than oil indexed prices. The function of the market is supposed to *form* prices, while not reduce them.



for the traditional utilities. These incumbents are often nationalised companies (or only recently privatised) with strong ties to governments, and thus have the incentives and capability to lobby for delays in the process of market liberalization demanded by European law.

Strong political will is needed to fight with the power of those incumbents that will suffer from the liberalization. UK was able to succeed in liberalization due to the aggressive nature of the government. The process of change was led by the strong political will to ‘privatise’ the nationalised British Gas by the government [12]. The change was also boosted by a strong alignment of interest from all the key market players [31]. On the contrary, a poor political and regulatory framework to encourage trading contributed to the failure of Italian PSV [25]. Similarly, TTF was only kick-started after the implementation of the ‘Gas Roundabout’ in the mid-2000s [36]. The gas market liberalization in Continental Europe was driven by the EU’s political ambitions to create both a fair market for all consumers and an integrated energy market [2].

Government regulations is a necessary instrument to safeguard the hub development. In Europe, the illegalized “Destination Clause” which limits the essential flexibility that a functioning gas market needs provides the legal foundation for importers to request destination free. The opening-up of Germany’s end-user market through legal decisions kicked off the change in attitude towards traded gas markets. Firstly, in June 2006, long term contracts between E.ON and its distributors were declared to be illegal, and limitations on the duration of any future supply contracts were imposed. Subsequently, in March 2010, the prices for natural gas for private clients were no longer allowed to be immediately linked to the prices for heating oil with the declaration from the German Federal Court of Justice [25]. In contrast, Italy and France lagged behind in hub creation and hub pricing development due to their regulations that place restrictions on both cross-border trade and their strong incumbents [28]. In Austria, only after the implementation of a new Austrian Gas Act in October 2011 and the start of the new VTP hub in January 2013, there have been noticeable improvements in the liquidity of that hub [25].

It has been argued that in the European gas market liberalization experience indicates that the successful development of a liquid wholesale gas market required the following efforts: clear rules and mechanism that address the choice of a transmission system model, the design of the balancing rules, and presence of transparency requirements [12].

#### 4.4. *Natural factors: domestic production and culture*

Some natural factors can affect the gas hub development and the much needed market liberalization and pricing transition. First, multiple sources of supply can facilitate the transition to hub indexation. Additional factors such as supply by several pipelines plus possible LNG, large demand by several buyers, and storage of gas are considered valuable to the pricing transition [37]. For example, when there is an alternative in Western Europe, Russia reduces its gas prices in the western European markets, but maintains the oil indexation

in the Eastern Europe. The British transition also has the advantage of multiple suppliers. Diversified supply sources, improving interconnections between and within markets and the European Commission’s favouring gas-to-gas competition as an alternative to oil indexation, are also key factors promote the transition (IGU, 2011).

The availability of domestic production facilitated the European market transition. It would be easier for regulation to force domestic producers to change their behaviour (move to hub trading), and thus create spot trading, through hubs. This is particularly true in the UK and the Netherlands, where the governments initially unbundled the vertical gas companies, and created domestic competition without incurring dispute with foreign companies. Such a trading hub revealed prices that can be used as a benchmark to force foreign suppliers to change their behaviour at a later stage. In the Netherlands, the transition to hub pricing was boosted by full commitments from the domestic incumbent producer, GasTerra (after some political pressure to ‘use the hub’), from the TSO and from the market participants [25].

Cultural factors could influence the gas market changes. Countries such as Great Britain, the Netherlands and the Nordic countries are benefiting from their long tradition of trading, hence both gas market liberalization and hub development progressed well in those countries. The Dutch and Norwegian suppliers were quickly open to the hub pricing model, and offer alternative contracts with indexation to hub prices [25]. In contrast, France, Italy and other southern European countries have traditionally been more defensive of their trading environments, selecting ‘national champions’ rather than allowing markets to decide. For example, the prevailing attitude in both France and Italy is much in favour of strong national ‘flag bearing’ companies, and thus liberalization of the gas sector is slow. The lack of pricing liberalization is the reason behind the slow development of hubs in those countries. In between the two ends of the spectrum are the Germanic countries, which have developed their own trading systems and are resistant to changes that would arguably improve performance, due to confidence of their own system [25]. Traditional utilities are also adverse to change, preferring to keep their franchise and control of consumers [2].

As part of the broader cultural factors, government administration tradition also matters. Liberalization and transition to competitive markets also challenges the ways of governance. Countries that value energy security more than market efficiency will find it difficult to adjust to the new model. The role of government in the economy has to be changed from the command and control model to an indirect market based model. Such transitions are complicated and often a challenge for governance capability.

However, cultural change is possible. The dominant culture of oil linked long-term contracts was fractured by the restructuring gas companies under the utilities umbrella. Even the employees in the old gas sector will be impacted by the transition of pricing mechanisms. The European experience has shown that the market players in the previous oil indexed world have gone, and the old paradigm has disappeared with the change of

executives in the gas trading industry. The latter do not share gas companies' ties and ways of doing business with non-European suppliers [7]. They do not hesitate to question the value of oil-linked prices and long-term contracts [7]. As a result, the terms of some contracts have been renegotiated and now include, or solely consist, of spot price indexation. New contracts also reduced take-or-pay levels [24]. With such changes in Northwest Europe, others will more or less be affected.

## 5. Implications for East Asia

### 5.1. A comparative study between Europe and East Asia

The significant difference between East Asia and Europe should be examined before taking any lessons from the European experiences considering the potential impact of natural factors.

First, East Asian gas markets are fragmented and lack local (domestic) supply in most countries. In contrast, the European gas markets are interconnected. Most East Asian countries, such as Japan, Korea and Singapore, have no domestic production, which makes their unbundling easier but the creation of competition more difficult than in the UK and the Netherlands. Such natural conduction lead to over-reliance on LNG, insufficient gas market liquidity and a lack of gas-on-gas competition and the dominance of LNG makes liquidity harder to be created in East Asia than in Europe.

Second, the long term oil indexed contract arrangement causes the gas prices to not reflect the region's own market fundamentals. While gas prices in the US and some European markets are set by hubs based on gas-on-gas competition, pipeline gas and most LNG into East Asia are traded under oil-indexed contracts. The share of oil indexed gas (both LNG and pipeline) in East Asia was 88%, much higher than the global average of 65% [38]. The prevailing destination clauses in long term contracts further limits the development of liquidity in the East Asian market [3].

Third, a lack of gas market liberalization in East Asia limits the prosperity of hub development. In contrast to relatively liberalized European markets, in particular those in Northwest Europe, all East Asian gas markets share similar characteristics, including a lack of wholesale competition, monopoly, and a limited number of market players. The Chinese gas markets are dominated by three major national oil companies (CNPC, Sinopec and CNOOC) and 70% of pipelines are owned by CNPC [36]. Japanese and Korean companies often purchase their LNG under long-term, mostly oil-indexed, contracts, and thus require limited competition in the downstream sector to secure the distribution to end users [1]. While in Korea, KOGAS is the only importer with access to the domestic gas market [39]. None of these major markets have well-functioning energy trading platforms and derivatives markets. Without a competitive spot market for natural gas, there is little incentive to change current commercial practices in East Asia, especially from the suppliers' side. Thus, the adjustment to a competitive gas markets would be very difficult and impossible without government's determination.

Fourth, the interdependence power liberalization and gas markets is another challenge for East Asia. The liberalization of the electricity sector, as the major gas user, will create competition in the electricity markets and thus force generators to change their business model from fully passing through the price risks in the gas markets to consumers to managing their fuel risks and thus creating demand for risks mitigation trade. The absence of power market liberalization can affect the evolution of gas consumption since power sector is one of the key drivers for gas demand. In the EU, the liberalization of power markets has usually been a step ahead of gas markets [1]. While in East Asia, power markets are largely regulated in the majority of countries, except Singapore. Even though the electricity market is liberalized in Japan, the Japanese utility companies have regional monopolies and rely on fixed and long term trading for security concerns [2].

Lastly, the different mind-set between Asia and Northwest Europe could discourage the process of market liberalization. East Asian countries often put security of supply at the top of their policy agenda, and thus prefer state interventions through big companies. The traditional energy security culture that is willing to pay a higher price for stable supply will be challenged by the unbundling of incumbents, as the higher prices cannot be passed through to final consumers in an unbundled sector. This concern is particular serious in Japan and Korea where the import dependence is high. Similar to the lack of enthusiasm in Southeast Europe [25], whether East Asian policymakers really want to have an open gas market is still not clear. Similar to both France and Italy, at least in China, the prevailing feeling is much in favour of strong national energy companies [25], and thus liberalization of the gas sector may not be as full as those in Northwest Europe.

East Asia also cannot replicate the European transition because of some other unique factors, such as the vertically integrated industry structure, which prevents the justification of contract renegotiation based on financial loss, since the loss incurred in downstream can be compensated by upstream, or the higher costs will be passed on to consumers.

However, the future growth in East Asia allows new model for newly added volume. The East Asian market is growing quickly, particularly in China, while the European market only develops slowly. The Asian natural gas market is the fastest growing gas market worldwide and the trend of growth is expected to continue. The IEA [2] predicts that Asia may absorb 80% of the incremental LNG imports over the medium term, among which China alone will absorb 30%.

### 5.2. Market liberalization

If some East Asian countries want to create a liquid gas hub, it will have to go through tough and challenging market liberalization process in the electricity and gas sector. The East Asian gas and electricity sector needs to go through a tough liberalization process. The European experience shows that the creation of hub indexation poses significant challenges to incumbents, who might be against the liberalization. Given the nascent status of market liberalization in both gas and

electricity sectors, the East Asian governments need to take measures to promote market liberalization if they want to realize a local gas hub.

Liberalization in the gas and electricity sectors needs to be deepened in China and Japan, and extended to other countries. China has started to liberalize its gas market, including promoting TPA [40]. Japan has announced in February 2015 that its gas and electricity sectors will be liberalized from 2017 [41]. The further liberalization of Japan's gas and electricity markets in the next decades may make Japan better prepared for a gas hub. But South Korea and Chinese Taipei have given no indication of whether they intend to pursue liberalization yet. The liberalization process, however, does not need to be developed simultaneously across East Asian importers.

Political will and strong leadership are needed to contest with the power of incumbents and restructure the gas market. Existing market participants do not like liberalization. As shown in the British case, the privatisation of nationalised industries, and their effective implementation have led to a liberalized gas market.

An alternative way to create an East Asian benchmark prices without demand of market liberalization is to create a regional LNG hub [42]. Such a regional hub could be building on trading and liquidity out of any national boundary through LNG spot markets. Eliminating destination restrictions in current LNG contracts could be a way to enhance trade flexibility and create an East Asian spot LNG market. However, such efforts of creating a LNG hub is unprecedented and whether it can succeed remains to be seen.

### 5.3. Pricing transition

East Asia cannot replicate the European experience of creating flexible gas markets by breaking rigid long-term contracts through renegotiation and arbitration. Unlike in the European transition, arbitration is not likely an option for East Asian market players to initiate the transition for a number of reasons. First, there is no critical situation, such as heavy financial loss. In particular, due to the current low oil prices, the need for change in pricing mechanisms is largely muted. Second, to have arbitration, there must be a hub trading to provide market reference, and the gap between the hub prices and the oil indexed prices are not reasonable. Since arbitration is not an option, the only way to change the practice of oil indexation is through negotiations, which must be agreed by both producers and consumers.

In order to balance benefits between importers and exporters and to find workable solutions for sustainable LNG market development, both exporters and importers must cooperate. Collaboration between consumers and producers are needed in order to change international trade practices for creating the demand for flexible LNG, and even pipeline gas trade. However, as spot prices have been lower than contract prices in recent years, discussions on the pricing mechanism have been incorrectly conflated with the ones on the association between gas trading hubs and low prices [14,43]. Dialogue forums for both producers and consumers should be

maintained and strengthened to discuss such contract flexibility issues. While the price gap is a key driver for pricing transition, the low gas price period is an window for initiating the pricing transition because the difference between alternative pricing mechanism are minimal [44].

### 5.4. Regulation and roles of government

The East Asian governments will have to enhance its governance capability in creating competitive markets, monitoring its operation, and regulating financial markets. Governments must maintain and supervise competitive market conditions instead of focusing on price regulation along the value chain. The governments' role is to put together the framework for the ease of trading, regulatory environment, infrastructure and transparency [45].

Governments also need to create the liquidity through mandating the sale of gas to the hub. In Italy, the government, through the Decree Law 7 (2007), mandates importers and domestic producers to sell certain amount of gas at the PSV [28].

East Asian government should promote cooperation among themselves and between producers and consumers. Importers can come together to share their experience in creating meaningful gas trading hubs [46]. Regional gas market integration would also be useful to increase the total liquidity in the LNG and gas markets. Pipeline interconnection, either through the existing pipelines in Southeast Asia, or through pipelines in Northeast Asia, could overcome the fragmentation and form regional gas trading hubs. For example, integrating the Singapore, Malaysia and Indonesia markets could form a gas trading area with diversified supply sources and increase liquidity of gas hubs in these three countries, if any.

Regulation of financial market players is important for the sustainable development of gas markets. The financial market players could be powerful because they hire the best minds and distort the gas markets. In the case of crude oil prices, even major OPEC members are complaining because they have difficulty in understanding oil pricing formation. If the government is not well prepared for the coming regulations, it is better to have a mixture of government (socialism) and the market (capitalism).

Although the roles of governments have been emphasized, it however does not mean that government is the creator. Trading hubs are not created by policy or regulation, but are created by trade and traders. For countries that have traditions of government intervention in the markets, even if the gas market is liberalized, creditability has to be established for a market of free from intervention. Credible state commitments to regional gas market competition can instil confidence, encourage new market participants, and promote the use of transparent hubs to balance producer portfolios.

## 6. Conclusion

The European experience highlights that market liberalization and transition of gas pricing mechanism are necessary in creating competitive markets that are needed for



functional gas hubs. Political will and regulations further safeguard the competition environment needed for hub development. Natural factors, such as domestic production and culture could have a significant impact on the hub development and pricing transition.

In contrast to the European experience, the lack of indigenous production and inter-connectivity, vertically integrated industrial structure, the traditional preference of supply security, and unclear political signals, suggest that the development of regional LNG trading hubs in East Asia might be more difficult than in Europe. However, the potential of gas demand growth offers East Asia an additional opportunity that does not exist in Europe: East Asia can apply new models for new contracts and thus start the transition with little effect on vested interests.

In order to creating functional hubs and transiting to hub indexation, East Asian governments will have to develop in such areas as gas and electricity market liberalization, transition of oil indexation pricing formula to hub indexation, and readjustment of government roles to boost competition. Enhancing flexibility in LNG markets to create a regional LNG trading hub and integrating gas markets to create gas trading hubs should be tried. Regional cooperation among consumers and between consumers and producers are should be enhanced.

Even if some East Asian countries are determined to develop their hubs, there is little chance to have one by 2030. The market liberalization and transition to hub indexation often take more than decade and the process is costly and challenging.

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