



Research Article

Key elements for functioning gas hubs: A case study of East Asia

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Abstract

This paper clarifies various concepts relevant to gas trading hubs and presents an innovative framework with key elements to create gas hubs. The nine key elements in the framework are further divided into basic elements for balancing hubs and advanced elements for benchmark hubs. The framework is applied to three East Asian case studies. The East Asian comparative case study shows that while Singapore is leading the way in establishing an LNG hub in Asia, the LNG hub concept is yet to be tested. Meanwhile, although China has the potential to host a gas hub, its current level of hub development is low. The paper suggests that these countries can advance their hub initiatives by strengthening the key elements as detailed in the proposed framework and create a more conducive environment through efforts such as market liberalization.

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Keywords: Gas hub; LNG hub; Elements; China; Japan; Singapore

1. Introduction

Given the transition from oil indexation to hub indexation in Europe, the significant difference between East Asian spot and long-term LNG prices, and the concern with the “Asian Premium” [1], oil indexed gas pricing has been facing challenges in East Asia [2,3]. With the upcoming expiration of long-term supply contracts, short-term contracts and spot trade will increase, thus encouraging new thoughts on the way natural gas is priced. As hubs are the foundation for the

creation of reliable (benchmark) price indexes for gas and LNG trade as alternatives to oil prices [4], many East Asian countries are planning to create local gas or LNG hubs [5].

Although several studies have addressed hub development experience, they do not address the question of how to create a gas hub. To date, the Oxford Institute for Energy Studies (OIES) has published three reports on hub building measures. In the first report, Heather [6] explains how a traded market operates but devotes little attention to the hub itself. In the second, Heather [7] measures the liquidity of most European hubs and categorizes them accordingly. In the third, Heather [8] evaluates the structure and effectiveness of European gas hubs and assesses the development of gas trading in each country. In another study, Miriello and Polo [9] focus on how the liberalization process creates a demand for wholesale gas—the foundation for a hub—but they do not address the key factors underlying the creation of a hub. Shi [10] studies Europe's experience in developing gas hubs with implications for Asia but he focuses on institutional and structural aspects such as market liberalization, separation of transport, and market players.

Abbreviations: CQPGX, Chongqing Petroleum and Gas Exchanges; DES, delivered ex-ship; FOB, free-on-board; JOE, Japan OTC Exchange; MT, million tones; METI, Ministry of Trade and Industry (Japan); NBP, National Balancing Point; OTC, over-the-counter; PRAs, price reporting agencies; OIES, Oxford Institute for Energy Studies; SGTm, secondary gas trading market (Singapore); SHPGX, Shanghai Petroleum and Gas Exchange; SLInG, SXG LNG Index Group; TPA, third party access; TSO, transmission system operator; TTF, Title Transfer Facility; VTP, virtual trading point.

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Although studies of Asia's gas market and hub development have emerged in recent years [1,2,11,12], these studies examine general issues and do not explain how a hub in East Asia can be created. A study from the International Energy Agency (IEA) [11] focuses on creating a competitive wholesale market and identifies some features of an Asian gas trading hub. The IEA [12] study presents a framework for the enabling factors of natural gas trading hubs, including hands-off governance, independent transport, third party access (TPA), wholesale price deregulation, sufficient network capacity, and a sufficient number of market players, but does not cover hub development itself. Shi and Variam [2] estimate the impact of various hub pricing scenarios on the world gas market and suggest that hub indexation and destination flexibility are favorable for East Asia. In the context of China, Shi [13] discusses the creation of a gas hub there. The US Energy Information Administration (EIA) [5] clearly defines the availability of infrastructure, with multiple pipelines that converge and interconnect, as well as the presence of numerous trading parties, as the foundation for hubs.

However, no study has discussed the key elements for successful hubs. The present paper fills this gap by examining the central question: what are the elements needed to create a benchmark hub? The contribution of this paper is three-fold. First, it proposes a reference framework that includes the key elements for establishing a gas hub and discusses their applicability to an LNG hub; second, it clarifies various concepts on hubs; and third, it comparatively analyzes the gas or LNG hub development status in China, Japan, and Singapore using the reference framework.

The development of gas markets in key East Asian countries such as China, India, Japan, and South Korea will add complexity and dynamics to the regional and global gas/LNG markets, thus necessitating more studies. East Asian gas markets will become more important to gas producers and the global LNG trade due to the uncertainty of Europe's demand and the disappearance of North America as an LNG importer [12]. East Asia is expected to become the second largest gas consuming region by 2025, with 790 billion cubic meters (bcm) of natural gas demand [11], and an important market in the global context. Over 73% of the global LNG demand is from Asia and 61% of that is from China, Japan, Korea, and Chinese Taipei [14].

The paper proceeds as follows. Section 2 presents the definitions of terms and the methodology. A reference framework including key elements for functional gas hubs is then proposed in Section 3. Section 4 compares the hub development status in the three countries mentioned based on the framework. Section 5 concludes the paper.

2. Methodology

The creation of a gas trading hub and its development as a benchmark hub have a few key prerequisites. In order to reveal these key elements, we draw on international experience, mainly that of the US and Europe, in the development of gas

hubs. Based on a literature survey, this paper proposes a reference framework of nine elements for creating hubs. The key elements of a hub are selected from various reports, including the "European Gas Hub Study" [15–17], which scores individual European hubs annually, as well as elements recommended and verified by the literature. For example, the IEA [11] reports that the major parties involved in the development of a natural gas hub include market participants, transmission system operators (TSOs), hub operators, brokers, and exchanges. The framework is then used to assess hub pricing initiatives in China, Japan, and Singapore.

2.1. Definition of hubs

Before discussing what is needed to create a hub, it is necessary to clarify the meaning of a hub, as the definition will affect the scope of the elements. Although gas hubs have been a hot topic, there is no clear definition that emerges from the various concepts of hubs. In other words, the concepts of hubs in the extant literature are diverse and sometimes contradictory. The hub concepts include varied terminologies such as hubs, benchmark hubs, financial hubs, balancing hubs, virtual hubs, physical hubs, risk management hubs, and exchanges. Such terminologies are sometimes contradictory. For example, Heather [8] stated that all European hubs were "balancing" hubs but only the most mature and successful hubs (i.e., the National Balancing Point (NBP) and Title Transfer Facility (TTF)) were "trading" hubs (in addition to being balancing hubs). In contrast, the IEA [11] labeled all European hubs as "trading hubs," regardless of their liquidity and the existence of financial trading. The European Federation of Energy Traders [17] seems to agree with the IEA [11] calling all European hubs, including the nascent ones, trading hubs. Thus, to date, a clear definition cannot be found within the extant literature on this topic.

This paper follows the IEA [11] approach by defining a hub as a platform where the title (ownership) of gas molecules is exchanged between a number of buyers and sellers in both spot and futures trades and by treating gas trading hub, hub, and trading point as interchangeable. The following subsections define some sets of hubs.

2.1.1. Physical hubs versus virtual hubs

A common hub classification is into physical delivery points and virtual market places. A physical hub is a geographical (centrally located and sufficiently interconnected) point in the network where a price is set for natural gas delivered at that specific location [11]. This mostly exists in North America with the Henry Hub as a typical example. The EIA [5] defines the presence of multiple converging and interconnecting pipelines, as well as numerous trading parties, as the foundation for such a hub.

In the case of a virtual hub, trading hubs can also be used interchangeably with virtual trading points (VTPs). VTPs are associated with the entry-exit system (market area) from which point the same or other network users can transport the gas to exit points [18]. A VTP is usually within a market

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