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Institutional preconditions and genesis of natural gas exchange trading¹

Abstract

Natural gas is one of the world's leading sources of primary energy, and gas exchanges are key players in the natural gas market, which ensure its functioning on a liberal basis. Given the current liberalization trends, exchange trading in natural gas is gaining momentum and importance in this market. *The main objective* of the study was to determine the institutional preconditions and the main stages of the genesis of the exchange segment of natural gas trade. *The study* showed that gas exchanges and gas hubs are the key institutions of natural gas exchange trading, as they ensure openness and transparency of the market. *As a result* of the study, the author identified the following institutional prerequisites for the creation of gas exchanges: the need to form a competitive gas market and ensure its availability to third parties, ensuring transparent pricing and setting the market price for gas, simplification of trade procedures and standardization of products, protection of the execution of agreements and limitation of risks, which is manifested in the security and reliability of supplies and increasing the energy security of the state. Identifying the stages of the evolution of natural gas exchange trading, the author distinguished gas trading on mixed commodity exchanges, gas trading on universal and specialized energy exchanges, which began to emerge slowly in the 1990s, and gas market liberalization, accompanied by a boom in the creation of gas exchanges and gas hubs. The recession of 2008–2009, the shale gas revolution, the process of decarbonization of the economy and the full-scale invasion of Ukraine by Russia have been the main catalysts for the modern transformation of the natural gas market in recent decades. The author concludes that the latter will significantly affect the natural gas market in the coming years, which will lead to a revision of European policy in this area and the struggle for energy security. This paper is an original scientific study of the evolution of natural gas exchange trading and makes a certain contribution to the study of the peculiarities of the gas market functioning.

Keywords

natural gas, gas exchange, gas hubs, gas market evolution, Europe

JEL: N24, N74



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1 Introduction

Over the past decades, natural gas has become one of the vital resources for the functioning of national economies. Despite the importance of natural gas as a fuel for the economy, the exchange segment of gas trading is relatively new. The boom of gas exchanges started only one or two decades ago. On the European market, this boom is closely linked to the creation of the European natural gas market and the implementation of EU directives and regulations aimed at liberalizing the natural gas market. Exchanges are key players in the natural gas market, which ensure its functioning on a liberal basis. This is evident from

their functions: pricing, price transparency, supply/pricing flexibility, physical balancing and financial risk management (Heather, 2015, p. 31).

In-depth studies are dedicated to the natural gas market foundations and peculiarities (Correljé, 2016) and to revealing the stages and features of its formation and development (Yukhymets, 2021). Some researchers analyze the creation of the stock exchange (Polikeyvych, 2015) and its role (Heather, 2015, p. 31–34). At the same time, there is a lack of research on the evolution of exchange trade in natural gas, which, given the current trends of liberalization, is gaining momentum and importance in this type of energy market.

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The purpose of this study is to identify the institutional preconditions and main stages of the genesis of the exchange segment of natural gas trade. This goal determined the logic and structure of the work. The main part of the work begins with the definition of historical preconditions of exchange trading in general and institutional preconditions of exchange trading in natural gas in particular. Section 3 is devoted to the analysis of the creation and importance of gas hubs in connection with the functioning of the gas exchange. The following sections describe the genesis of natural gas exchange trading, the establishment and functioning of gas exchanges, as well as the main catalysts of modern transformations of the natural gas market. In the last section, in accordance with the results obtained, conclusions are drawn on the main institutional prerequisites and stages of the evolution of natural gas exchange trading and modern transformations in the gas market.

2 Institutional prerequisites for natural gas exchange trading

The exchange market is the highest form of organized trade and the main form of the wholesale market of mass goods, the key element of which is the stock exchange. On the way to creating a modern exchange market, wholesale trade has undergone significant transformations from traditional markets, fairs, auctions to the stock exchange. Its emergence and development was an objective consequence of the development of large commodity production, the desire of traders to simplify the trade process associated with logistics and price fluctuations in the market. Its history dates back to the 15th century. Since then, the exchange has evolved from an organized place for the immediate purchase and sale of commodities to the sale of forward contracts, futures and options. From a place that did not provide regulation of legal relations regarding concluded contracts to clear, strict rules with guarantees and payment of margin. From the commodity type of exchange to the dominance of trading in financial assets, the creation of stock, currency, futures, cryptocurrency and universal exchanges. With the development of Internet technologies, electronic trading has become a widespread phenomenon. The end of the 20th century is also characterized by the consolidation of exchange trade, acquisitions and the emergence of new exchange associations.

Thus, the emergence of an exchange is a marker of market maturity, and the natural gas market needed more than one and a half hundred years for this. Gas production began in the early 19th century in the United States and in the mid-20th century in Europe. Trading of gas contracts on the exchange began in the 1980s, and gas exchanges started to appear a decade later.

Natural gas is a unique commodity by its physical and chemical properties and importance for the economy. The extraction (production) processes and infrastructure development usually require significant investments, which leads to the formation of monopolies in the supply sector due to the lack of appropriate technologies at the stage of market nucleation. The gas market was not a systemic phenomenon and consisted of several unconnected gas pipelines connected to large consumers. The peculiarity of the gas infrastructure was its dependence on the availability of consumers capable of ensuring stable demand, which was also dictated by the impossibility of stopping gas production. Combined with other possible risks, this led to long-term contracts of 20 to 40 years. One of the conditions was a guarantee that no other gas company would have similar supply rights in a certain territory (Yukhymets, 2021, p. 22). On the one hand, this sphere was not regulated by the state and operated on the principle of "laissez-faire". On the other hand, arbitrary pricing, a limited number of participants, closed access for third parties and limited access to information made it impossible to compete, which is the main market mechanism.

With the development of industry, the demand for natural gas has been increasing. Companies reacted to this by trying to use their monopoly position to make profits, which led to government intervention, regulation of the industry and the formation of national monopolies. Gradually, this type of energy resource has become necessary for many industries and has influenced the structure of the economy, especially in developed countries, which were able to ensure the construction of gas transportation infrastructure and the required number of end users (Yukhymets, 2021, p. 24). Today, unprocessed or raw natural gas is one of the world's leading sources of primary energy, accounting for approximately 1/5 of the world's primary energy. It is used in households for heating, water heating, cooking, as a fuel for vehicles, as well as for industrial purposes (Natural Gas).

The limited number of gas producers and the dominance of state-owned companies in production and exports in one country have created conditions for oligopolistic behaviour on the market and threatened competitiveness (Hulshof et al., 2016). This situation laid the next precondition for the formation of the exchange market – the need to reduce the price of gas, as natural gas has become a basic resource. By price reduction is meant the establishment of a market price, since price reduction is possible to the extent that the price is fair and ensures profit, since gas production and transportation require significant investments. In the absence of profit, the activity in the industry becomes inexpedient.

In the context of gas price formation, an important point was its dependence on oil and other fuel prices. Accordingly, with a sharp increase in oil prices, the gas price according to this formula became unreasonably high. The exchange, as an institution that allows for competitive bidding with a large number of participants, also ensures the formation of prices that actually reflect the market value of goods and resources.

The peculiarity of natural gas is that its consumption increases in winter and decreases in summer. Exchange products create an opportunity to diversify sources and conditions of supply, secure supplies through hedging and due to the complex contractual structure of the gas exchange.

3 Gas hubs and exchange trading

Exchange trading in natural gas is inextricably linked to the functioning of gas hubs. Dubovskiy (2020) consider the exchange to be synonymous with a hub. Some researchers and experts note that exchanges coincide with gas hubs in the wholesale gas market (CEER, 2011, p. 19), Markevych, Omelchenko (2016, p. 18) and Yukhymets (2021, p. 78) characterise virtual gas hubs as particular exchanges.

By definition, a gas hub is a point where several gas pipelines converge, enabling trade and physical

exchange of gas between many buyers and suppliers (Reuters Staff, 2017). Therefore, despite some terminological uncertainty, hubs are necessary for the functioning of the gas exchange. Thus, in the late 1980s, the NYMEX (New York Mercantile Exchange) chose Henry Hub as the place of delivery of futures contracts for natural gas, after which the relevant contracts began to be traded on the exchange.

A gas hub is the central point of pricing for natural gas in the network (Reuters Staff, 2017; Kulikh, 2016, p. 6). It can be physical (typical for the USA) or virtual (typical for the European market). In Europe, the first gas hub appeared in the UK in 1996, and since the early 2000s, the process of their creation has spread to continental Europe (Table 1).

One of the first gas hubs, which belong to the mature type and, at the same time, are the benchmarks for determining gas prices, are Henry Hub in the USA, NBP in the UK and TTF in continental Europe. The birthplace of gas hubs is the USA, where one of the first and largest in the world Henry Hub is located in Louisiana and was launched in the 1950s. The role of Henry Hub in the market began to grow with the beginning of gas market deregulation in the 1970s. NBP (National Balancing Point) was the first gas hub in Europe. Its path to maturity took about ten years. In 2003, the TTF (Title Transfer Facility) was established in

TABLE 1 Establishment of gas hubs in Europe

	Gas hub	Launch	Country
NBP	National Balancing Point	1996	United Kingdom
ZEE/ZTP	Zeebrugge Hub / Zeebrugge Trading Point	2000/2012	Belgium
TTF	Title Transfer Facility	2003	The Netherlands
PSV	Punto di Scambio Virtuale	2003	Italy
AOC/PVB	Almacenamiento Operativo Comercial/Punto Virtual de Balance	2004/2015	Spain
GTF i ETF	Gas Transfer Facility; Exchange Transfer Facility	2004; 2008	Denmark
PEG (N,S,T)/ TRS/TRF	Point d'Echange de Gaz (Nord, Sud, TIGF)/Trading Region South/ Trading Region France	2004/2015/2018	France
CEGH/VTP	Central European Gas Hub / Virtual Trading Point	2005/2013	Austria
GPL	Gaspool	2009	Germany
NCG	NetConnect Germany	2009	Germany
MGP	Magyar Gázkiegyszerítési Ponton	2010	Hungary
UDN	Ulusal Dengeleme Noktasi	2011	Turkey
VOB	Virtuální Obchodní Bod	2011	Czech Republic
VPGS	Virtual Point Gaz-System	2014	Poland
NIBP	Northern Ireland Balancing Point	2015	United Kingdom
SVOB	Slovenskom Virtualnom Obchodnom Bode	2016	Slovakia
IBP	Irish Balancing Point	2017	Ireland
HTP	Hellenic Trading Point	2018	United Kingdom
PVT	Punctul Virtual de Tranzactionare	2020	Romania
VTT	Virtualna Turgovska Tochka	2020	Bulgaria

Source: compiled according to (Heather, 2015, p. 99, 2021, p. 22)

the Netherlands, where the huge Groningen gas field is located.

4 Genesis and experience of launching natural gas exchanges

Before the advent of energy exchanges, energy resources, including natural gas, were traded on mixed commodity exchanges. Energy exchanges started to be established in the 1990s and specialized mainly in electricity. In the 2000s, two types of energy exchanges emerged: universal exchanges that traded different energy resources (EEX, APX-ENDEX, ICE-INDEX) and specialized exchanges that focused on trading a specific type of energy, such as natural gas (Pownext, Finnish Gas Exchange, GET BALTIC) or electricity (Polikeyvych, 2015). In the 1990s, the small number of exchanges and their territorial limitations led to a lack of competition between them. The situation started to change with the implementation of EU directives and regulations, market liberalization and opening of more exchanges (Table 2), which led to increased competition on the gas market.

The launch of *the Austrian gas exchange* was preceded by the over-the-counter (OTC) trading platform CEGH in October 2005. The CEGH GAS exchange was launched in December 2009. At the same time, the spot market segment was added (together with the Vienna Stock Exchange). A year later, the futures market segment of the CEGH GAS Exchange was added. In December 2013, together with Power Exchange Central Europe (PXE), it launched a platform for trading gas futures contracts. Since 2016 CEGH is the operator of the Austrian virtual trading point (VTP). In December 2016, CEGH launched exchange-traded products on PEGAS (Dickx et al., 2014, p. 71; *SEGH*; Voytiv, 2016).

The launch of *the French gas exchange* was preceded by the creation of a balancing platform with the French TSO. Since December 2006 GRTgaz (the TSO)

and CRE (the regulator) have been consulting on the introduction of market balancing to meet the balancing needs of the operator. In April 2007, Pownext and GRTgaz launched the balancing platform: Pownext developed a platform dedicated exclusively to the TSO's needs; GRTgaz was to participate systematically in trading; 2 auctions per day (intraday at 11:15 and day-ahead at 16:15).

The next step was to launch a gas exchange. For this purpose, in 2007-2008 Pownext conducted an in-depth study on the establishment of a gas exchange in France with the participation of 40 market participants. In November 2008, Pownext launched the physical gas exchange – an organized spot and futures market where standardized products are traded: day-ahead spots, day-ahead futures, months, quarters, seasons and calendar (Dickx et al., 2014, p. 61; Rasmussen et al., 2020).

In 2002, as a result of the two German energy exchanges (the European Energy Exchange in Frankfurt and the LPX Leipzig Power Exchange in Leipzig) merger, EEX (European Energy Exchange AG) was founded. EEX is based in Leipzig and has more than 235 agents from 26 countries. It features a derivatives market and a spot market where electricity, natural gas, CO₂ emissions certificates, coal, and oil are traded (Markevych & Omelchenko, 2016, p. 32). Since July 2007, EEX has become *the German gas exchange platform*. Initially, only futures were traded on the H-gas (high-calorie gas) Open Grid Europe market. Since October 2007, the offer has been expanded to include the spot market (day-ahead). In 2008, gas exchange trading was expanded to include a virtual trading point of the joint high-calorific gas market area of NCG and Gaspool (Dickx et al., 2014, p. 44–45). The result of the joint efforts of EEX and Pownext was PEGAS. In 2012, EEX and Pownext signed a Memorandum of Understanding to combine their natural gas market activities to create a pan-European gas market (*EEX*, n.d.)

TABLE 2 Leading European energy exchanges and their connection with gas hubs

Country	Energy Exchange	Founded	Gas hub
United Kingdom	InterContinental Exchange (ICE)	2000	NBP, TTF
France	Pownext	2008	PEG Nord, TTF
Germany	European Energy Exchange (EEX)	2002	TTF, NCG, GASPOOL
	PEGAS – regional exchange (merger of EEX and Pownext)	2012	NBP, GASPOOL, NCG, PVS, PEG Nord, TRS, TTF, ZTP, ZEE
Austria	Central European Gas Hub GAS Exchange (CEGH GAS Exchange)	2009	CEGH GAS
Denmark	Gas Point Nordic (GPN, formerly Nord Pool Gas)	2008	GTF, NPTF
Italy	Gestore Mercati Exchange (GME)	2000	PVS/PVS fin
Poland	Polish Power Exchange (POLPX)	1999	POLPX

Source: compiled according to (*Europex*; *GAZ-SYSTEM*; *List of Power & Energy Exchanges Worldwide*; *SEGH*; *Dubovskiy*, 2018)

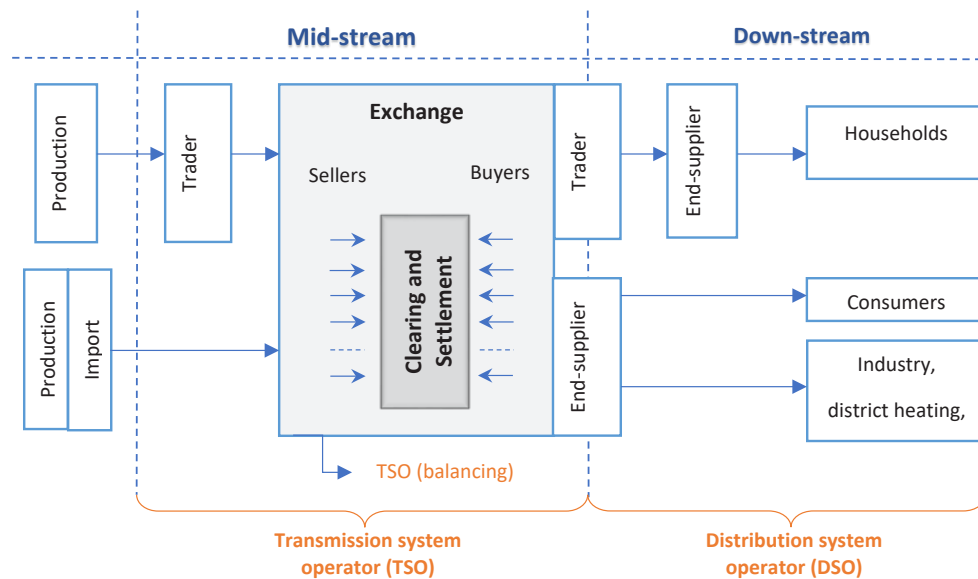


FIGURE 1 Scheme of exchange market functioning

Source: compiled according to (Pozsgai, 2019; Correljé, 2016)

The gas exchange generally works like a regular commodity exchange. This platform allows a shipper or trader to buy or sell gas anonymously. The general scheme of the gas exchange market is shown in Figure 1.

The gas exchange operator is responsible for combining the volumes of gas offered and requested, as well as for facilitating the financial transaction (Pozsgai, 2019). The trading conditions developed by the operator unilaterally apply to the exchange, so different rules may apply to different exchanges.

A significant difference from the OTC market is the charging of fees for trading products, settlements (clearing) and (sometimes) for placing orders, as well as the fact that trading is conducted in clearly defined standardized products (Haizmann et al., 2018, p. 24). These differences may explain the necessity of the OTC market in conditions when not all players can afford to pay transaction and registration fees or wish to buy and sell non-standard product.

On the exchange market, there are physical and financial products (Haizmann et al., 2018, p. 29–30). Products with physical delivery must end with the actual delivery of the product. Although financial products are rarely physically delivered, they are used to hedge financial transactions against price fluctuations or changes in foreign exchange rates. Accordingly, spot market products, futures, forwards and non-standard contracts are physical, while options and swaps are financial.

5 Catalysts for the natural gas market modern transformations

During the recession of 2008–2009, demand for natural gas fell sharply, and the market, particularly

the American one, was flooded with liquefied natural gas. Nevertheless, prices were growing due to oil indexation of gas prices. This prompted a gradual transition from formula to market gas pricing, which has become a trend in recent years (International Gas Union, 2021, p. 6).

A relatively short-lived phenomenon called a *shale revolution* has had significant implications for the energy sector. As a result of shale gas production, the production volume increased several times – from 8 billion cubic meters in 1996 and 57 billion cubic meters in 2008 to 138 billion cubic meters in 2010. This led to a decrease in the price of natural gas from \$200 to \$100 or less per 1000 cubic meters in the United States (Lukianchuk, 2011). The share of shale gas in total US natural gas production increased from 5 to 44% between 2007 and 2014 (Yergin, 2014).

Meanwhile, the demand for natural gas increased sharply from 2010 to 2014, which was caused by: China's becoming the leader of the world economy and the leading importer of hydrocarbons, the accident at the Fukushima nuclear power plant in March 2011, the shutdown of nuclear reactors due to the scandal with components with false certificates in Korea (Sung, 2017). The combination of these factors contributed to the fact that the United States turned from an importer of energy resources into an exporter and achieved energy independence and security. More than 180 million dollars. US dollars were invested in 260 new American projects for the production of chemical products. It is expected that by 2020 they will create more than 400, 000 jobs (Mills, 2018, p. 10). Significant hopes were pinned on the development of new shale gas deposits in the world and on the repetition of the North American

success, which would increase the share of natural gas consumption.

A steady trend in recent years in energy consumption policy is to reduce greenhouse gas emissions and *decarbonize* the economy, which leads to a revision of the above expectations. On the one hand, the threat of global warming, the achievement of sustainable development goals and the goals of the Paris Agreement should increase the demand for natural gas (the cleanest type of fossil fuel and energy resources) and for gases with low or zero carbon content. Accordingly, the importance of gas and gas infrastructure in the energy transition will grow (Rystad Energy et al., 2022). On the other hand, natural gas remains a non-renewable resource. Therefore, modern challenges require a transition to alternative, i.e., renewable energy sources. The development of appropriate technologies and the introduction of the EU countries' policy of reducing dependence on Russian hydrocarbons have led to a decrease in oil prices, slowing down the development of new deposits and shale gas projects (Yukhymets, 2021, p. 171).

It is impossible to overestimate the impact of *Russia's full-scale invasion of Ukraine*, launched on February 24, 2022. Having caused the energy crisis, it has become perhaps the most important catalyst for changes in the European gas market. Sanctions hit not only Russia, but also affect the European market. In March, gas prices reached their historical maximum "The wholesale price of natural gas in Europe increased by more than 40% to 173 euros per megawatt-hour." (Ghilès, 2022, p. 1) The dependence of the European market on Russian gas has led to enormous consequences.

6 Conclusions

The historical overview of the emergence and development of the gas market, the peculiarities of natural gas as an economic good, as well as the fact that natural gas has become one of the key resources that ensure the functioning of national economies, allowed to identify the institutional prerequisites for the creation of gas exchanges, which are: the need to create a competitive gas market and ensure its accessibility for third parties; ensuring transparent pricing and setting the market price for gas (to avoid

a situation when the price will be overstated, fueling consumer dissatisfaction, or underestimated, making the gas industry unattractive for investment); trade facilitation and, accordingly, product standardization; protection of the agreement's implementation and limitation of risks, which is manifested in the security and reliability of supplies; increased energy security. The study showed that gas exchanges and gas hubs are key institutions of exchange trade in natural gas, the gas exchange operates on the same principles as a regular commodity exchange and ensures openness and transparency of the market.

The birth of exchange trading in natural gas began with gas trading on mixed commodity exchanges. It required a gas hub as a place of delivery of futures contracts for natural gas. The peculiarity of exchange trading in natural gas explains the coincidence of the boom in the creation of gas hubs and gas exchanges, especially in the European market. The next step was gas trading on universal and specialized energy exchanges, which started to appear slowly in the 1990s. A further stage of the genesis concerned the liberalisation of the gas market, which was accompanied by the establishment of an increasing number of gas exchanges and, consequently, by an increase in competition on the market. This led, among other things, to a reduction of gas prices, in particular on NBP (UK).

The consequences of the recession of 2008–2009, the emergence of China as a leading importer of hydrocarbons, as well as the shale revolution have led to significant changes and modern transformations. Thus, the United States has turned from an importer of natural gas into an exporter, and there was a refusal from oil indexation of gas prices. In recent years, the impact of the decarbonisation strategy has become increasingly visible. It directly affects the market of natural gas – the cleanest and richest in hydrogen of all hydrocarbon energy carriers, which remains a non-renewable fossil resource. In the coming years, one of the most important catalysts for change will be the energy crisis caused by Russia's full-scale invasion of Ukraine, which will lead to a revision of European policy in this area and the struggle for energy security.

Further research and deeper analysis focused on the relationship between the establishment of gas exchanges and the conditions of European integration.

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