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The Prerequisites for International Spot Sales of Natural Gas in the Iran Energy Exchange

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Highlights

- Hardware platforms currently available for spot sales of natural gas in Iran;
- Legal and structural aspects need improvement;
- Long-term contracts with neighboring countries exist as a barrier;
- Monopoly of the natural gas industry's value chain by state companies;
- Incomplete unbundling of the value chain;
- Lack of third-party access to pipelines and storage facilities;
- Natural gas price in the country is subsidized;
- Absence of law on the integration of the natural gas market;

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Abstract

The supply of natural gas in energy exchanges has emerged as a significant aspect of the global energy landscape since the 1990s, requiring the establishment of appropriate trading platforms. In Iran, the spot sale of up to 10 billion cubic meters of natural gas was envisioned following the approval of the budget law of 2021. However, despite these projections, no offerings were made on the Iran Energy Exchange (IRENEX) due to various challenges. This research aims to identify the essential prerequisites for gas supply in energy exchanges using a systematic review approach and subsequently analyze these prerequisites within the context of Iran's gas market. The findings of this study reveal that while the technical requirements for such transactions are presently available, significant strides are needed in terms of legal and structural aspects. Notably, challenges arise from the presence of long-term contracts between the National Iranian Gas Company (NIGC) and neighboring countries, the monopolization of the country's natural gas industry's value chain by state-owned Companies, incomplete unbundling of the mentioned chain, limited third-party access to pipelines and storage facilities, gas supply with subsidized tariffs, and the absence of a comprehensive law governing the integration of Iran's natural gas market. Overcoming these obstacles is imperative for enabling natural gas supply in the IRENEX and successfully implementing the gas supply plan. Policymakers must carefully address these prerequisites to foster a conducive environment for gas trading within the energy exchange and pave the way for effective implementation.

Keywords: Budget Law, Gas Market Liberalization, Iran Energy Exchange, Prerequisites

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1. Introduction

Regardless of the reasons for the emergence of vertical integration or monopolies in the past, which were prevalent in most countries of the world, in the late 1980s, financial, technical, and political debates surrounding this issue propelled some countries toward market liberalization for natural gas transactions. The United States of America (USA) pioneered natural gas market liberalization. In the USA, gas market liberalization, which had already been initiated in 1978 with Order 436 of the Federal Energy Regulatory Commission (FERC), was fully implemented in 1992 with Order 636 of the FERC through mandatory unbundling of transportation services from sales. In Europe, the liberalization of the natural gas trade market began in the UK[1] and then extended to other European countries. The European Commission, by issuing three directives in 1998, 2003, and 2009[2], outlined and announced the mechanisms for natural gas market liberalization for its member countries[3]. Most Western European countries put an end to the monopoly on natural gas production and supply of many companies by the directive issued in 1998, resulting in the successful development of markets such as TTF in the Netherlands and GPL in Germany (Stern, 2018). Many countries like Japan, China, South Korea, and Brazil are seriously pursuing natural gas market liberalization. Turkey and Russia, neighboring markets to Iran, have also undergone liberalization in their natural gas markets. In 2001, Turkey adopted the Natural Gas Market Law[4], which ultimately led to the launch of the natural gas spot market in 2018. Similarly, Russia adopted a strategy by Gazprom (Sharples & Henderson, 2019) to launch an electronic trading market[5] for natural gas, resulting in further liberalization in the region. In late 2022, India was also considered one of the target markets for Iran's gas, offering natural gas on the spot and futures forms through IGX (Natural Gas World, 2022).

The National Iranian Gas Company (NIGC) has monopolized the natural gas market in Iran[6]. However, the discussion of privatization and liberalization of Iran's natural gas market gained momentum with the announcement of the general policies of Article 44 of the Constitution by the Supereme Leader of Iran in 2005[7], which was concurrent with the developments related to the liberalization of the natural gas market in many countries in the world in the 2000s. However, in the early 2010s, privatization in Iran's oil and gas industry, including the activities of the NIGC, was halted by the government, and the natural gas trade remained monopolized by the government-owned NIGC[8].

International trades related to natural gas in Iran are traditionally carried out by the NIGC, although there have been some exceptions[9]. This company initiated the initial international trades through long-term contracts of 20 to 25 years. As time passed, the duration of the contracts was shortened, and the

1 The liberalization of the gas market in the UK began in 1986 with the privatization of British Gas, and the process continued with third-party access to infrastructure and the unbundling of gas companies. The gas market in this country became competitive in Europe with the introduction of the NBP in the late 1990s.

2 (DIRECTIVE 98/30/EC , 1998), (DIRECTIVE 2003/55/EC, 2003), (DIRECTIVE 2009/73/EC , 2009)

3 The liberalization of the European gas market was recognized as essential with the adoption of a law (GAS Transit Directive) in 1992, which obligated gas transmission companies to grant third-party access (TPA) to their pipeline networks.

4 Natural Gas Market Law No. 4646, dated 18 April 2001, published in the Official Gazette dated 2 May 2001 and numbered 24390.

5 Electronic Gas Sales Platform (ESP)

6 For more information about NIGC's Structure and subsidies see:
https://nigc.ir/index.aspx?siteid=1&fkeyid=&siteid=1&pageid=163

7 The General Policies of Article 44, May 22, 2005 retrieved: https://ipo.ir/

8 Based on the published news, applying and distributing gas are considered governmental.

9 The Crescent gas contract was signed by the NIOC, and the SWAP (Azerbaijan) and Gas against Electricity (Armenia) contracts, as well as the Iraq and Pakistan contracts, were signed by the National Iranian Gas Export Company (of which 100% of shares belonged to the NIOC). Since 2016, with the exception of the Crescent and Pakistan contracts, the execution of all contracts has been assigned to the NIGC.

contracts terms were limited to a 5–6-year execution period. Sometimes, short-term contracts of a few months have also been concluded and executed[1].

Although the duration of international natural gas contracts in Iran has decreased, the NIGC has not yet engaged in global natural gas trade under spot contracts format. The approval of Article K of the 2021 budget law can be considered a turning point in the liberalization of the natural gas market of Iran and the development of international natural gas sales under spot contracts.

To commercialize and increase the share of the private sector in the energy sector of Iran, the Ministry of Oil is obliged to provide the necessary physical and software infrastructure through the relevant subsidiary company to supply and carry out sales of up to 10 billion cubic meters of natural gas on the energy exchange in the year 2021[2].

The exact reasons for including such a clause in Iran's budget law are unclear. However, according to Article 3 of the implementing regulations of paragraph (k) of paragraph (1) of the single article of the country's budget law, it can be inferred that commercialization and increasing the share of the private sector in the energy sector is essential[3]. It seems that the government is trying to control the country's rising gas consumption, which is one of the vital energy concerns, by implementing a limited market liberalization and by supplying gas on the IRENEX to provide the conditions for creating a competitive market. However, passing the budget law alone is not sufficient for the success of such a plan. The experiences of natural gas market liberalization in other countries show that successful liberalization of energy markets requires the establishment of legal (Zyuzev, 2008), commercial (Weller, 2010), and technical infrastructure (UN, 2012; IEA, 2019). Additionally, market liberalization is a long and gradual process, and in most countries, a similar process has been followed to create such markets (e.g those of USA, UK and Wsetern European Countries).

In any case, approving the abovementioned law is considered a step toward liberalizing Iran's natural gas market. For this reason, this research aims to identify the requirements for supplying gas in IRENEX and to examine and analyze the prerequisites and necessities of creating such a market in Iran based on the stages taken to liberalize the natural gas market in other countries.

The novelty of the research lies in its comprehensive analysis of the prerequisites required for successful gas supply in a liberalized gas market and the facilitation of gas trading in energy exchanges in Iran. While numerous studies worldwide have investigated the prerequisites for market liberalization and gas supply in energy exchanges, including notable works by the International Energy Agency (IEA, 2019) and Shell Center (Shell Centre, 2017), there has been a lack of such a comprehensive study in the context of Iran. Previous research in Iran, such as the work of Azimzadeh Arani on "The Role of Regulatory Instruments in the Case of the Gas Industry's Unbundling in Iran" (Azimazadeh Arani, 2019) and Alavi's research on gas market liberalization, which primarily focused on supply–demand balance and pricing, have not comprehensively addressed all the requirements (Alavi & Rahimi, 2009). Thus, the current research in Iran offers valuable insights that can inform policymakers, industry stakeholders, and researchers in Iran's gas market of the critical elements needed for successful implementation and development in the evolving energy landscape. By bridging this gap in the existing

1 Gas Export Contract to Iraq (entered into agreement in 2013 and 2015) and Gas SWAP contract between NIGC and SOCAR (entered into agreement in 2021), References: (Tasnim News Agency, 2017), (MFA Baku, 2021).
2 The budget law for the year 2021, approved by the Islamic Parliament of Iran on 19 March 2021, Article 1, clause k.
3 The executive regulations for clause (k) of note (1) of the single article of the national budget law approved on 6 June 2021 by the Council of Ministers, Article 3.

literature, this study contributes significantly to understanding the prerequisites for a thriving gas market and the potential for gas trading in energy exchanges within the country.

This research examines the prerequisites for international natural gas sales in the IRENEX through a sequential methodology, including a historical review of global gas market liberalization and gas hub formation (Section 2). The prerequisites necessary for successful gas hub establishment are identified using a systematic review of relevant literature (Section 3). Iran's gas market is then analyzed to assess its alignment with the identified prerequisites (Section 4). Finally, the findings are summarized, and conclusions are drawn regarding Iran's readiness for international gas sales in IRENEX, potentially offering valuable insights into gas market liberalization and hub establishment (Section 5).

2. Natural gas market liberalization and the emergence of gas hubs

The history of natural gas market liberalization goes back several decades. In recent decades, reforms have been introduced in the natural gas markets of Asian, European, and American countries to open the wholesale gas market to new entrants, increase cost efficiency, and attract private companies to invest in this industry. The USA in 1985 and the United Kingdom in 1989 were the pioneering countries in the field of gas market liberalization and reforms; Argentina in 1992, Mexico in 1993, Hungary in 1994–1995, and Japan in 1994 subsequently put this process on their agenda (Rudy Swennen, 2017) and (Juris, 1998). In natural gas markets close to Iran, Turkey (Mehmet Efe Biresselioglu, 2019), Russia (Henderson, 2019), and India (Corbeau, Hasan, & Dsouza, 2018) are also among the countries that have partially liberalized their natural gas markets. Economic reasons mainly drive gas market reforms, and the aim is to reduce government intervention in the industry, which leads to inefficient pricing and ineffective operations (Stern, 2018). Liberalizing the market creates a regulatory framework that allows independent market players to maintain supply and demand equilibrium in a competitive environment. The overall goal of liberalization is to improve efficiency and reduce consumer prices by creating competition in markets that have traditionally been national or regional monopolies (either by government or private companies). Adopting a liberalization policy with facilitative laws and regulations ultimately led to the emergence of gas trading hubs, which were previously impossible due to the long-term nature of natural gas contracts and the limited number of traders.

Natural gas hubs are usually formed around critical infrastructure such as gas transmission lines, gas production, and LNG regasification terminals. One prominent example is the Henry Hub, located in the southern USA, which is now recognized as one of the world's most important natural gas markets, with high importance in terms of natural gas pricing.

Gas trading hubs are distinguished from other natural gas markets, mainly from a pricing perspective. The price discovered in gas hubs is a benchmark for pricing gas throughout the network and derivative transactions (futures and forwards). Hub prices are used as the basis for pricing long-term natural gas contracts. For example, petrochemical feedstock contracts in Iran are based on price indexes of Henry Hub, Canada's AECO, the UK's NBP, and the Dutch TTF.

Gas hubs require gas transmission networks and storage facilities that enable intermediaries and traders (including those who cover their gas supply risks) to operate and facilitate resource movements in the short term while providing access to end consumers. The USA and Europe are the world's largest consumers of natural gas, possessing extensive and integrated gas transmission networks and huge gas storage reservoirs around them. In addition to providing natural gas distribution infrastructure, gas storage facilities are essential from the supply security perspective. One prominent feature of storage facilities is the prevention of high gas prices during supply shocks, which was well observed in Europe during the cold seasons of 2021 and 2022.

Gas supply through various sources to gas hubs is paramount to avoid monopolies and the dominance of a specific supplier in the market for domestically produced products. Gas is imported through pipelines and LNG terminals to that supply. On the demand side, various customers, from residential to industrial and power plants, are essential to shape a balanced market.

Gas trading hubs have taken shape and developed with changes in the contractual structure of long-term contracts to short-term contracts, including natural gas spot contracts, and a shift from government-set prices to index and momentary prices set by the market. Today, numerous gas trading hubs are operating worldwide, with the most essential and well-known being the Henry Hub in the USA. Heather and Petrovich (2017) defined various criteria for comparing gas hubs. They classified the most developed gas hubs in the world based on the number of participants, traded products, transaction volumes, tradability index, and the number of times[1] a gas cargo is traded in natural gas markets (Heather & Petrovich, 2017). According to Heather, the number of times a gas cargo is traded is one of the most important ranking criteria for gas hubs, with the Henry Hub having the highest liquidity, followed by the TTF and NBP hubs in the subsequent positions (Heather, 2020).

3. Prerequisites for the successful establishment of gas hubs

Natural gas hubs have emerged due to natural gas market liberalization, and the establishment of natural gas hubs has a direct relationship with the deregulation of natural gas markets. The liberalization of gas markets takes place in stages, as shown in Figure 1. The order of stages is not necessarily as shown in the diagram although further progress will not be possible until the first three steps are taken. A few countries have gone through all nine stages, but this process takes about a decade (and may take longer) for countries that have done so. The development of regulations and government policies to ensure the progress of liberalization is a critical issue not mentioned in the diagram. Countries may take years even to take the first step, and some have never done so; although they may have created laws and regulations for third-party access, this has never been implemented (Stern, 2018). For example, Turkey's energy market liberalization policy has been on the country's agenda since 2001 with the approval and implementation of various laws. Still, in practice, the spot natural gas market was launched in 2018, which is a relatively long period from the approval of rules and regulations to implementation and execution.

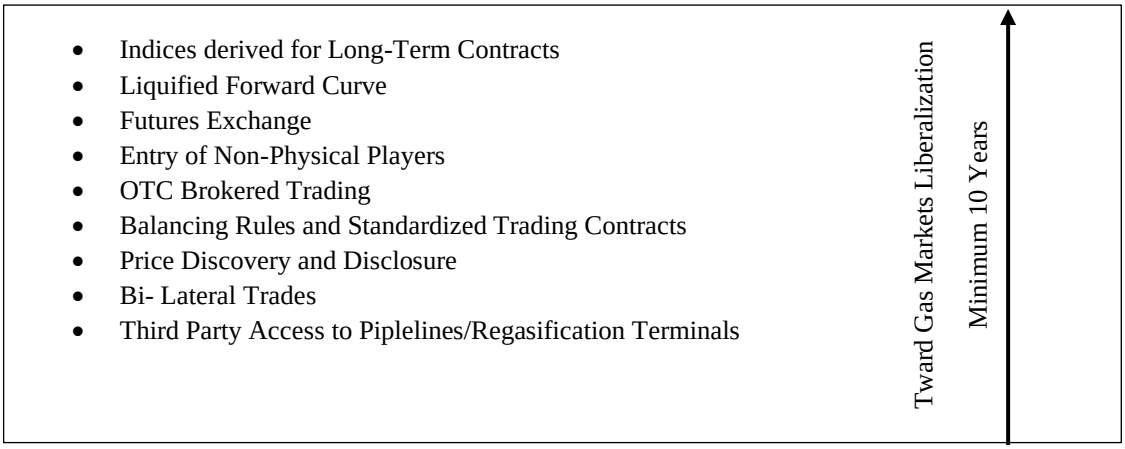

Figure 1

The evolution of natural gas markets from their inception to maturity (Heater, 2015)

1 Churn rate

Heather (2015) has described the above process as "a path to maturity". According to his study, the experience of North American and British markets shows that transitioning from traditional markets to mature markets can be achieved within 10 to 15 years, a claim that has later been proven in Europe. However, achieving a smooth transition requires the commitment of governments, suppliers, and system operators. This process usually begins with moving toward third-party access (TPA) to the gas network infrastructure, which often requires legal changes to force current operators to release infrastructure capacity and increase gas supply volume, thereby encouraging independent parties to enter the market. The approval of laws and regulations governing the physical aspects of the business is essential, while preparing and drafting standard contracts strengthen the commercial aspects of the transition. This process often continues with the help of the first brokers engaged in bilateral trade, which helps create commercial opportunities between opposing parties. Subsequent transactions are reported in trade publications, thereby creating a transparent market. With the disclosure of prices, price discovery occurs, attracting more players, often smaller physical traders at this stage, and initial experimental movements are made by financial actors. The creation of exchange-traded products (futures) based on fundamental physical contracts provides greater access to the market, particularly by non-physical players (who always close their trading positions before expiration). Gradually, as the number of participants trading in a particular market increases, a forward-looking curve is created, which is used for risk management purposes.

The final stage of market maturity is reached when the hub creates sufficient liquidity for traders to use specific traded products (such as next-day or next-month) as benchmarks for pricing their physical trades (Heather, Patrick, 2015).

This research employed a systematic review method to identify the prerequisites for supplying gas in energy exchanges. To achieve this objective, 312 research articles, books, and reports were gathered from various international research databases, including Google Scholar, Scopus, ProQuest, ScienceDirect, International Energy Agency (IEA), and Oxford Energy Studies. Iranian databases such as Magiran, Noormags, and SID were also utilized to find relevant Persian literature. The search terms used in the databases included "Gas Market Liberalization", "Natural Gas Market Liberalization", "Requirements for Gas Market Liberalization", "Gas Market Liberalization Prerequisites", "Gas Market Deregulation", and "Gas Market Restructuring" in English, as well as their equivalents in Persian. After eliminating duplicate items, the initial findings were reduced to 119. Through title and abstract reviews, 64 items were excluded, leaving 55 relevant items. A further 38 items were excluded after reviewing the entire paper, resulting in a final selection of 17 items for the systematic review. A filtering criterion was employed to include studies published between 1980 and 2023 to manage the scope and obtain a comprehensive yet manageable dataset. Limiting the timeframe to this period, the research aimed to capture the relevant developments and evolution of gas market liberalization over the past few decades. This filtering approach facilitated a comprehensive analysis of the available literature, allowing for valuable insights into the progression and impact of gas market liberalization from its inception to the present year.

After reviewing all the studies, the research classified the requirements for successfully liberalizing the gas market and launching energy exchanges into seven prerequisite classes: privatization, competitive pricing, technical infrastructures, third-party access, regulatory body, unbundling, integrated gas laws and regulations, and competitive pricing (Table 1). While some of these factors were identified as direct prerequisites, it was noted that pricing, particularly in the context of Iran's subsidized gas supply, required special consideration. Although pricing might not typically be considered a prerequisite, its unique nature in Iran's market necessitated its inclusion as an essential factor to be addressed before supplying gas in the exchange. Therefore, this research recognizes the significance of analyzing pricing

and its associated legal implications to ensure a comprehensive understanding of the prerequisites for gas market liberalization and energy exchange establishment in Iran.

Table 1

Identifying the prerequisites for launching successful gas hubs

No.	Prerequisites class	Issues investigated in the studies
1	**Privatization**	Gas market regulations and de-regulation
2		Gas market commercialization
3		Gas market restructuring
4		Gas market privatization
5		Gas market de-monopolization
6	**Competitive gas pricing**	Price determination and pricing mechanism
7		Role of government interventions and subsidies
8		Market transparency and information disclosure
9		The challenges and opportunities related to cross-border gas pricing in international gas trading scenarios
10	**Technical infrastructure**	The existing pipeline infrastructure and its capacity to transport gas efficiently within and across regions
11		The availability and adequacy of gas storage facilities to manage supply–demand imbalances and enhance market flexibility
12		The distribution infrastructure and its capability to deliver gas to end-users effectively
13		The functionality and performance of trading platforms, such as gas exchanges or electronic trading systems
14		The compatibility and standardization of technical systems to facilitate seamless gas trading and exchange operations
15		The robustness of cybersecurity measures to protect critical infrastructure and market-sensitive information
16		The potential need for grid modernization to accommodate changes in gas supply patterns and demand fluctuations
17		The mechanisms for balancing gas supply and demand to ensure system stability and reliability
18	**Third-party access**	Gas market open-access policies
19		The laws and regulations related to third-party access in gas markets, including entry requirements, access rights, and dispute resolution mechanisms
20		The barriers that new entrants face when accessing the gas market, such as licensing requirements, administrative procedures, and technical standards
21		Whether access to gas infrastructure is provided on a non-discriminatory basis, ensuring fair competition among market participants
22		The transparency of information related to gas infrastructure availability, capacity, and tariffs for third-party users
23		The compatibility and standardization of technical systems to facilitate third-party access across different gas infrastructure operators
24		The potential for market power abuse by incumbent gas infrastructure operators and its impact on third-party access
25		
26	**Regulatory body**	The role of regulatory authorities in monitoring and enforcing third-party access rules and ensuring compliance with regulatory requirements
27		The legal and institutional framework governing gas market liberalization and the role of regulatory bodies in overseeing the process
28		The regulatory bodies' role in monitoring market activities, ensuring compliance with rules, and detecting anti-competitive practices

No.	Prerequisites class	Issues investigated in the studies
29		The regulatory mechanisms for market entry and exit, including licensing requirements and exit procedures for market participants
30		The role of regulatory bodies in setting and monitoring tariffs for gas infrastructure and services
31		The regulatory measures to promote and ensure fair competition in liberalized gas markets
32		The regulatory measures in place to protect consumers' interests, ensuring affordable and reliable gas services
33		The independence and autonomy of regulatory bodies to make impartial decisions without undue political influence
34		The regulatory efforts to enhance market transparency and information sharing among market participants
35		The regulatory design and establishment of market rules to govern gas trading and exchange operations
36	**Unbundling**	The separation of ownership between gas production, transmission, distribution, and retail activities to promote fair competition and prevent anti-competitive behavior
37		The financial separation of different gas market activities to ensure transparency and prevent cross-subsidization
38		The establishment and role of independent system operators to manage gas transmission and ensure non-discriminatory access to gas infrastructure
39		The extent to which unbundling promotes open access to gas infrastructure for all market participants
40		The impact of unbundling on market competition and the emergence of new market players in the gas sector
41		The efficiency and performance improvements achieved through the unbundling of gas market activities
42		The effects of unbundling on consumer welfare, including affordability and access to gas services
43	**Integrated gas laws and regulations**	The necessity of the development and implementation of integrated and unified gas laws and regulations to govern the entire gas value chain
44		How integrated gas laws promote market competition and prevent anti-competitive behavior
45		The role of integrated gas laws in setting and monitoring tariffs for gas infrastructure and services
46		How unified gas regulations harmonize technical standards and market rules across different regions or countries
47		The independence and autonomy of regulatory bodies under unified gas laws to make impartial decisions without undue political influence
48		The provisions in integrated gas laws that govern gas trading and exchange operations ensure market efficiency
49		The provisions in unified gas laws to protect consumers' interests, ensuring affordable and reliable gas services

4. Analysis of the prerequisites for establishing a booming gas hub in Iran

4.1. Privatization

The first prerequisite for developing a thriving wholesale market and a liberalized commercial market is to ensure the complete liberalization and privatization of industrial, commercial, and residential sectors. Liberalization creates competition among suppliers and encourages the end user to demand at a competitive price, making the wholesale market need to find a free market to manage its portfolio risk. In this case, gas suppliers are ultimately driven to participate in gas hubs (Heather, 2015). The issue of privatization gained momentum in Iran after the Iran–Iraq war. Still, the announcement of the general policies of Article 44 of the Constitution by the Supreme Leader of the Islamic Republic of Iran on 22 June 2005 accelerated the process to some extent. According to the Supreme Leader's statement,

the oil sector's upper hand is to remain entirely in government ownership. It is also decided that downstream industries in the oil sector, including refineries, petrochemical industries, gas distribution networks, and service contractors, should be privatized. Following the announcement of these policies, the relevant law was passed and implemented on 29 January 2008. According to this law, some of the subsidiaries of the Ministry of Petroleum were privatized, and subsidiaries of the NIGC, such as the Iranian Gas Transmission Company, Gas Refining Companies, and 32 provincial gas companies primarily involved in downstream operations, were included in the privatization list. However, transferring them to private ownership was halted with the new government taking office in 2013. According to the then-minister, the main reason for the privatization freeze in the petroleum sector was the government's failure to perform its sovereign duties concerning these companies. Based on the provisions of the law passed in 2008, the government's ownership, investment, and management in the extraction and production of crude oil, gas, and oil and gas mines, which are upstream activities, are recognized as legal. It seems that downstream activities, especially natural gas sales, do not fall within the scope of the government's essential activities. Therefore, it can be concluded that the boundary between governmental and non-governmental activities in Iran's oil and gas industry is not precisely defined. Until the Iranian gas industry moves toward market liberalization and, if necessary, privatization, it cannot be expected that the share of the private sector in at least the downstream industry will increase.

Privatization in Iran has had less appeal than other countries and has received less attention and support from managers and policymakers (Jafarpour, 2020). Several studies have been conducted on the obstacles and challenges of privatization implementation in Iran, including studies by Alipour et al. (2012), Dolatabadi et al. (2014), and Jafarpour (2019).

According to Jafarpour (2019), privatization has fundamentally changed governmental economies over the past 50 years, benefiting some countries and losing others, such as Iran. Therefore, privatization in Iran has received less attention and support from managers and policymakers and has had less appeal for Iran compared to other countries. According to Jafarpour (2019), a lack of clear separation between governmental duties and those of private enterprise is one of the 20 significant challenges in implementing Article 44 of the Constitution and privatization.

With the suspension of privatization in the gas industry in Iran, the natural gas for the Iranian market is currently exclusively provided by the NIGC. This company transmits gas from production sites to consumption areas through the Iranian Gas Transmission Company, which owns 100% of its shares. NIGC supplies natural gas to end-users at subsidized prices through provincial gas companies, which also own 100% of their shares. Sales at the prices mentioned above act as a hindrance to market liberalization.

4.2. Competitive pricing

The price of natural gas in Iran for various sectors, including households, agriculture, refineries, petrochemicals, steel, metal industries, and cement, is determined and announced annually based on relevant laws and regulations[1]. These tariffs significantly differ from the price of gas sold in regional markets[2]. Among these sectors, the price of gas delivered to petrochemical companies is determined under more competitive conditions than other sectors because a part of the pricing formula is indexed

1 Among the provisions of the Law on Targeting Subsidies ratified on 6 January 2010, only paragraph (a) of Article 1 of the Law on the Addition of Some Articles to the Law on Regulating Part of the Government Financial Regulations (2) ratified on 25 February 2015, the budget law of the relevant year, the 5-year development plans, and the law on the duties and powers delegated to the Ministry of Petroleum are exempted from.
2 For comparison, refer to the gas prices traded on EPIAS (Turkey).

to some welknown hubs in the world (such as Henry Hub in the US, Alberta Hub in Canada, and NBP and TTF hubs in the UK and the Netherlands)[1]. Therefore, the only sector that may be willing to buy gas through the energy exchange is petrochemical companies. Nevertheless, the NIGC cannot supply gas to the aforementioned companies through the IRENEX at a higher price due to the Law on the Annexation of Some Materials to the Law on Regulating a Part of Government Financial Regulations (2). In case of interruption or reduction of gas and liquid feedstock delivery outside the contract and with the government's will, the Ministry of Petroleum must compensate for the damages from the delivered feedstock subsequently, according to Article 25 of the Continuous Improvement of Business Environment Law. With regulations that allow gas purchase at low prices and compensate for damages in subsequent stages, petrochemical companies will not be willing to buy gas at competitive prices (higher than the price determined by the formula).

As mentioned above, it is evident that gas is not provided to domestic consumers at competitive prices. However, the supply of natural gas at competitive prices in the Iranian energy exchange is only possible for consumption in foreign markets, considering the different supply conditions for gas at the international markets and the fact that the selling prices of natural gas in Iran are based on the global prices of oil and its products.

4.3 Technical infrastructure

Forming a gas hub requires the participation of gas suppliers and consumers and an operational platform, including interconnected gas pipelines throughout the country or region. Henry Hub, the largest gas hub in the world located in the southern USA, has such characteristics. Thirteen different intrastate and interstate pipelines connect this market. Due to its central location and high connectivity, it is designated as the delivery point for the New York Mercantile Exchange (NYMEX) natural gas futures contract. Locating at the entry points of gas through the sea and proximity to gas production and consumption sites are other reasons for this gas hub's growth (Levine, Carpenter, & Anul, 2014), (Heather, Patrick, 2015), and (CME Group, 2023). In forming gas hubs, the convergence of import points (including pipelines and LNG regasification) with production and storage, on the one hand, and transmission routes, consumption, and export destinations, on the other hand, is of particular importance. Henry Hub, TTF, and NBP have such characteristics. From a technical infrastructure perspective, Iran seems to have an acceptable situation. The supply and demand infrastructure and the gas demand–supply balance in Iran will be examined below.

Iran has land borders with seven countries, including Iraq, Turkey, Armenia, Azerbaijan, Turkmenistan, Afghanistan, and Pakistan, and sea borders with eight countries, including Kuwait, Saudi Arabia, Qatar, United Arab Emirates, Oman, Bahrain, Russia, and Kazakhstan. According to the presented map, it is evident that this country has the potential for significant exports/imports of gas to/from these countries in terms of a national gas network and pipelines.

1 Circular No. 503280-20/2 of the Minister of Petroleum dated 16 January 2016 regarding the natural gas feedstock for petrochemical units.

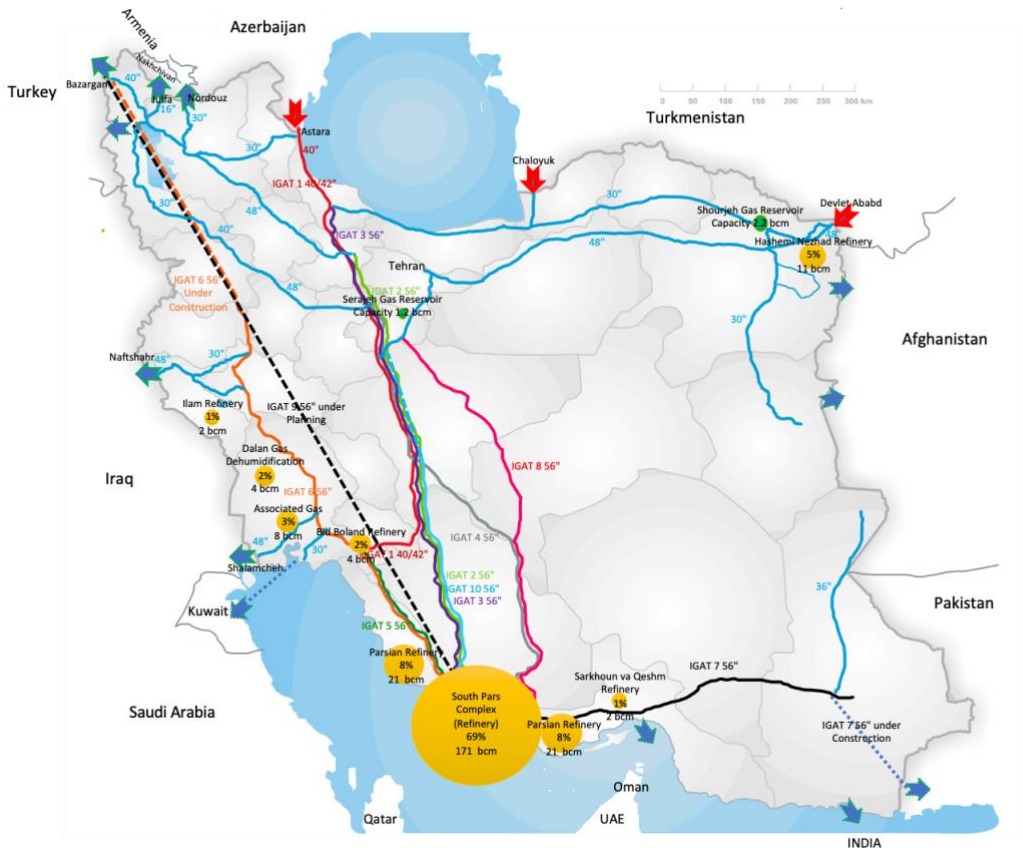

Figure 2

The designed main gas pipelines and facilities for gas production and storage in Iran (data source: NIGC)

Iran currently exports gas to Armenia (Mahdokht & Saberi, 2022), Turkey (Demirken and Cihan, 2018), and Iraq (under two separate contracts) (Afarinesh, 2023). It also has a gas import agreement with Turkmenistan (Eurasianet, 2017), suspended due to disputes and outstanding debts between NIGC and Turkmengas Company. Another gas agreement exists with Azerbaijan, under which Azerbaijani gas is supplied to the Nakhichevan Autonomous Republic. During 2016–2018, gas swap agreements from Turkmenistan to Azerbaijan were executed but eventually halted due to U.S. sanctions (Tasnim News Agency, 2017). The following table shows Iran's gas agreements with neighboring countries that share land borders. Based on the following information, it is clear that NIGC has entered into long-term contracts with foreign customers (primarily government-owned), which, according to global gas market liberalization experiences, act as a fundamental barrier to the development of spot gas markets.

Table 2

Iran's gas contracts at a glance (Mahdokht and Saberi, 2022; Tasnim News Agency, 2017; Eurasianet, 2017; Afarinesh, 2023; MFA Baku, 2021)

No.	Year		Subject	Term (Year)	Current Condition		Party of contract	Volume (BCM)
	Entered into	Commencement			executing	terminated		
1	1995	1997	Import	25		✓	Turkmengas	14
2	1996	2001	Export	25	✓		BOTAS	10
3	2004	2005	SWAP	20	✓		SOCAR	0.4
4	2004	2007	Barter	20	✓		YTPC	0.37
5	2013	2017	Export	6	✓		MOE of Iraq	10.5

No.	Year		Subject	Term (Year)	Current Condition		Party of contract	Volume (BCM)
	Entered into	Commencement			executing	terminated		
6	2013	2018	Export	6	✓		MOE of Iraq	9.8
7	2016	2016	SWAP	2		✓	N/A	~2
8	2017	2017	SWAP	~2		✓	N/A	~3
9	2009	-	Export	25	-	-	ISGS	21
10	2021	2022	SWAP	5	✓		SOCAR	~3

Although Iran's gas pipeline network covers the entire country well and is connected to target markets and gas-producing countries (including Turkmenistan and Azerbaijan), suitable gas reserves and gas availability for export and supply in the energy exchange are other vital points that should be considered.

Gas consumption in Iran has been increasing rapidly[1]. In addition to the increase in household, industrial, and power plant consumption, using electricity for cryptocurrency mining has caused a greater demand for gas in power plants than ever before. In 2021, Iran was one of the top 5 countries in cryptocurrency production (Rauchs, 2021), which has made the balance of gas supply and demand negative in Iran. As a result, Iran has faced difficulties in fully implementing its export contracts.

Although historical data on gas production and consumption from 2009 to 2020 show a 5.9% growth in output and a 5.2% growth in consumption (BP, 2021), it should be noted that with the full implementation of the contracts listed in Table 2 since 2017 and the discontinuation of gas imports from Turkmenistan and the beginning of gas exports to Iraq (Baghdad since 2017 and Basra since 2018), Iran has faced negative gas balances. In 2020, the volume of this deficit was 8.12 billion cubic meters per year. Iran compensated for the negative balance between 2017 and 2020 by limiting consumption or reducing exports to Turkey and Iraq compared to the contractual amounts [2]. Iran also limits gas delivery to some industries/petrochemical plants during the cold months of the year, which is evidence of controlling and restricting gas consumption in the country.

In the power sector, the consumption of petroleum products (oil, gas, and furnace oil) has increased by over 20% compared to last year, and the consumption of natural gas has decreased by 10.1% (NIGC, 2020), indicating a shift from using petroleum products to using gas in the power sector.

The following graph illustrates a negative balance that has occurred since 2017. In this graph, the production–consumption balance from 2020 to 2023 has been estimated based on the growth rate calculated for production and consumption (2009–2020), plus the development plans of the NIGC. The import–export balance has been estimated based on the duration of contracts and their respective volumes.

4.4. Third-party access to gas infrastructure

As gas industry projects in transmission and distribution are capital-intensive and time-consuming, the cost of entering and exiting this industry is very high for intermediaries and downstream players. Therefore, there will always be a significant barrier to effective competition in these sectors (Stenseve, 2000). Transmission and distribution in each region are naturally monopolistic due to the need for relatively expensive rework and physical networks (Cristina Mathias & Szklo, 2007). This monopoly prevents third-party entry into the natural gas trade, resulting in inefficiency in the company's

1 Based on the historical data provided on Iran's gas consumption in BP's publication, the average growth rate of gas consumption in Iran over the past 10 years has been 5%.

2 The historical data on Iran's exports from 2017 to 2020 clearly shows that Iran has delivered less gas to its customers than the contracted volume.

performance or monopolistic system and ultimately leading to market failure. For this reason, governments have provided third-party access to such infrastructure in many gas markets worldwide by enacting laws and regulations.

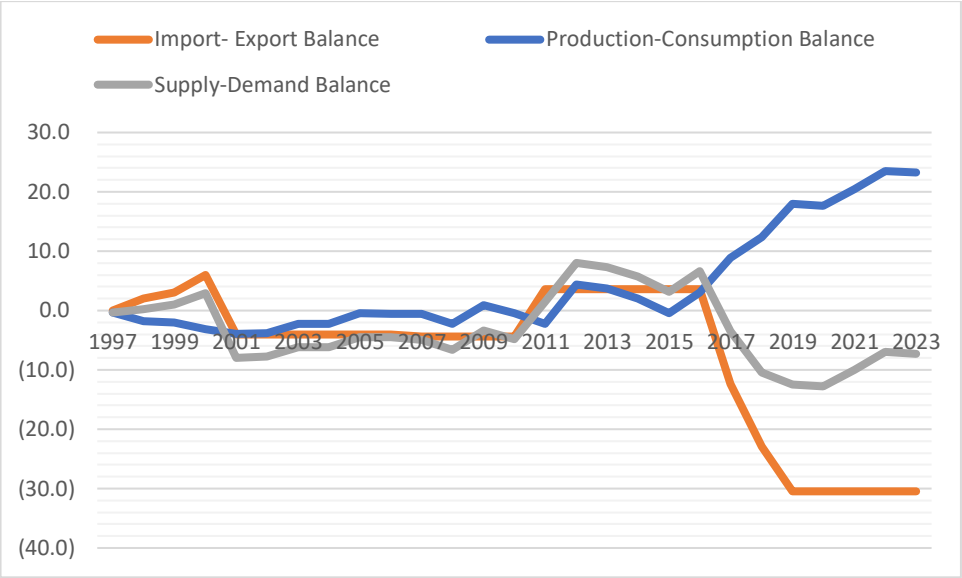

Figure 3

Iran's gas supply–demand and import–export balances (data source: BP, 2021)

Third-party access (TPA) is independent economic companies' legal and enforceable right to access various energy network facilities owned by other companies and use them under certain conditions (Kotlowski, 2007). The central concept of TPA is that the owner of the infrastructure for gas imports and transportation, or the owner of the right to use such infrastructure, must make the capacity of that infrastructure available to the third-party user in exchange for a fee or tariff, which is done in two ways. On the one hand, if the infrastructure owner has an empty capacity, they may voluntarily do so and charge a tariff for that capacity. On the other hand, the owner may be required by law to release empty capacity for other third parties with no ownership interest in the infrastructure and is not committed to purchasing long-term rights to capacity (Nelson & Whitaker, 2017).

According to Kavallier (2007), non-discriminatory access to essential gas value chain facilities under the control of a vertically integrated gas company is necessary for effective competition and market efficiency.

The supply and demand of natural gas in Iran is shown in Figure 5. According to this chart, the value chain of the country's natural gas industry is exclusively controlled by the government. Each of the National Iranian Oil Company (NIOC) and the NIGC can, at their discretion and within the scope of their articles of association (which is approved by the Islamic Consultative Assembly) and other laws and regulations (including cabinet resolutions), delegate some of their responsibilities to third-party individuals or legal entities. The NIGC rarely delegates such duties to third parties. In the field of gas exports and imports, during the gas crisis of 2017 (due to the suspension of imported gas from Turkmenistan), the NIGC granted permission to supply gas to two third-party companies at the Turkmenistan border point. However, the NIOC, within the framework of its articles of association and other laws and regulations, including the general conditions, structure, and model of upstream oil and

gas contracts (IPC) approved by the Cabinet, allows domestic and foreign third-party companies to engage in exploration, development, and production activities to the extent defined in these regulations[1].

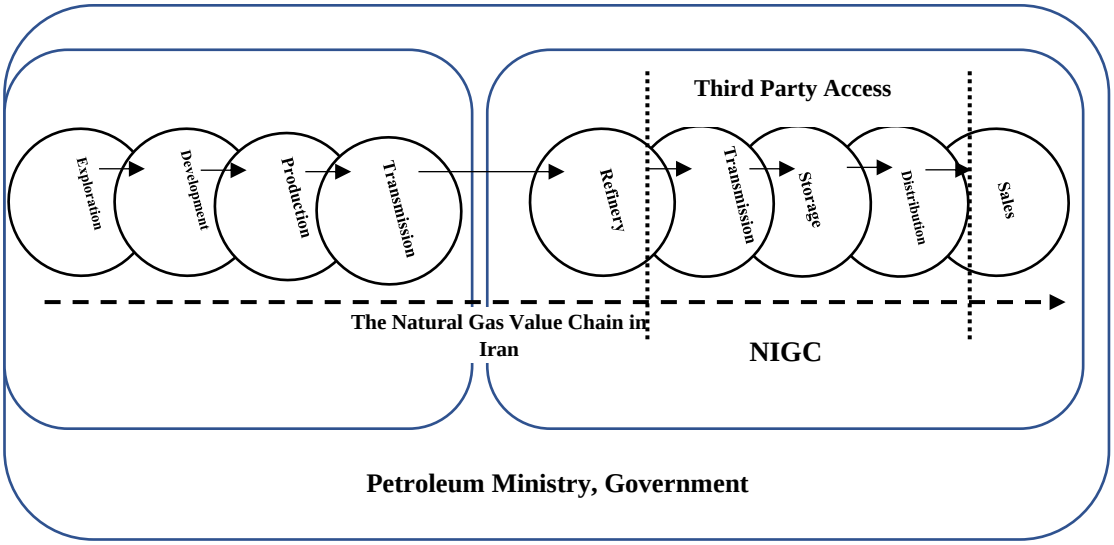

Figure 5
Iran's natural gas supply chain value

Juris (1998) observed that in the USA's natural gas market, state-owned gas companies maintain the traditional gas markets that were in place before the reforms, which have been vertically integrated into the gas industry, forming a single market. In this type of market, all related operations from production to distribution are sold exclusively in a "package" to end consumers.

The current monopoly situation of various state-owned companies in Iran (Figure 5) is consistent with Juris' description. Although the defined tasks in the value chain of gas supply to NIGC and NIOC and subsequently to its various subsidiaries (including 41 subsidiaries of the NIGC) have been assigned, the monopoly of the government remains due to the absence of an independent regulatory authority for the natural gas market from production to distribution and sales.

4.6. Regulatory bodies

In general, markets can be divided into two categories: competitive and non-competitive. A study by Don (2015) on market failure indicates that both types of markets, competitive and non-competitive, face failure, and each of these markets requires tools appropriate to its kind to overcome failure. Competitive markets face failure due to monopoly (mandatory–legal), and non-competitive markets face failure for reasons such as public goods and natural monopolies. Therefore, competition law is used as a regulatory tool in competitive markets, and partial regulation is used as a regulatory tool in non-competitive markets.

According to Azimzadeh Arani (2019), the gas industry supply chain can be divided into two competitive and non-competitive sections. Based on his findings, in some markets (transmission and distribution sections), due to some characteristics such as natural monopoly, making the gas market competitive is not easy, and even if these markets are made competitive, the harm to the general public would be greater than the benefit they gain. In such markets, natural monopolies lead to failure due to non-competitiveness. According to Azimzadeh Arani (2019), competition law facilitates entry into an

1 The Articles of Association of the NIOC, approved on 16 May 2016 by the Islamic Consultative Assembly, Article 2.

industry where competition is possible. In sections such as gas transmission lines where competition is not yet possible, the government uses regulatory tools to control them.

However, in addition to the transmission and distribution infrastructure, natural gas storage facilities in Iran are considered public assets (in the form of "Anfal"). They are under the natural monopoly of the government. Therefore, storage facilities can also be placed in the non-competitive section of the gas industry chain and used as a partial regulatory tool to regulate competition.

With the privatization of Iran's oil industry, most refineries and petrochemical plants were privatized. However, there was no regulatory body to ensure public benefit, address market failures, and monitor the proper implementation of these companies' activities (Islamic Parliament Research Center, 2019).

Tariffs related to third-party access to the network and the use of LNG terminals and storage facilities must be determined and implemented by a regulatory body by laws and regulations that the relevant legislative body has previously established. Access without discrimination is guaranteed by the said regulatory body, depending on the market conditions and circumstances that are constantly changing.

FERC[1] in the USA, Ofgem[2] in the UK, ACER[3] in the European Union, EMRA[4] in Turkey, and AERA[5] in Azerbaijan are among the regulatory bodies for the gas market that have emerged alongside the liberalization of the natural gas market and play their role by establishing and executing laws and regulations.

There is no independent regulatory body in Iran for the natural gas market. The central governing institutions for Iran's oil and gas industry are the Ministry of Petroleum, the NIOC, the Ministry of Energy, the Supreme Council for the Supervision of Oil Resources, and the Supreme Council (of Energy). Each of these entities has duties and powers under the country's laws, some of which should fall within the regulatory authority and be separated from the institutions mentioned above (Islamic Parliament Research Center, 2019). However, as a comprehensive and overarching organization, the Competition Council was established in 2008 as the only authority to deal with anti-competitive practices in Iran. Most of the council's activities are focused on the automobile, telecommunications, and electricity markets (Competition Council and National Competition Center, 2023), and it rarely addresses issues related to the natural gas market. In 2022, due to the existence of various monopolies, including natural and legal monopolies in infrastructure, feedstock supply, and primary material industries in the extensive chain of activities in the country's oil, gas, and petrochemicals sectors, to create a healthy and transparent competition environment among economic actors in this sector, the Competition Council proposed the establishment of a regulatory body for the oil, gas, petrochemical, and related industries under Article 59 of the "Amendment to the Implementation of the General Policies of Article 44 of the Constitution Law" (Article 7 of the amendment to the said law, passed in 2018) and Article 13 of the "Duties and Powers of the Ministry of Oil Law", to present the Articles of Association to the Cabinet. From the perspective of the Competition Council, considering the unique features of the oil, gas, petrochemical, and related industries, including technical characteristics, the behaviors of international actors, and especially economic features (the existence of monopolistic conditions, including legal and natural monopolies such as networks and infrastructures in the oil, gas, and petrochemical sectors, which have led to none of the supply, demand, and pricing elements having

1 Federal Energy Regulatory Commission
2 The Office of Gas and Electricity Markets
3 Agency for the Cooperation of Energy Regulators
4 Energy Market Regulatory Authority
5 Azerbaijan Energy Regulatory Agency

a straightforward situation, inevitably resulting in the market failure in these sectors), the necessity of using regulatory tools to create and strengthen competitiveness is one of the essential requirements of the business environment in these industries and is unavoidable[1,2]. However, the Competition Council has concluded that in the country's oil, gas, and petrochemical sectors, there is no need to establish a new structure and independent regulatory body, and addressing competitive issues and matters in these sectors is possible within the current structure of the Competition Council and by forming specialized working groups under the Council. Therefore, the proposals made by the Competition Council were returned to the government, and the aforementioned working group was not formed at the time of writing this article.

4.7. Unbundling

Gas transmission and distribution networks have the characteristics of a natural monopoly. Experience has shown that after setting laws and regulations to eliminate the monopoly, companies responsible for gas transmission in the upstream and downstream sectors also engage in activities and continue their monopolistic behavior by creating opacity in pricing, line capacities, and network balance[3]. Therefore, free access of third parties to pipeline capacities is vital in providing a non-monopolistic competitive environment. In liberalized markets, to achieve successful access of third parties to separation pipelines, upstream and downstream activities, especially gas transmission and distribution from retail to wholesale, are essential.

According to Cavaliere (2007), separation means separating competitive activities such as production, import, wholesale, and retail of the natural gas industry from vertical value chain segments of gas such as transmission, storage, and distribution, which are managed by a natural monopoly. This separation can be done through account, ownership, legal, and performance separation, and the most vital type of separation is ownership separation.

The separation process can also be divided into five categories: service, financial, legal, structural, and ownership (Shell Centre, 2017). In service separation, pipeline and transmission companies must provide third-party companies access to infrastructure services and gas sales. Financial separation separates the financial accounts of intermediate companies from those of upstream and downstream companies. In a legal separation, the legal entity of distribution and transmission companies becomes independent from upstream and downstream companies. Structural separation defines a legal and regulatory framework for operating different companies active in the gas value chain industry. In ownership separation, the legal entity of transmission companies is completely separated from other upstream and intermediate companies, and no shared interests remain between these companies.

All company shares in the Iranian gas industry value chain (Figure 5) belong to the government. Although accounting, legal, and performance separation has been carried out among these companies, the most critical type of separation, ownership separation, has not been implemented. Further, there is no solid legal framework for the operation and control of various Iranian companies active in different parts of the gas industry value chain. Below is an overview of the state of separation across multiple gas markets worldwide and in Iran.

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1 Minutes of the Meeting on the subject of review of the statutes of the regulatory body of the oil, gas, petrochemical and related industries sector, dated 09/08/2021, Competition Council, retrieved from https://dotic.ir/news/11132 on 21/03/2023

2 Resolution No. 516, dated 13/11/2022, Competition Council, Subject No. 1 retrieved from https://www.nicc.gov.ir/council/decisions-council/1530-516-8-1401.html on 21/03/2023.

3 For instance,: BOTAS in Turkey, NIGC In Iran and Petrobras in Brazil

Table 3

Unbundling in different gas markets and countries; the information is taken from Shell Centre (2017), except for Iran

Country	Service	Account	Legal	Structural	Ownership
UK	1986		1994	1996	2000
Netherland		1998	2004		2005
France		1998	2003	2012	
Germany		1998	2005	2013	
Japan	1995	2004			
USA				1992	
Turkey				2001	
Iran	1998	1998	1998		

In 1998, based on Paragraph (n), Clause 2 of the 1998 Budget Law, provincial gas companies, gas refining companies, Iran Gas Transmission Company, and Iran Gas Trading Company became legally separate entities after their establishment. Although these aforementioned companies were established as private joint-stock companies, due to 100% ownership of shares by the NIGC, they did not have significant operational and legal independence. They operated under the management of the NIGC.

4.8. Integrated and unified natural gas laws and regulations

Successful market liberalization requires an effective and efficient legal framework accompanied by continuous monitoring to ensure the implementation of relevant laws and regulations (Shell Centre, 2017).

Regarding legal regulations, there are scattered laws and regulations regarding energy or natural gas in Iran, and the existing laws and regulations are not unified and transparent enough. The rules and regulations enacted by the Islamic Consultative Assembly of Iran, including the Articles of Association of the NIGC, the Articles of Association of the NIOC, Policy General No. 44, Oil Law, Amending the Oil Law, Law on the Duties and Powers of the Ministry of Oil, Five-Year Development Plan Laws, Budget Laws, Annexation of Certain Articles to the Law Regulating Some Government Financial Regulations No. 2, and Targeted Subsidies Law, and the policies of the Ministry of Oil of Iran in natural gas trade, resolutions of the Council of Ministers, and resolutions of the Supreme Energy Council[1] are among the most important sources of international trade law rights regarding natural gas in Iran. Figure 6 shows the legal sources and their relationship with the natural gas market.

First, let's look at the legal environment of the gas industry in Iran. Who decides to whom the gas belongs, and what is the legal aspect of international gas sales?

According to Article 2 of the Amendment of the Petroleum Law, passed on June 29, 2011, all oil resources are Anfal and public assets. According to Article 1 of the Law on the Duties and Powers of the Ministry of Petroleum passed on May 22, 2012, the Ministry of Oil has been formed to formulate policies, manage, plan, and supervise all upstream and downstream operations of the oil, gas, petrochemical, and refining industries to achieve the general policies of the Islamic Republic of Iran and, on behalf of the Islamic government, exercise sovereignty and public ownership over oil and gas resources and reserves. According to Article 3 of the amended Petroleum Law, the Supreme Council of Oil Resources Monitoring oversees the exercise of sovereignty and public ownership over oil resources.

1 For reviewing all the resolutions of Supreme Energy Council refer to: https://dotic.ir/cat/115

According to Article 4 of the Petroleum Law passed on September 29, 1987, the Ministry of Petroleum may establish oil operations and exploitation companies throughout the country, the continental shelf, and seas. The articles of association of oil, gas, and petrochemical companies will be implemented after the Islamic Consultative Assembly approves. According to Article 1, Paragraph 18 of the Amendment on the Petroleum Law, the main subsidiary companies of the Ministry are NIOC, NIGC, National Petrochemical Company, and National Iranian Oil Refining Distribution Company. Therefore, the NIGC is a state-owned company, 100 percent of which is owned by the Ministry of Oil of Iran[1].

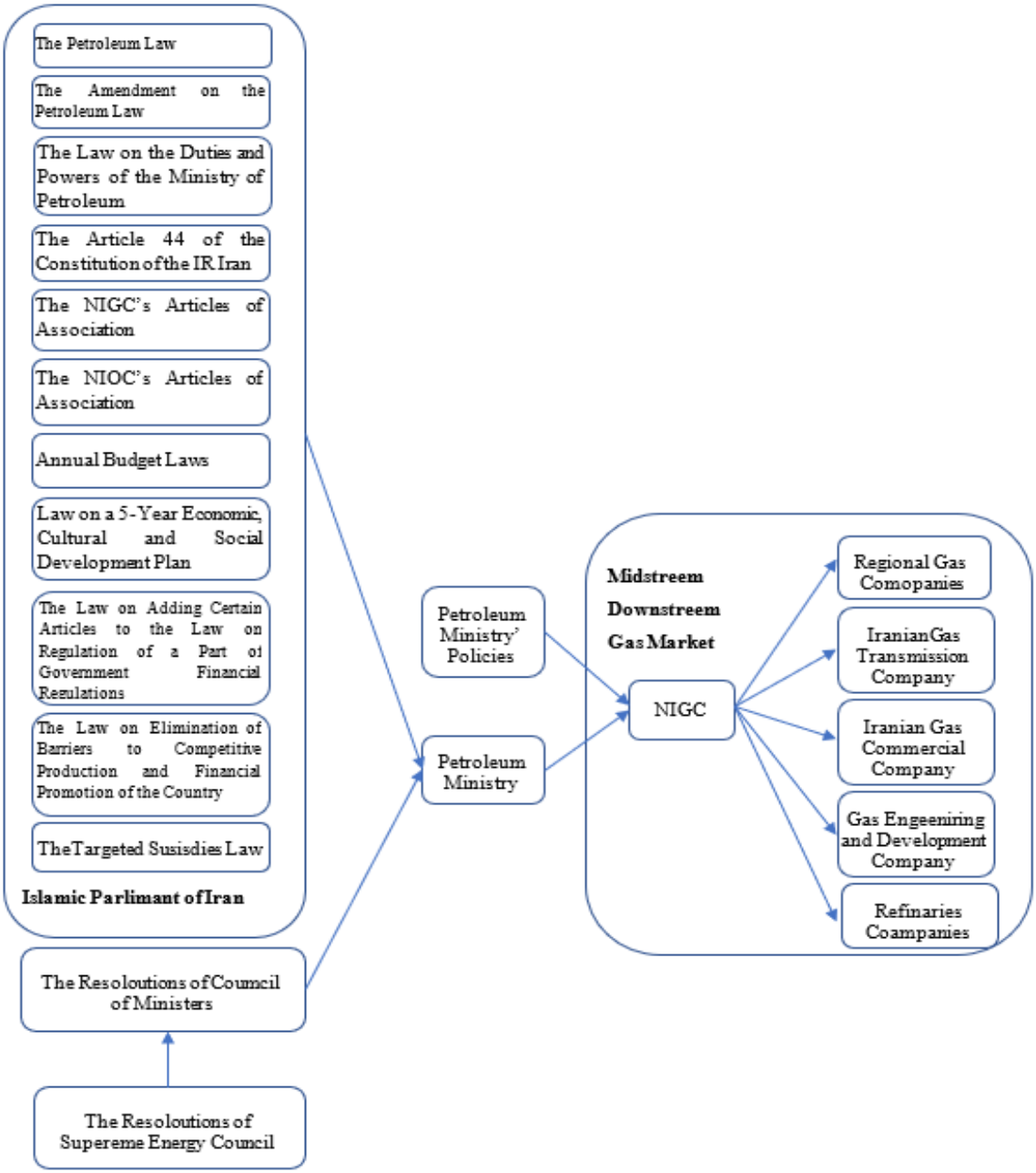

Figure 6

The most important sources of Iran's international natural gas trade law

1 Currently, the shares of the National Iranian Gas Company are owned by the government through the National Iranian Oil Company.

The articles of association of the NIGC were approved by the parliament in 1965, before the Petroleum Law, the Amendment of the Petroleum Law, and the Law on the Duties and Powers of the Ministry of Petroleum. However, after the approval of the aforementioned petroleum laws, it was decided that the articles of association of the gas company would be revised and promulgated one year after the approval of the Petroleum Law. As of the writing of this article, the new articles of association of the NIGC have not been approved. Nonetheless, according to Article 5, Paragraph H of the 1965 Articles of Association, one of the duties of this company is to export various types of gas and its derivatives and sell them for export. Additionally, under Paragraph D, the NIGC is responsible for undertaking any commercial activity related to the procurement, production, export, and sale of various types of gas and its derivatives. Nevertheless, essential and contractual decision-making is often carried out with the policy and guidance of the Ministry of Petroleum.

From a financial perspective, a small portion of the revenues[1] generated from the international gas trade belongs to the NIGC. According to Article 1, Paragraph Z of the Law on Adding Certain Articles to the Law on Regulation of a Part of Government Financial Regulations (2) enacted on February 23, 2015, government-owned companies affiliated with the Ministry of Petroleum are obliged to deposit their rial and foreign currency revenues into centralized rial and foreign currency accounts opened in their name by the Central Bank of the Islamic Republic of Iran. Under Article 14 of the amended Petroleum Law, all revenues from the sale of crude oil, natural gas, and gas condensates, after deducting reciprocal payments, are directly deposited into the treasury of the Central Bank of Iran under the framework of the law on the plan. Therefore, the revenue from Iranian natural gas exports must be deposited immediately into the account of the NIGC with the Central Bank, and any withdrawal/transfer from it requires permission from the treasury. Legally, the share of the NIGC in the amounts received for natural gas exports is included in the annual budget.

Another issue that needs to be examined in Iranian law is how existing laws and regulations support the liberalization of the natural gas market. Although the NIGC has been granted the authority to export/import gas according to its discretion and control the supply and demand of natural gas in the country, sometimes it has handed over its commercial rights to third-party companies. For example, from 2016 to 2018 and from 2022 to 2026, the rights to swap natural gas from Turkmenistan to Azerbaijan have been awarded to third-party companies, and the NIGC has only received the fee for the swap. It has also been observed that the NIOC has directly entered into contracts for the export of natural gas, although none have been operational yet.

According to the strategies outlined in the national energy roadmap of the country, the collection, processing, and conversion of associated gases currently being flared in the oil and gas industry are encouraged, taking into account economic and environmental considerations (The Council of Ministers & Supreme Council of Energy, 2018). Also, According to Article 12 of the Law on Removing Barriers to Competitive Production and Improving the Country's Financial System, the benefits of plans to collect associated gases with oil, which are usually flared in Iran, storage of gas in low-consumption seasons, and the benefits of any plan that leads to increased exports or the consumption of natural gas can be purchased by the government (through NIGC). This aligns with the provisions outlined in the National Energy Strategy Roadmap. However, according to Article 2 of the law's implementing regulations, exporting natural gas collected by individuals who prevent its waste is impossible. Following existing laws and regulations, the NIGC will export the said gas, if necessary, and settle its price in Rials or foreign currency with a third-party company.

1 14.5% in 2022

Therefore, given the absence of supportive laws and regulations for the entry of third-party companies, it can be argued that the monopoly of the natural gas market by the NIGC still acts as a vital barrier to the entry of third-party individuals into this market.

5. Conclusions

The liberalization of natural gas markets began in the 1980s, and the experience of various countries shows that it has been a gradual and time-consuming process. Establishing a liberalized and competitive gas market makes buying and selling natural gas on the commodity/energy exchange platform possible. The Iranian budget law for 2021 predicted the possibility of supplying up to 10 billion cubic meters of natural gas on the exchange platform. This study identified the prerequisites for natural gas supply in competitive markets through a systematic literature review. Based on this, it was determined that privatization, competitive pricing, availability of technical infrastructure, third-party access to gas pipelines and facilities (including storage), the existence of a natural gas market independent regulator, unbundling, and uniform and transparent laws and regulations are among the necessary prerequisites for the supply of natural gas on the exchange platform.

The value chain of the Iranian natural gas industry is monopolized by the NIOC and the NIGC, which act as executive arms of the Ministry of Oil and the government. Privatization has not occurred in this value chain, particularly in the downstream and retail sectors, which have significant importance in the competitiveness of the natural gas market. This is while regional gas distribution companies in Iran were previously included in the privatization list. The duality in the privatization of Iran's gas distribution activities indicates that the boundary between governmental and non-governmental activities has not been clearly defined. Also, as long as prices within the country include high subsidy amounts, final consumers cannot be expected to switch to competitive prices. For this reason, this article identified the international supply of natural gas through the exchange as an executive solution for the budget law.

In discussing technical infrastructure assessments for developing gas trading through the energy exchange, it has been determined that Iran has a suitable capacity for gas supply domestically and internationally from an infrastructure standpoint. Iran's gas network and transmission pipelines are well connected to production, consumption, storage, import, and export points and have the potential to become an international gas hub. However, increasing natural gas consumption in the country, commitments for gas exports to Turkey, Iraq, Azerbaijan, and Armenia under long-term contracts, and insufficient storage of gas in the country's natural reservoirs are obstacles to international gas supply on the energy exchange in Iran.

Free access of third parties to gas transmission and storage infrastructure has been the most important measure taken by various countries to liberalize the natural gas market. The monopoly of the NIGC in gas transmission and distribution has made the system inefficient and ultimately led to market failure. The insufficient supply of gas demand to domestic (and foreign) consumers and the large gap between gas supply and demand in the country during summer and winter seasons indicate the inefficiency of the defined gas transmission and distribution system and the failure of the natural gas market.

To compete in the natural gas market and increase its efficiency, as well as prevent market failure, regulatory bodies play a vital role. In Iran, due to the existence of various monopolies, including natural and legal monopolies in infrastructure, supply, and primary material industries in the extensive chain of activities in the country's oil, gas, and petrochemical sectors, to create a healthy and transparent competition among market players in this sector, an establishment of regulatory body was identified for the oil and gas sector as essential by the Competition Council, and the National Center approved its

articles of association for Competition Council; however, the aforementioned institution returned its proposal to the government and handed over the investigation of competition issues in these sectors to specialized working groups that can be formed under the current structure of the Competition Council; a group that has not yet been formed. Therefore, at present, there is no independent regulatory body for the natural gas market in Iran. The responsibilities of such an institution have been divided among the Ministry of Petroleum, the NIOC, the NIGC, the Ministry of Power, the Supreme Council for the Monitoring of Oil Resources, and the Supreme Energy Council as governing institutions in the Iranian oil and gas industry.

Unbundling upstream and downstream activities in the natural gas value chain, especially unbundling gas transmission from distribution and retail, is vital in providing individuals free access to gas network infrastructure. Generally, activity unbundling can occur from services, financial, legal, structural, and ownership perspectives. Ownership and structural unbundling are unique in liberalizing the natural gas market. Although in Iran, the tasks related to transmission and retail have been separated in terms of legal, financial, and service aspects, the companies operating in the transmission and retail sectors still have the same ownership and structural relationship with the NIGC, leading to the company's monopoly.

Considering that until these obstacles are removed, it is impossible to expect a prosperous supply of natural gas in the IRENEX.

Nomenclature

ACER	Agency for the Cooperation of Energy Regulators
AECO	Alberta Energy Company
AERA	Azerbaijan Energy Regulatory Agency
EMRA	Energy market regulatory authority
ESP	Electronic gas sales platform
FERC	Federal Energy Regulatory Commission
IGX	Indian Gas Exchange
IPC	Iranian petroleum contract
IRENEX	Iran Energy Exchange
LNG	Liquified natural gas
NBP	National balancing point
NIGC	National Iranian Gas Company
NIOC	National Iranian Oil Company
NYMEX	New York Mercantile Exchange
OFGEM	The Office of Gas and Electricity Markets
TPA	Third party access
TTF	Title transfer facility

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