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Energy Transition and Asset Specificity Transformation of the European Gas Market[1]

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Abstract

In 2021, the European Union (EU) is entering a new phase of energy transition, reducing the use of fossil fuels to achieve climate neutrality by the mid-century. For a qualitative assessment of the impact of the EU gas market's green policy, transaction cost theory and the concept of asset specificity is referenced in this article. During the first stage of market development, the level of asset specificity was high, while a decline can be observed with market liberalization. However, at the current stage, a radical transformation of specificity in the context of energy transition can be seen. Assets that used to guarantee higher profitability (gas pipelines, gas processing plants, liquified natural gas (LNG) terminals) will soon be disqualified. In this article, the long-term prospects for the natural gas market in Europe, and what will happen to key assets if the climate agenda dominates the issue of energy security, are considered; qualitative assessment of the changes and of the future of the assets on the European gas market is undertaken.

Keywords: asset specificity, gas markets, European gas market, assets disqualification, pipeline, LNG, Green deal, energy transition

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Specificity in Natural Gas Markets

The concept of "asset specificity" has its origins in the new institutional economics theory and the theory of transaction costs. In its most general form, asset specificity is determined by the investment, made by one or both parties during the actual partnership, that has limited alternative use [Joskow, 2005, p. 327]. Education creates specific assets – researchers (human capital) that cannot be effectively applied in another area – while physical assets' usage derives from technological preconditions [Bernanke, 1983; Pindyck, 1991].

In this article, asset specificity is evaluated using the classification of the level (or degree) of specificity proposed by P. Joskow: high, medium and low [1988, p. 100]. A high level of specificity implies a complete impossibility for alternative use of an asset; medium-level specificity implies high costs of using the asset alternatively; low-level specificity means there is a wide range of opportunities for using the asset in other industries.

[1] This article was submitted 24 March 2021.

While no general approach for determining specificity in applied science exists, there are three that should be mentioned. Within the framework of the first approach, specificity is classified and then referred to certain selected types [Morrill, Morrill, 2003]. Within the second approach, analysis is conducted at the general level without splitting into types of specificity [Espino-Rodríguez, Padrón-Robaina, 2006]. The third combines elements of the first and second approaches: specificity is considered both by type and in general [Brouthers, Brouthers, 2003]. In this article, the third approach is used; furthermore, competitive advantages will be treated as a simple consequence of asset specificity.

O. Williamson introduced an acknowledged typology of asset specificity [2005, p. 21]. Each industry has its own characteristics; hence, all types of specificity acquire different connotations depending on the industry where assets are located. Table 1 presents the features of the types of asset specificity in the gas industry.

Table 1. Types of Asset Specificity in the Gas Industry

Type of Specificity	Gas Industry Features
Site specificity	The geographic location of the field and its proximity to crucial markets. The type is important for pipeline and tanker transportation (due to transportation costs)
Physical asset specificity	Characteristics of the assets used during exploration, production, transportation, processing, and delivery to the consumer
Temporal specificity	A combination of technological and management factors, ensuring stable supply
Brand name capital	A company's reputation. State intervention and participation changes (and often diminishes) the risks
Human asset specificity	Knowledge, skills, and a company's (and industry's) accumulated experience allowing it to benefit from substantial competitive advantages during production or services provision
Specificity of technologies	Geological characteristic of the field might require more advanced technologies (for example, unconventional reserves)
Specificity of institutions	State policy, quality of arbitration, stable fiscal system, stable currency, characteristics of subsoil legislation, and market regulation

Source: Compiled by the author.

In addition to those mentioned by Williamson, types appropriate to the gas industry can be identified. The specificity of technologies can vary depending on the geological characteristics of a gas field: from high-level for non-conventional to medium-level for conventional gas. The level increases as the extraction complication grows due to geological and climate conditions at the production site. The reverse influence is created by the development of the service sector, increasing investments in research and development by the state and private companies, and technological progress that optimizes costs.

Institutional specificity (or resource regime [Young, 1980]) is associated with energy policy goals and characteristics. Characteristics such as the attractiveness of investments, subsoil legislation, the fiscal system, the degree of market liberalization, and the availability of financial institutions and instruments (such as favourable loan conditions for small regional companies) are also significant. The more convenient the resource regime in the industry, the lower the costs (including transaction costs), and subsequently, the level of specificity.

Asset specificity is the main factor determining the difference in transaction costs [Riordan, Williamson, 1985, p. 367], the mechanisms of control (or coordination), and the market structure. If assets are idiosyncratic,[2] hierarchy is the most appropriate governance mechanism [Williamson, 1979, p. 247]. In other words, for assets with a high level of specificity, the optimal mechanism of governance is a vertically integrated company. Other mechanisms comprise hybrid (long-term contracts) and market (price mechanism) ones.

Natural gas reserves as an asset per se are not idiosyncratic since gas produced in different countries and regions is interchangeable. However, gas is the most environmentally friendly fossil fuel. For a long time, it was considered a bridge between coal and renewable energy sources (RES) [Hausfather, 2015]. Thus, the inherent characteristics of natural gas (first and foremost, its "environmental friendliness") determine its specificity as an asset.

The gas sector can be divided into three segments: upstream (exploration and production), midstream (transportation, processing, storage), and downstream (sales). It should be noted that the level of specificity in each of the segments can vary. In this article, the focus is on midstream and downstream assets, as they historically have the highest level of specificity in the industry.

For some time, due to the lack of opportunities and high dismantling costs, the most acceptable mechanism was hierarchy, that is, establishing a bilateral monopoly or vertically integrated oil companies. However, today we are witnessing the effectiveness of the price mechanism (or market mechanism) in the two largest markets – Europe and North America – at once.

The pipeline infrastructure includes a trunk (cross-border) pipeline and several groups of participants: a seller (exporting country), a buyer (importing country), and often a transit country. Although capital construction costs for gas pipelines are high, the operating expenses are low during a long service period. For example, the construction costs of the Nord Stream amounted to three million euros per kilometre of pipeline [Frolov, 2012]. The service period of trunk pipelines can exceed 70 years.[3]

Liquefied natural gas (LNG) transportation infrastructure is distributed among different players (Figure 1). A tanker can be owned either by an exporter or an importer or by a third party providing leasing services.

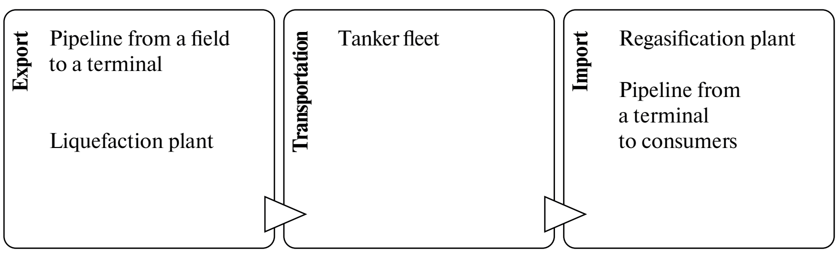

Fig. 1. LNG Infrastructure Scheme

Source: Compiled by the author.

Pipeline transportation currently has a higher level of specificity compared to tankers for several reasons. First, if the pipeline crosses the territories of several transit countries, transaction costs increase. The risk derives from the possibility of opportunistic behaviour of transit

[2] Unique, having the highest level of asset specificity.

[3] With an outer diameter of 1420 mm, a pipe wall thickness of 17.5 mm, and a design pressure of 7.4 MPa.

countries and the problem of "hold-up" if the level of asset specificity is high [Rogerson, 1991, p. 777]. Second, constructing "alternative" gas pipelines involves significant investments, while the capacity might be excessive. Finally, suppose a breach of contract or interruption of supply happens. In that case, both the supplier and the buyer will suffer time and financial losses associated with new construction and the dismantling of the existing infrastructure. During a partnership, it is impossible to change the number of its participants; the prospect of concluding a new agreement is practically levelled by the volume of required investments and the geographical features of a territory. An acceptable coordination mechanism is a long-term "take-or-pay" contract with automatic renewal.

Researchers confirmed a direct correlation between the duration of a contract and the level of asset specificity [von Hirschhausen, Neumann, 2008]. The more idiosyncratic the asset is, the longer the contract duration becomes.

LNG allows responding to fluctuations in supply and demand quickly. Tanker transportation has some competitive advantages. One of them is the equalization of the efficiency of LNG and pipeline gas transportation, even taking into account the economies of scale [Eremin, 2015, p. 35]. If the infrastructure investments have already been made, the specificity during the transportation phase is lower.

Due to competitive advantages in 2019, the volume of LNG trade in the world was almost equal to the volume of pipeline gas trade (Figure 2).

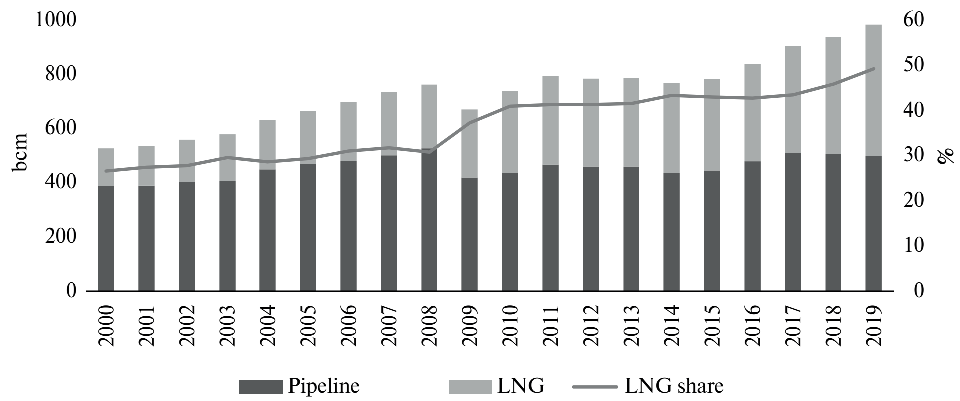

Fig. 2. Global Gas Trade (bcm), LNG Share in Global Gas Trade, % (right-hand scale), 2000–20

Source: Author's calculations based on data from BP [2020].

With the development of technologies, infrastructure, and reforms in state (interstate) policy, factors affecting specificity are also changing. The first group of factors is historically represented by geographic location and geological features (resource allocation). The resource base is driving transformation: the time of giant and super-giant deposits is almost over, so the influence of economies of scale – which used to provide higher profits at low costs – has decreased.

While newly discovered gas fields have modest reserves (in comparison to discoveries of the 20th century), the number of separate projects is growing. The realization of these projects does not necessarily suggest the construction of trunk pipelines. Small and medium-sized deposits are changing the geography of supplies. The latter is becoming increasingly dependent on transportation costs. The produced gas is often easier (and cheaper) to sell on the domestic market.

The second group of factors comprises technologies and technological progress. Even during the early stages of market development, technology influenced the construction of infrastructure. Thus, Soviet gas supplies to Europe were carried out at the expense of a loan for German large-diameter pipes [Gustafson, 1989]. In the 20th century, natural resource-based industries were treated as a relic of the past. Reconsideration of this attitude is associated with new opportunities opened up through the formation of innovation systems [Andersen, 2012] and the development of the service sector.

In Norway, the service sector is the second largest industry in the country. It is represented by 1100 companies, exporting 29% of total production, worth $36 billion [Norwegian Petroleum, n. d.]. Demand from natural resource-based industries for new technologies [Fagerberg et al., 2009; Sæther, Isaksen, Karlsen, 2011], digitalization, and information technology (IT) has become the main driver for the development of the particular industries and the national economy in general [Engen, 2009]. Innovation tends to optimize costs, foster value chains, and create new industrial linkages with other sectors. These processes are associated with the declining specificity of technologies.

The third group of factors is related to the climate agenda, particularly relevant in Europe. The mostly successful implementation of the 20-20-20 programme (partly due to a sharp decrease in CO_2 emissions during the pandemic) and, in some countries, the achievement of primary objectives under the Paris Agreement, dictate new conditions on the natural gas market in Europe. The most important goal is to achieve carbon neutrality by 2050 and ultimately move away from fossil fuels in favour of RES [EC, 2020a]. The coming to power of the Biden administration in the United States and China's new climate policy aimed at achieving carbon neutrality by 2060 indicate that the energy transition concept is gaining more support.

The transformation of specificity associated with fundamental changes in the natural gas market is already taking place and will only accelerate in the near future [Kryukov, Medzhidova, 2021]. The focus of attention of the exporters is shifting to natural gas decarbonization technologies and the possibility of hydrogen supply [Stern, 2020]. For a long time, asset specificity determined the structure and mechanisms of governance in the gas markets. However, under the influence of the above groups of factors, the essential prerequisites for specificity have changed. The main question is what will happen to a giant continental pipeline infrastructure with a high level of asset specificity constructed over the past half-century.

European Natural Gas Market and Its Assets

Even though natural gas accounts for 24% of the global energy balance, there is no single gas market. The three largest regional markets, located in North America, Europe, and the Asia-Pacific region, differ in the degree of liberalization, the preferred type of contract and pricing formula, the dominant mode of transportation, and the number of participants. Depending on the market, the general level of asset specificity changes, as do the factors influencing it.

The European gas market is represented by a relatively large number of importers and several exporters (Norway, Great Britain, Algeria and Russia). With the development of the LNG market, the number of exporters has grown, but the supply is still mainly carried out through pipelines from Algeria, Norway and Russia.

Growth of natural gas imports in 2000–19 amounted to about 100 billion cubic metres, while the Russian supply share fell from 74% to 53%. In recent years, LNG import volumes have increased, while pipeline supply has remained relatively stable. At the beginning of the 21st century, the share of LNG import was less than 13%, but in 19 years, it has expanded to 34%. The increase accounted for 90% of the total import growth.

During the indicated period, gas consumption in Europe was stable, but with a downward trend: the average annual decline (2001–19) was 0.1% (Figure 3).

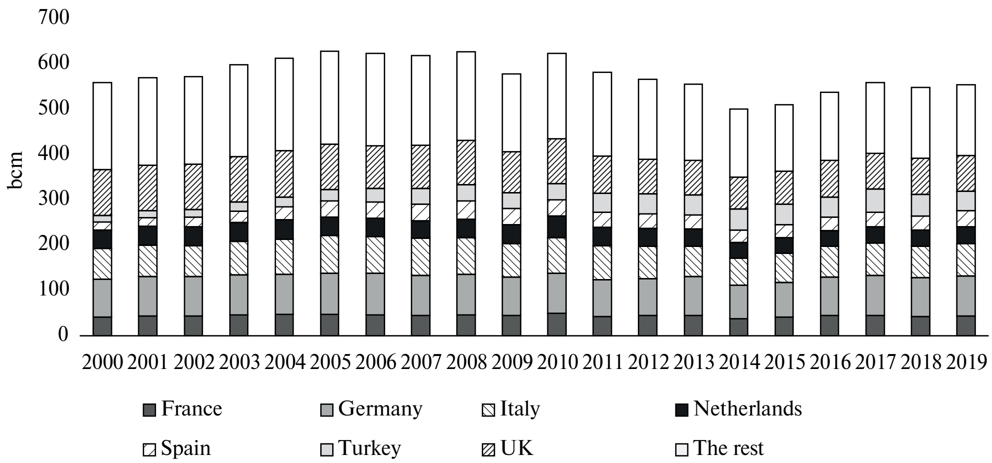

Fig. 3. Gas Consumption in Europe by Country (bcm), 2000–20

Source: Author's calculations based on data from BP [2020].

The liberalization of the European gas market was carried out through directives and energy packages. A liberalized market has the following features: access to gas pipelines and regasification terminals for third parties, the presence of gas hubs,[4] and gas-to-gas pricing (that is, the binding of contracts to the price at the hubs). Liberalization contributes to a decrease in the level of asset specificity due to access to transport facilities of third parties and consequently increased competition in the downstream segment. The latter leads to lower transaction costs and decreases the possibility of opportunism.

Several major consequences of the liberalization of the gas market can be highlighted. First, the number of gas hubs and the volume of gas traded increased [Heather, 2015, 2019]. Today, two hubs have reached maturity – the Dutch TTF and the British NBP [Heather, 2020]. Second, the share of spot (up to four years) contracts increased, indicating a decrease in the level of specificity. New LNG projects can change this trend, but only during the construction phase. Today, spot trade accounts for 40% of total LNG imports [GIIGNL, 2021] and continues to grow.

The European Union's (EU) midstream is represented by the trunk pipelines and the European gas distribution network. The four largest operating companies (Snam, Enagas, Fluxys and CRTgas) own pipelines over 105,000 km long [Statista, 2019a]. In addition, the ongoing construction of gas pipelines (Southern Gas Transportation Corridor and Nord Stream 2) is underway at the height of the battle for climate neutrality. Despite the desire to move away from fossil fuels, Europe is pursuing a policy of enhancing energy security. As the experience of Nord Stream 2 shows, even a rich country such as Germany cannot give up coal, gas, and nuclear power plants at the same time [Schultz, 2021]. Natural gas continues to act as a de facto bridge.

The midstream segment also includes LNG terminals, liquefaction plants (in exporting countries) and regasification plants (in importing countries). Twenty-six LNG terminals operate in the EU, seven are under construction, and 21 are projected [Statista, 2019b].

[4] The central pricing point in the natural gas market.

Since the construction of an LNG terminal involves high costs and (in times of low gas prices) a long payback period, many European countries have opted for floating regasification units (FSRU). They have lower capital costs (up to $300 million) and a shorter construction period (one to three years). The storage, liquefaction and regasification capacities of these plants are inferior to those of the terminals. The operation of the FSRU can meet the needs of the countries with a modest volume of natural gas consumption. These units have a lower level of asset specificity than an LNG terminal, not to mention a pipeline.

According to the Global Energy Monitor, the EU and the UK plan to build infrastructure to increase import capacity by 233 billion cubic metres per year (138 billion cubic metres through gas pipelines). Such large-scale construction will require up to 100 billion euros, including the cost of gas-fired power plants, requiring 35 billion euros [Inman, 2020].

The announced construction plans support the stocks of energy infrastructure operators, while the stocks of extracting companies (Total, E.ON) are on a downtrend. The first peak (Figure 4) happened before the 2008–09 financial crisis. However, the entry into force of the Kyoto Protocol in 2005 did not affect the growth of stocks. The next peak is associated with the rise in hydrocarbon prices until 2014. The Paris Agreement could have been a factor restraining growth from 2015.

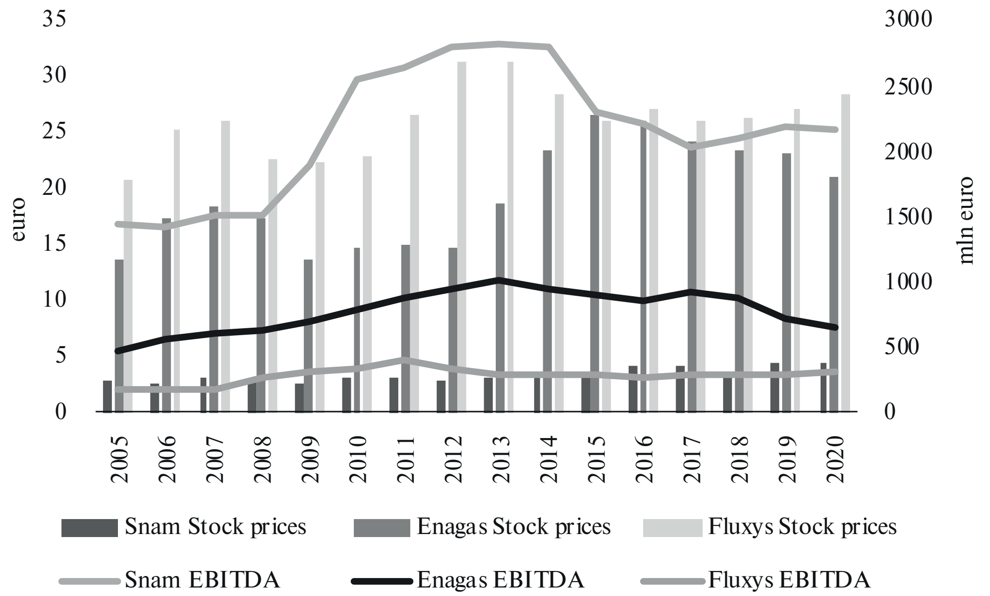

Fig. 4. Stock Movements of the Major European Gas Infrastructure Operators (euros), EBITDA (million euros), 2005–20

Source: Author's calculations based on Bloomberg Terminal.

It is difficult to make a forecast on the changes in stock prices in 2021–30. Despite the green European plans, construction, refurbishment, and dismantling of infrastructure are far from complete. In 2012–20 the average annual drop in EBITDA by companies amounted to: Snam – 3.1%; Fluxys – 0.7%; Enagas – 4.4%; Total – 2.3%. In terms of transaction cost theory, the ownership of assets with a high level of specificity leads to higher financial performance. Nevertheless, the political decisions of states affect the market.

Gas processing plants have a high level of specificity. As the equipment is focused on methane processing, there is little room for it in a green European future.

For a long time, the factor of energy security had a massive impact on the specificity of assets. Diversification of imports justified the costs of the construction of pipelines and LNG infrastructure. As already noted, different segments have different levels of asset specificity. In particular, LNG has an advantage over pipeline infrastructure in this regard since it involves a larger number of players. More importantly, the LNG market lacks a rigid connection between the supplier and the consumer. In general, diversification of imports and expansion of the number of suppliers is in line with the objectives of the EU's energy policy. However, the trend toward reducing emissions and introducing RES can weaken the position of natural gas and hence the main assets in this market.

Impact of EU Climate Policy on the Natural Gas Market

Today, one of the most discussed topics is climate change mitigation and the consequences humanity will face if the temperature rises by more than 2° C [Thuiller, 2007]. Over the past decades, European countries have been pursuing and promoting the transition to a green economy. The fourth energy transition is being performed with the enthusiastic assistance of the state and under the influence of state policy [Grigoryev, Medzhidova, 2020].

In 2015, the Paris Agreement was signed, according to which each country independently sets emission caps [Makarov, Stepanov, 2018]. European countries have set some of the most ambitious targets through pan-European and national strategies. After successfully implementing the 20-20-20 programme [Stankeviciute, Criqui, 2008], the EU adopted a goal to achieve carbon neutrality by 2050. The Green Deal is a large-scale programme that involves restructuring the entire economy and moving it to a green track.

As a part of the Green Deal, an investment plan was developed in March 2020: it is expected to attract at least one trillion euros over 10 years. More than half of this amount will come from the EU budget (503 billion euros), part from national budgets (114 billion euros), and part from the InvestEU fund (279 billion euros) [Hafner, Raimondi, 2020]. A Just Transition Mechanism has been proposed since European economies are prepared for the transition to varying degrees. It is supposed to mobilize over 150 billion euros through several European funds in 2021–27 to help the regions, industries, and workers facing the highest costs. However, the pandemic and the recession in 2020 have already changed the situation, resulting in a 6.5% decline in gross domestic product (GDP) in the eurozone [IMF, 2021]. Today, we discuss debt financing of the recovery of the European economies with a simultaneous transformation of the energy balances. Although funding has been expanded to 1.9 trillion euros, the problems of the energy transition in the context of the crisis remain severe.

Efficient investments allocation persists as an essential issue. Coal is still mined in the EU and used for power generation. Over the past 30 years, the share of coal in electricity generation has halved, but it was still 20% in 2018 (Figure 5). The withdrawal of these capacities and the transition to gas or RES will require investment and political determination. It will lead to job losses and reduce exports (in Poland and Germany, for example). At the same time, in Poland, the share of coal in the energy balance in 2019 was 74%, in Estonia – 70%, and in Germany – 30%.

From the point of view of asset specificity, the transition from oil to gas (the third energy transition) was accompanied by the active construction of infrastructure – trunk pipelines, gas distribution networks, and gas processing plants. As a result, the level of specificity in the midstream and downstream sectors was extremely high. Long-term import contracts formed a bilateral monopoly that excluded any competition in the market [Gustafson, 2020]. With the diversification of imports and liberalization, the level of specificity declined, first of the domestic market assets and then of the import assets. The mainstreaming of the climate agenda and the introduction of combined cycle gas turbines led to a dynamic switch from coal to gas in several countries, especially in power generation.

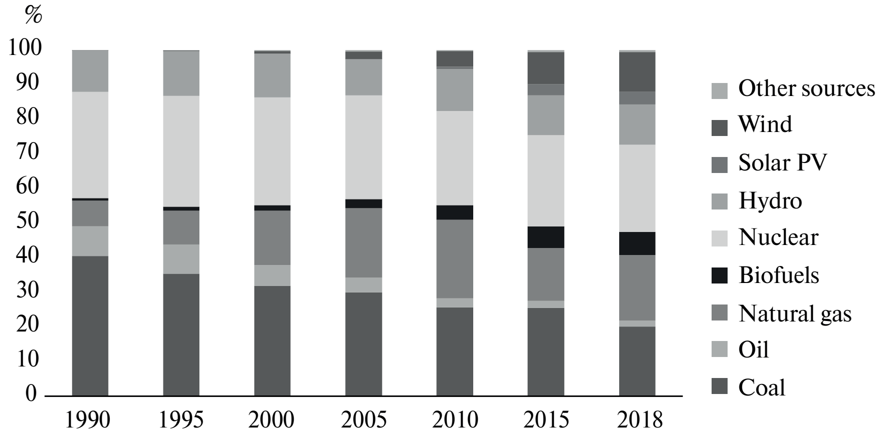

Fig. 5. Electricity Generation in EU-28 by Source of Fuel (%), 1990–2018

Source: Author's calculations based on IEA [2021].

The fourth energy transition and the goals of achieving carbon neutrality and a fundamental restructuring of the fuel and energy balance lead to the *disqualification of assets*. Asset disqualification is the loss of specificity and the ability to generate income, which primarily derives from political (state) decisions. In other words, the demand for assets that were previously characterized by a high level of specificity and guaranteed a competitive advantage for the owner is falling. At the same time, the drop in demand is not a natural process but a consequence of states' decisions. If the level of specificity is low (which suggests that there exist alternative ways to use an asset), the assets most likely will not be disqualified. Restructuring of such assets for other needs can be carried out at a low cost. In the context of the energy transition, it is not feasible to build new transport facilities [Correljé, 2016] and some highly specific assets are being transitioned into the category of practically useless ones.

The specificity level directly impacted the mechanisms of governance and the interaction between economic agents. A good illustration is provided by the OPAL case. The company was deprived of the opportunity to buy more than 50% of the gas volumes supplied by Gazprom. This decision of the European Commission led to an increase in gas prices in the Czech Republic for several years. The problem was resolved only in 2016 when the European Commission allowed OPAL to sell empty capacities, while Gazprom was allowed to buy them [Kurdin, Shastitko, 2018]. When the level of specificity is high, even in the liberalized markets, the government often needs to intervene to prevent monopolization and find the optimal solution. The price mechanism is effective, but asset specificity creates the preconditions for a neoclassical mechanism (trilateral governance) during crises.

The fate of the entire gas distribution infrastructure in Europe largely depends on technologies and innovations: in what time frame technologies will be proposed and introduced to optimize costs, reduce emissions, and increase production and what the cost of these technologies will be. Biogas and biomethane can be transported through existing pipelines, but production is highly costly. Hydrogen can be mixed with methane if the proportion of hydrogen remains within 5–20% [Peters et al., 2020], but this sphere also requires additional research.

In line with the new EU targets, transport companies have developed an action plan combining three options. The first option is to replace methane with biomethane and synthetic methane; the second option is to blend methane and hydrogen; the third option is to use hydrogen in particular regions (clusters). Instead of replacing the existing infrastructure, the plan is to restructure it for the new needs, which is associated with a 10–33% cost reduction compared to constructing a new pipeline system [ENTSOG, 2020]. At the same time, operators are ready to take on investment at the initial stage, which will require some regulatory changes.

In sum, 60 billion euros must be invested in hydrogen by 2030, of which more than 24 billion will be directed to infrastructure, including gas pipelines and plants for the production of hydrogen using RES. In 2019, there were 190 projects in the EU; the total investment amounted to more than 1.5 billion euros [FCH JU, 2019], but with the support of the state, this number will grow. However, the costs will also increase. The above data does not include the cost of dismantling disqualified assets or plant and pipeline refurbishment to meet the new European energy policy goals, not to mention the construction of additional pipelines and LNG terminals.

International agreements and national strategies aim to reduce emissions associated with the production of carbon-intensive products on the territory of the countries. Indirectly this leads to the “leakage of emissions” [Makarov, Sokolova, 2014] due to imports. To adjust these indicators, the EU plans to introduce a carbon tax on all imported products. According to BCG estimates, losses for the Russian oil and gas sector could reach $1.4–$2.5 billion. The tax could provide significant support for financing the Green Deal if used directly and on purpose [Krukowska, 2020]. However, such a tax will increase the burden on the exporters, especially when natural gas prices are low.

Today, climate policy is the most crucial factor that directly impacts the transformation of specificity in the European natural gas market. The greening of the economy and the region’s dependence on imports intensifies the energy transition from hydrocarbons to renewable energy sources. The Green Deal has long-term implications for Russian exports and the implementation of LNG projects. The basic conditions for the profitability of infrastructure and production are changing and the very meaning of specificity is changing. There is currently no clarity regarding the new EU hydrogen market regulation and the associated transaction costs. Obviously, the assets that provide competitive advantages and additional income will be threatened, if not by dismantling, then by significant refurbishment.

The pandemic and the associated crisis are the factors accelerating the energy transition. Global lockdowns and supply delays led to a decline in hydrocarbons (including natural gas) consumption in 2020. The prospects for recovery remain unclear, but most likely, it will be partially green in the EU.

State support and subsidies can be received by those companies or even industries that make the most outstanding contribution to reducing emissions and use renewable energy sources. Investment in fossil energy sources declined significantly in 2020, in contrast to investment in renewable energy [IEA, 2020b]. Such a scenario will only accelerate the reduction in gas demand. However, it will not lead to its complete exclusion from European countries’ energy balances in the near future. At the same time, it must be underscored that the investments in renewable energy in the EU peaked in 2011, steadily declining since then [FS-UNEP Center & BNEF, 2019]. A significant decrease in hydrocarbon prices in 2020 increases their competitiveness compared to renewable energy sources [Telegina, Khalova, 2020]. The further development of alternative sources remains largely an act of political will.

Since renewable sources have a number of disadvantages, including the lack of large capacities for energy storage, generation volatility, and the lack of correlation between demand and production, a complete transition to renewable energy is a complex task.

Technologies creating green natural gas are considered a feasible solution. J. Stern offers several ways to decarbonize natural gas. The first option is to obtain biogas or biomethane through gasification. The second and third alternatives are associated with hydrogen production through RES or methane using sequestration[5] [Stern, 2019b]. Today, biogas production and hydrogen production through RES are limited to small volumes. Hydrogen can replace the consumed volumes of methane. However, the transition to hydrogen will require investment in the foreseeable horizon and entail a long period of higher production operational costs [Stern, 2020].

Some scenarios (before the Green Deal) assumed a slight increase in gas consumption in Europe by 2040 [Makarov, Mitrova, Kulagin, 2019]. However, the new scenarios assume a sharp decline in gas demand. According to the International Energy Agency's (IEA) scenario, achieving carbon neutrality will require a reduction in consumption by 80% by 2050. In addition, all gas will be decarbonized, and more than half of the consumed volume will come from hydrogen (generated by RES) and biomethane [IEA, 2020a]. Complete dismissal of gas by 2050 seems impossible to most energy economists, although it is acknowledged as a goal by some politicians. However, today the largest European mining companies are switching from hydrocarbons to renewable energy sources. In particular, BP plans to reduce hydrocarbon production and build wind farms; Total is interested in wind energy and electric vehicles; Shell – in hydrogen production; Eni – in biomethane [Gurkov, 2020].

In considering the transition to hydrogen, several comments should be made. First, hydrogen can be obtained from various sources, including coal, natural gas, methanol, electricity, and RES. This might lead to a reduction in imports for the European region. Second, the transition to hydrogen will be accompanied by large-scale infrastructure projects. As the leading exporter of pipeline gas to Europe, Russia will need to develop sequestration technologies and build the corresponding capacities. In other words, the level of specificity of these assets will be high.[6] Third, it is highly likely that transportation will require replacing existing gas pipelines and gas processing plants, both in Russia and Europe. It will be necessary to replace gas pipelines and the infrastructure for the LNG projects. Fourth, there is still no estimate of the costs of these large-scale projects and the time frame of their practical implementation within 10–20 years.

Suppose hydrogen is to meet up to a quarter of the energy demand. In that case, the active participation of companies is expected, as well as the development of technologies that could minimize costs [FCH JU, 2019].

In the medium term (until 2030/35), the main factor determining the specificity of the European gas market will remain the climate agenda. LNG is associated with higher emissions than pipeline gas but contributes to the security of supply and reduces dependence on the dominant exporter [Grigoryev, Medzhidova, 2021]. Liquefaction of hydrogen is carried out at even lower temperatures. Further development of LNG infrastructure is associated with setting political priorities in Europe and choosing between climate and security.

[5] The process of capturing and storing carbon dioxide underground.

[6] In this article, the specificity of the hydrogen market is not analyzed; however, its high level and, accordingly, hierarchical structure with long-term contracts (without the state's decision on liberalization) seems obvious.

In the long term (until 2050), a significant reduction in gas demand is expected due to an increase in the share of renewable energy sources in energy balances and energy efficiency growth. An open question remains: is it rational to build a new gas distribution network, trunk pipelines and pipelines for transporting carbon dioxide in the context of falling consumption? Through the FRSU and further limited distribution, gas imports in small volumes will act as a "reserve capacity" for renewable energy sources.

At the same time, the widespread use of LNG does not facilitate climate change mitigation, but on the contrary, complicates it. Emissions are generated during the production, liquefaction, and regasification stages; emissions from LNG imports generally exceed those from pipeline supplies [Stern, 2019a]. Sequestration costs can render LNG uncompetitive. Large-scale projects aimed at introducing biogas and hydrogen will require comparable investments. The planning horizon shifts to 2030, then the EU will switch to green hydrogen from renewable energy sources [EC, 2020b].

Russia can become one of Europe's leading hydrogen suppliers, but cooperation will be determined by mutual willingness for the mentioned transformations. Since the IEA scenario allows replacing only 50% of the consumed hydrogen, the gas transmission network connecting Russia and Europe can be used for supplies in future until 2050.

In summary, by 2050, the EU plans to:

- Satisfy 24% of final energy demand with hydrogen.
- By 2030, allocate 60 billion euros for the development of the hydrogen market.
- Achieve carbon neutrality with over one trillion euros of Green Deal investments.
- Reduce natural gas consumption by 80% (as estimated by the IEA) with renewables and through energy efficiency growth.
- Dismantle and/or rebuild highly specific assets for hydrogen.

The construction of additional import capacities does not correlate with these plans (the minimum investment is 100 billion euros); however, it derives from the energy security issue.

The EU faces a difficult choice: the primary goal of the previous decade – strengthening energy security – is in confrontation with the new climate plans. The feasibility of building new transport infrastructure, especially trunk gas pipelines, remains highly controversial. With the active replacement of renewable energy sources, it loses its attractiveness in the eyes of investors. In this case, the main risks are borne by the state. The example of German companies that have received compensation from the state for dismantling nuclear power is a striking precedent [DW, 2016] that speaks to the common fate of the infrastructure of the European gas market.

In 2011, Germany decided to phase out all nuclear power plants in the country by 2022. In response to this decision, in 2016, the companies owning nuclear power plants – E.ON, RWE, Vattenfall – demanded a revision of the compensation proposed in the law. The demand to switch power generation to gas, and then to renewable energy sources, was accompanied by an increase in retail prices for electricity and the loss of dividends for the companies' shareholders. The court took the side of the companies and ordered the federal government to increase compensation, as the companies failed to sell the same amount of electricity compared to usual market sales. In other words, the government had to compensate for the long-term investments in disqualified assets. In 2018, Germany pledged to revise payments to operators after the closure of all reactors in 2023. However, Vattenfall, which did not agree with this decision, continues to file claims. According to one of them, filed with the International Centre for Settlement of Investment Disputes, the company has demanded several billion euros in compensation [FitchRatings, 2021].

It is notable that the courts in Germany did not question the need to close nuclear power plants. However, the proper course does not imply the absence of adequate compensation for the assets that will become useless and will no longer be profitable as a result of the state's decision. Disqualification "from above" is a de facto economic sanction by the state against those of its own companies that own highly specific assets. A similar fate may await gas distribution infrastructure, trunk pipelines, and gas processing plants. Another, so far undeveloped, problem remains the technological readiness of the industry and the cost of a dramatic, simultaneous, and large-scale transition in such a short period in many countries with different technological, economic, and political situations.

The economic consequences of the political decision to disqualify assets in Germany included the loss of dividends and profits and the costs of dismantling the assets. A new round of energy transition in the EU will lead to the same consequences, but in 27 countries simultaneously and after a severe crisis, which led to an increase in sovereign debt.

Conclusion

In terms of transaction cost theory, the issue of asset disqualification has not yet been addressed. It is important to note that the higher the specificity of the assets in the gas industry, the higher the dismantling costs. The forthcoming contraction of the natural gas market will lead to a new revision of the market structure and relations between the players. There is a high probability of a return to a hierarchical structure and long-term contracts since the number of players will decrease, the level of competition will drop, and the best guarantor of supplies will not be the company's reputation but rather the state.

Under the energy transition conditions, the pipeline infrastructure's level of specificity will be associated with the possibility of its refurbishment for the supply of "blue" and "green" hydrogen.[7] In other words, if it is possible to reduce the specificity of the infrastructure, the problem of its dismantling will be solved. However, the refurbishment of gas pipelines will only be a solution to the asset disqualification problem in the medium term. In the long term, the EU plans to switch to green hydrogen and increase energy efficiency, which will reduce import demand to zero. Technologies for transporting hydrogen by tankers have not yet been invented.

We are witnessing a fundamental restructuring of the global energy sector, affecting the transformation of asset specificity. In the EU, political decisions affect the cost structure, profitability of companies, and the nature of their actual investments. Hence, the necessity arises for radical transformations in the energy sector and simultaneously in most EU countries. The nature, speed, and depth of the disqualification of currently active assets depends on the decisions made in the near future. Accordingly, a difficult transition period in the EU energy sector will begin, accompanied by a revision of bilateral and multilateral relations and spheres of their further development.

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[7] Blue hydrogen is produced from natural gas, using sequestration technologies. Green hydrogen is produced by electrolysis from renewable energy sources.

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