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Prospects for the use of LNG terminals to meet the demand for natural gas in the EU

ABSTRACT: In recent years, changes have been made in the structure of primary energy use in the European Union In addition, a reduction in the use of primary energy has also been observed. According to the forecasts of the International Energy Agency, the European energy market will be subject to further changes in the perspective of 2040. These may include the reduction of the energy consumption and the change in the structure of the energy balance as a result pro-ecological activities. Natural gas will be the only fossil energy carrier whose role in covering the energy demand will not change. Along with the changes taking place in the European energy market, global changes can also be observed. The EU Member States will continue to strive to diversify natural gas supplies. One of the main elements of diversification of natural gas supplies is the use of LNG regasification terminals. The reasons for that include the increasing production of natural gas, particularly in the case of unconventional deposits, the ongoing development of liquefaction terminals, and, as a consequence, an increase in the LNG supply in the global market. The article presents the utilization of regasification terminals in the EU Member States and plans for the development of LNG terminals. Europe has the opportunity to import natural gas through LNG terminals. However, until now, these have been used to a limited extent. This may indicate that in addition to diversification tasks, terminals can act as a safeguard against interruptions in gas supplies.

KEYWORDS: natural gas, LNG, energy balance

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Introduction

One of the major problems of the energy sector, currently discussed in the European Union, is the future energy demand policy. The discussions and actions carried out concern the energy balance, the energy carriers used, and activities aimed at improving the energy efficiency. The ongoing debate is a consequence of climate change and the proposed actions are aimed at reducing greenhouse gas emissions. Significant differences in the energy balance of individual Member States make these discussions extremely difficult. The main demands in the ongoing debate include a strong reduction of use of coal or a total move away from this primary energy carrier. Instead, increasing the use of renewable energy sources or natural gas is proposed. The actions carried out by individual EU countries have led to a decrease in the EU energy consumption in the last seven years by less than 5%. In 17 EU countries, a reduction in the energy consumption has been reported. This also applies to the largest energy consumers, i.e.: the United Kingdom and Italy (a decrease by more than 10%), France (a decrease by more than 7%), the Netherlands (a decrease by more than 11%), and Spain (a decrease by more than 5%). Meanwhile, in the remaining 10 countries, an increase in the energy consumption has been observed. The mentioned countries include: Germany and Poland (an increase by 2%), Sweden and Bulgaria (an increase by about 5%), and Estonia (an increase by more than 10%). The energy consumption of the EU countries in the period from 2010 to 2017 is presented in Table 1. As a consequence of the reduced energy consumption in the analyzed period in the EU, a decrease in the consumption of fossil fuels, i.e. coal (a 45.9 Mtoe decrease, which is a 16.4% reduction), crude oil (a 40.2 Mtoe drop, which is a reduction by 5.9%), and natural gas (a decrease by 46.5 Mtoe, which is a 10.4% reduction) has been observed (BP Statistical Review of World Energy 2018; International Energy Agency 2011−2017).

1. The forecasts of energy consumption in the European Union according to the International Energy Agency

According to the forecasts of the International Energy Agency, by 2040 the energy consumption in the European Union will decrease compared to the year 2016 regardless of the adopted scenario. Three scenarios are currently under consideration. The Current Policies Scenario analyzes the impact of the policies and objectives which were adopted by mid–2017. In addition, the assumption of the scenario is that the least ambitious plans will be implemented. This scenario assumes a careful assessment of the implementation of adopted policies in the absence of additional government incentives. The New Policies Scenario is the main scenario and assumes the development of the energy industry in accordance with policies adopted by individual

TABLE 1. The primary energy consumption in selected countries of the European Union in 2010–2017

TABELA 1. Zużycie energii pierwotnej w wybranych państwach Unii Europejskiej w latach 2010–2017

Country	2010	2011	2012	2013	2014	2015	2016	2017	Changes in the years 2010–2018
	Mtoe								%
Austria	35.5	33.4	35.0	34.8	33.7	33.7	34.9	35.9	1.3
Belgium	66.6	61.9	59.5	60.9	56.8	58.0	62.4	62.3	–6.6
Bulgaria	17.9	19.2	18.1	16.7	17.9	19.1	18.0	18.8	5.4
Croatia	9.2	8.1	7.5	8.2	8.2	7.8	8.1	7.5	–18.1
Cyprus	2.9	2.9	2.7	2.4	2.4	2.5	2.7	2.8	–5.7
Czech Republic	44.0	42.6	42.2	42.1	40.5	40.5	39.8	41.6	–5.4
Denmark	19.7	18.7	17.3	18.1	17.5	16.9	17.4	17.3	–12.1
Estonia	6.2	6.2	6.3	6.8	6.5	6.1	6.0	6.8	10.7
Finland	31.9	29.3	28.4	28.0	27.0	27.6	28.3	27.6	–13.5
France	256.0	247.2	247.4	250.3	240.6	242.3	238.9	237.9	–7.1
Germany	328.7	317.0	321.3	330.7	317.2	323.3	328.2	335.1	2.0
Greece	31.8	31.0	29.5	28.0	26.4	26.6	26.6	27.6	–13.2
Hungary	23.8	22.9	21.3	20.3	20.3	21.4	22.0	23.2	–2.6
Ireland	15.4	14.4	14.2	14.0	13.9	14.8	15.4	15.6	1.7
Italy	174.9	171.0	164.6	158.0	149.1	152.2	153.8	156.0	–10.8
Latvia	4.2	3.7	3.9	3.7	3.4	3.5	3.8	4.2	0.3
Lithuania	5.6	5.9	5.9	5.4	5.2	5.5	5.6	5.7	1.8
Luxembourg	4.3	4.1	4.1	3.9	3.7	3.6	3.5	3.7	–12.8
The Netherlands	97.0	92.9	89.4	87.3	82.2	83.3	85.2	86.1	–11.2
Poland	100.1	100.6	97.6	97.9	94.3	95.3	99.5	102.1	2.0
Portugal	25.8	24.6	22.5	24.6	24.8	24.7	26.8	26.4	2.2
Romania	34.0	34.9	33.7	31.3	32.7	32.8	32.8	33.9	–0.3
Slovakia	17.5	16.9	16.3	16.9	15.6	15.8	15.8	16.2	–7.4
Slovenia	7.3	7.1	6.9	6.8	7.0	6.4	6.9	6.9	–5.9
Spain	146.6	143.8	143.0	135.7	133.3	135.3	136.7	138.8	–5.3
Sweden	51.9	51.8	55.1	51.9	52.1	53.4	52.8	54.4	4.9
UK	213.5	202.0	204.5	203.7	192.0	194.4	192.2	191.3	–10.4
EU	1 774.7	1 716.6	1 700.8	1 690.7	1 626.7	1 649.2	1 666.4	1 689.2	–4.8

Source: own work based on BP Statistical Review of World Energy 2018.

governments for the development of the sector. It is intended as a source of information for decision-makers in order to improve the adopted solutions. It covers not only policies and measures that have already been implemented by governments around the world, but also the likely effects of the announced policies, expressed in official goals or plans. The Sustainability Scenario was first introduced in 2017 and has a fundamentally different approach than the above scenarios. The former are based on certain assumptions about the adopted policies, while the Sustainable Development Scenario is based on a vision that an integrated approach to achieving energy goals should take place. This approach should be based on the principles of UN sustainable development, while decisive actions in the field of climate protection and the dissemination of access to modern energy solutions should also be carried out. According to the New Policies Scenario, energy consumption will decrease by 282 Mtoe (a decrease by 18%), in the Current Policies Scenario the energy consumption will decrease by 116 Mtoe (a 7% reduction), while in the Sustainable Development Scenario the energy consumption will be 407 Mtoe and will decrease by up to 26%. Depending on the considered scenario, a change in the structure of primary energy consumption is also forecasted. Focusing on natural gas, it should be noted that its consumption will depend on the scenario under consideration. According to the New Policies Scenario, natural gas consumption will be reduced by 2%, i.e. 8 Mtoe, while in the Current Policies Scenario an increase in natural gas consumption by 20%, i.e. 75 Mtoe, is expected. Meanwhile, according to the sustainable development scenario, the consumption of natural gas will decrease by 26%, i.e. 100 Mtoe (International Energy Agency 2017). In the last 7 years, the share of natural gas in the EU energy balance has decreased. In 2010 it amounted to 25.6%, while in 2017 to 23.8%. A slightly greater decrease was recorded in the case of coal – from 15.8 to 13.9%, respectively, while the share of nuclear energy and hydropower decreased by 0.8 and 0.7%, respectively.

TABLE 2. The structure of the energy balance of the European Union in 2010–2017, percentage value

TABELA 2. Struktura bilansu energetycznego Unii Europejskiej w latach 2010−2017 [%]

Item	Crude oil	Natural gas	Coal	Nuclear power	Hydropower	RES
2010	38.0	25.6	15.8	11.9	4.8	3.9
2011	37.9	24.2	16.8	12.2	4.1	4.9
2012	36.7	23.7	17.4	11.9	4.5	5.8
2013	35.9	23.5	17.2	11.8	5.0	6.5
2014	36.8	21.6	16.6	12.4	5.3	7.4
2015	36.9	22.1	16.1	11.9	4.7	8.3
2016	37.3	23.5	14.5	11.6	4.8	8.3
2017	38.2	23.8	13.9	11.1	4.0	9.0

Source: own work based on BP Statistical Review of World Energy 2018; Energy BP Statistical Review of World 2011−017; International Energy Agency 2011−2017.

In turn, the shares of crude oil and renewable energy sources in the energy balance have increased by 0.2% and 5.1%, respectively (BP Statistical Review of World Energy 2018; Energy BP Statistical Review of World, 2011–2017; International Energy Agency 2011–2017). Table 2 shows the structure of the energy balance of the European Union in the years 2010–2017.

According to the forecast of the International Energy Agency, the change in the amount of energy consumed by 2040 will be accompanied by a change in the structure of the energy balance. Table 3 presents the forecasted energy balance of the EU. Among fossil fuels, only natural gas will increase its share in the energy balance; depending on the scenario, this increase will be up to 7%. The share of other fossil energy carriers will decrease; in the case of coal from 6 to 10%, and in the case of crude oil from 7 to 17%. The largest share increase in the energy balance of the EU, ranging from 8 to 21%, is planned for renewable energy sources (International Energy Agency 2017).

TABLE 3. The forecasted structure of the European Union's energy balance until 2040, percentage values

TABELA 3. Prognozowana struktura bilansu energetycznego Unii Europejskiej do 2040 roku [%]

Item	2016	2025	2030	2040	Scenario
Crude oil	33	29	27	23	New Policies Scenario
		30	28	25	Current Policies Scenario
		28	24	16	Sustainable Development Scenario
Natural gas	24	26	27	28	New Policies Scenario
		26	28	31	Current Policies Scenario
		27	26	24	Sustainable Development Scenario
Coal	15	13	11	7	New Policies Scenario
		14	12	9	Current Policies Scenario
		9	7	5	Sustainable Development Scenario
Nuclear power	14	13	12	12	New Policies Scenario
		12	11	11	Current Policies Scenario
		14	16	18	Sustainable Development Scenario
Hydropower	2	2	2	3	New Policies Scenario
		2	2	2	Current Policies Scenario
		2	3	3	Sustainable Development Scenario
RES	13	18	21	27	New Policies Scenario
		16	18	21	Current Policies Scenario
		20	24	33	Sustainable Development Scenario

Source: own work based on International Energy Agency 2017.

In the last four years, the natural gas consumption in the EU increased by 16%, reaching the level of 466 bcm (billion m^3) in 2017, while the production of this raw material in the EU Member States has decreased. Only in the last four years it decreased by 14%, reaching 117.8 bcm in the last year. The natural gas needed to cover the demand was imported mainly via pipelines, while the main suppliers were: Russia, Norway, Denmark, and Algeria.

2. Changes in the global LNG market

One should, however, bear in mind the changes taking place in the global gas market, where, thanks to the dissemination of LNG technology, the share of liquefied natural gas in global trade of this raw material is increasing. Figure 1 shows the share of liquefied natural gas in the global natural gas trade. In the analyzed period, the role of LNG in natural gas trade is systematically increasing. The ratio of natural gas in pipelines to natural gas in LNG form in 2010 was more than 2.27, while in 2017 – 1.88. In the analyzed period, the trade volume of natural gas in

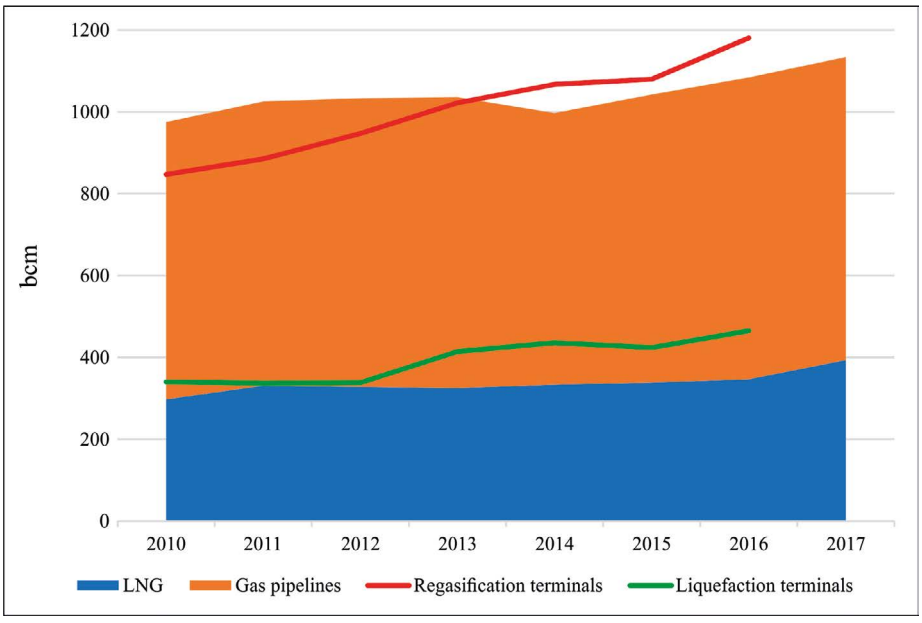

Fig. 1. The share of liquefied natural gas in the global natural gas trade and the comparison of liquefaction and regasification capacities of LNG terminals
Source: own based on Energy BP Statistical Review of World 2011–2017; International Energy Agency 2011–2017

Rys. 1. Rola skroplonego skroplonego gazu ziemnego w światowym handlu gazem ziemnym oraz zestawienie możliwości skraplających i regazyfikacyjnych terminali LNG

liquefied form increased on average by 4.5% annually, which is more than three times as much as in the case of gas in pipelines (1.33%). At the same time, one should take increasing the liquefaction and regasification capacities into account. Special attention should be paid to the fact that the regasification capabilities far outweigh the liquefaction capabilities. In 2010, the ratio of regasification capabilities to liquefaction capabilities was 2.49, while in 2016 it changed slightly and amounted to 2.53 (Energy BP Statistical Review of World 2011−2017; International Energy Agency 2011−2017; Ruszel 2014).

A significant increase in the liquefaction capacity of natural gas started in 2016 and lasted until the beginning of 2018. Since March 2018, the total liquefaction capacity of LNG export terminals has been at the level of 480.2 bcm/year (369.4 million tons/year) after an increase by 43.16 bcm/year (32.2 million tons/year) at the end of 2016. As of today, liquefaction terminals with a capacity of about 119 bcm/year (92 million tons/year) are currently under construction. A large share of these investments is concentrated in Australia and the United States. It should be noted that four vessels, which will be used for the liquefaction of natural gas with a total capacity of 13 bcm/year, are currently under construction (International Gas Union 2018). From 2020 on, further investments in liquefaction terminals, with a total capacity of approximately 1137 bcm/year (875 million tons/year) are also planned. In the last two years, investments in liquefaction terminals were on hold, due to the low prices of raw materials and related budgetary restrictions. In 2017, liquefaction capacities amounted to approximately 460 bcm/year, while the average use of liquefaction installations was less than 83% (BP Statistical Review of World Energy 2018; International Gas Union 2018). Figure 2 presents liquefaction capacities in

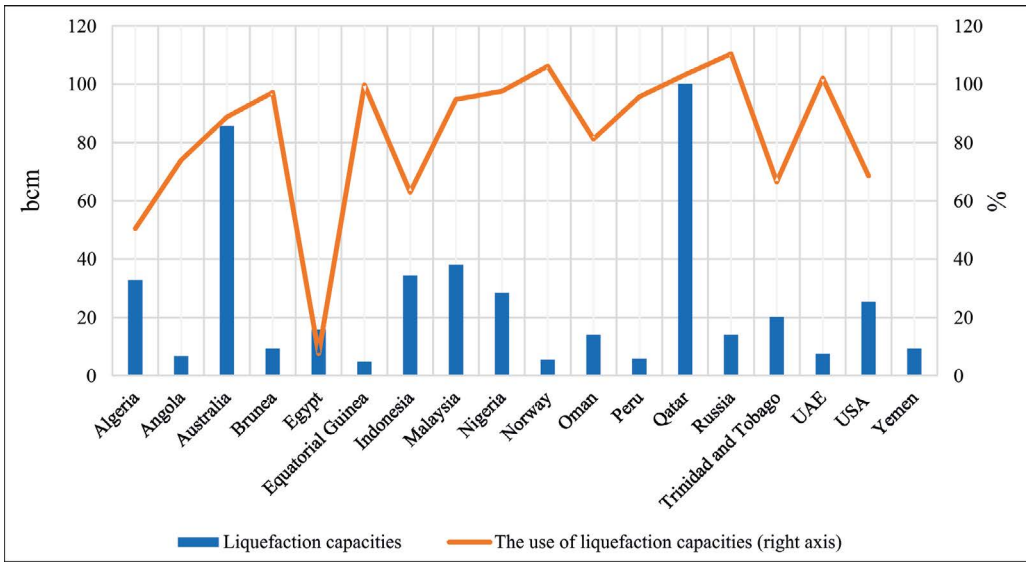

Fig. 2. Liquefaction capacities in individual countries and their utilization in 2017
Source: own work based on BP Statistical Review of World Energy 2018; International Gas Union 2018

Rys. 2. Zdolności skraplające w poszczególnych państwach oraz stopień ich wykorzystania w 2017 roku

individual countries and their utilization in 2017. Bearing the mentioned increase in liquefaction capacities in mind, the possible use of liquefaction capacities in the next 5 years should be taken into account. Figure 3 presents the expected increase in liquefaction capacities and the degree of use of liquefaction terminals in the period from 2013 to 2023, assuming that: the use ratio is the ratio of LNG produced to technical liquefaction capabilities, while the maximum utilization rate is the ratio of the actual liquefaction capacity to the potential liquefaction, taking both planned stoppages (e.g. maintenance and repairs) and emergency stoppages into account. In the years 2018−2023, an increase in liquefaction capacities of approximately 144 bcm/year is expected, which should increase the availability of LNG in the market by approximately 110 bcm. It is also expected to reduce the use of liquefaction capacity from 79 to about 70% in 2020 and then return to values from 2017, i.e. around 79%, in 2023 (International Energy Agency 2018; International Gas Union 2018; International Group of LNG Importers 2018).

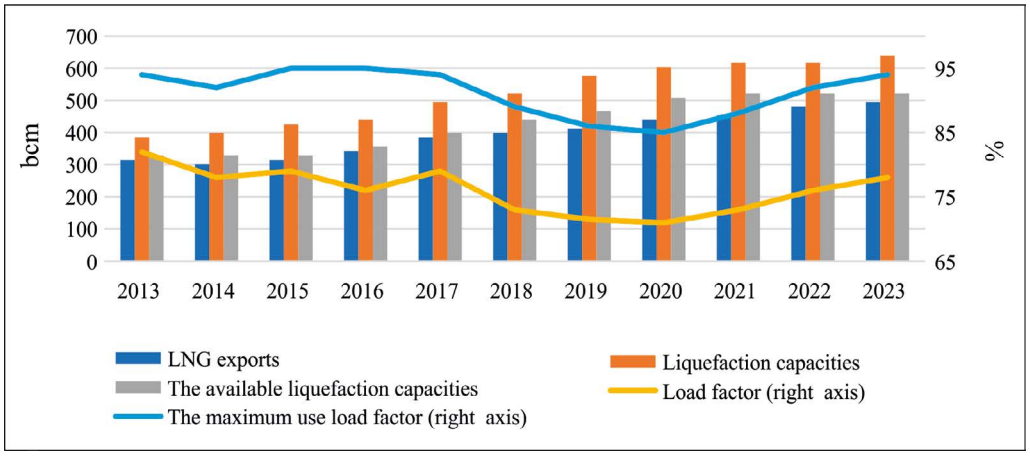

Fig. 3. Liquefaction capacities and their utilization in the years 2013−2023
Source: own work based on International Energy Agency 2018; International Gas Union 2018

Rys. 3. Zdolności skraplające oraz stopień ich wykorzystania w okresie 2013−2023

3. European LNG terminals

As already mentioned, the demand for natural gas in the EU is largely met by the import of this raw material. When analyzing the use of liquefied natural gas in the energy balance of the EU Member States, the capacities of LNG terminals in the EU should also be taken into account. Currently, 10 Member States have 21 terminals with a total regasification capacity of 224 bcm/year.

Since 2012, these capacities increased by more than 16%. Table 4 presents the regasification possibilities in individual EU countries and the amount of imported LNG. Since 2012, 8 to 12% of the demand for gas in the EU was met by LNG imports. Figure 4 shows the amount of LNG supplied to the EU. In the analyzed period, the total use of regasification capacities in the EU ranged from 18% (in 2014) to 29% (in 2012), while in 2017 it amounted to 22%. Assuming that regasification capacities would be used in 100%, around 42–49% of gas demand would be met by LNG imports (Gas Infrastructure Europe 2018).

TABLE 4. Regasification capacities in individual EU countries in 2017 and the volume of LNG imports [bcm]

TABELA 4. Zdolności regazyfikacyjne w poszczególnych państwach UE w 2017 roku oraz ilość importu LNG [bcm]

Item	Regasification capacity	The amount of imported LNG	Consumption
Belgium	15.20	1.119	16.4
France	42.72	9.69	44.7
Greece	7.01	1.49	4.8
Italy	17.56	11.64	72.1
Lithuania	4.28	1.155	2.2
Poland	5.56	1.711	19.1
The Netherlands	15.73	0.782	36.1
Portugal	6.58	3.646	6.2
Spain	65.21	15.937	32
UK	44.16	5.845	78.8
Total	224.02	53.02	312.4

Source: own work based on BP Statistical Review of World Energy 2018; Gas Infrastructure Europe 2018.

When analyzing the use of regasification capacities in individual countries in the year 2017, it should be noted that the greatest use took place in Italy – 66%, where LNG covered 16% of gas demand. The second biggest regasification capacity (55%) was recorded in Portugal, where 58% of the gas demand was covered by LNG. The use of regasification capacity in Poland amounted to 31%, putting it in third place, while LNG covered 9% of the gas demand. Given the fact that the amount of the imported LNG in the period January–July 2018 (1.66 bcm) almost equaled the amount of imported LNG in 2017 (1.711 bcm), the use of the LNG terminal in Świnoujście will significantly exceed the current values. If the level of received volumes is maintained, then

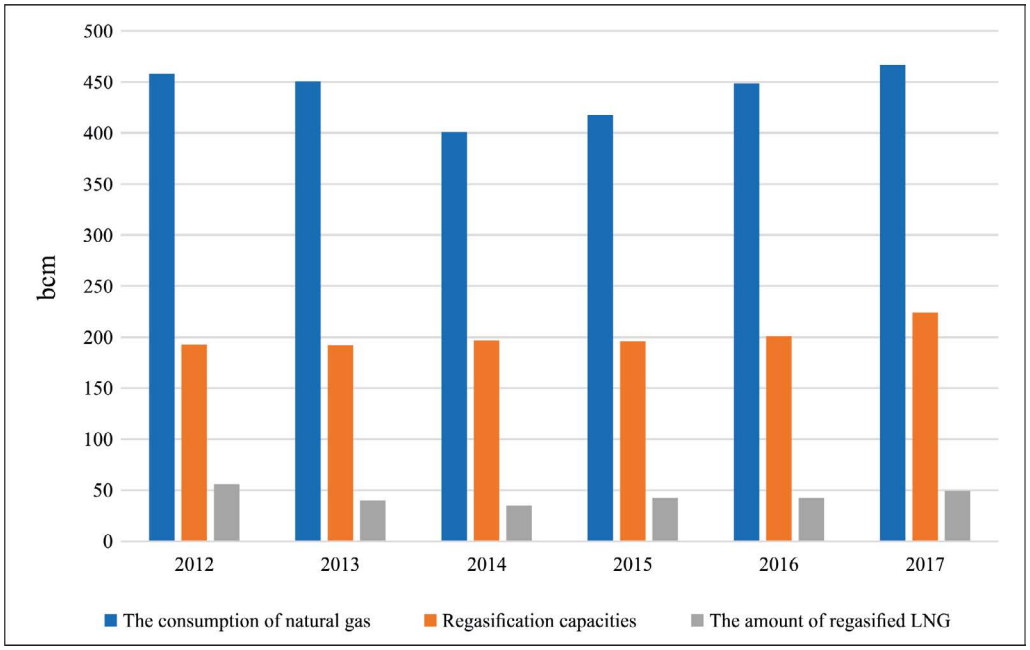

Fig. 4. The volume of natural gas consumption in the EU and the volume of LNG imports in the period from 2012 to 2017
Source: own work based on Gas Infrastructure Europe 2018

Rys. 4. Wielkość zużycia gazu ziemnego w UE oraz wielkość importu LNG w okresie 2012–2017

the use could be as high as 60% at the end of 2018. In the case of the other countries the use of terminals did not exceed 27%. The lowest use took place in the Netherlands – 5% (Sikora and Sikora 2018; International Gas Union 2018; BP Statistical Review of World Energy 2018).

Conclusions

The gap between the extraction and consumption of natural gas in the EU has grown in recent years. In the period 2010−2017, the output of EU countries decreased by over 64 bcm and, as expected, the downward trend will continue in future. The result is a need to increase imports. Despite the expected decrease of energy consumption in the EU countries, natural gas will remain the main fossil energy carrier. By 2023, the three global players: Australia, the United States, and Qatar will produce 60% of global LNG supplies. The United States, reaching the liquefaction capacity of 101 bcm per year, will become the second largest exporter of LNG right behind Qatar

(105 bcm/year). The changes taking place in the LNG market increase the energy independence and affect the competition in the market. The analysis of the objectives concerning the liquefaction infrastructure indicates the development of new LNG terminals in the coming years, which may result in a decrease of natural gas prices; this applies to both LNG and pipelines. It should be borne in mind that LNG terminals allow a quick and flexible change of gas suppliers, which significantly affects both energy security and market competition. Bearing in mind the reserves, meaening unused regasification capacities in the EU Member States, one should expect an increase in their share in the global LNG trading and thus a change in the current conditions of natural gas trade in Europe.

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Perspektywy wykorzystania terminali LNG do pokrycia zapotrzebowania na gaz ziemny w UE

Streszczenie

W ostatnich kilu latach miały miejsce zmiany w strukturze użycia energii pierwotnej w Unii Europejskiej, zanotowano także jej zmniejszenie. Zgodnie z prognozami przedstawianymi przez Międzynarodową Agencję Energii w perspektywie do 2040 roku, europejski rynek energetyczny będzie podlegał dalszym zmianom. Należy tutaj wymienić redukcję zużycia energii oraz zmianę struktury bilansu energetycznego na skutek prowadzonych działań proekologicznych. Gaz ziemny będzie jedynym kopalnym nośnikiem energii, którego udział pokryciu zapotrzebowania na energię się nie zmieni. Wraz ze zmianami zachodzącymi na europejskim rynku energii obserwować można globalne zmiany. Państwa członkowskie UE dążyć będą w dalszym ciągu do dywersyfikacji dostaw gazu ziemnego. Jednym z głównych elementów dywersyfikacji dostaw gazu ziemnego jest wykorzystanie terminali regazyfikacyjnych LNG. Z uwagi na fakt, że wzrasta wydobycie gazu ziemnego, w szczególności ze złóż niekonwencjonalnych, następuje rozwój instalacji skraplających, a w konsekwencji wzrost podaży LNG na globalnym rynku. W artykule został przedstawiony stopień wykorzystania terminali regazyfikacyjnych w państwach UE oraz plany dotyczące rozbudowy terminali skraplających. Europa posiada znaczne możliwości importu gazu ziemnego poprzez terminale LNG, jednak do tej pory wykorzystywane one były w ograniczonym zakresie. Świadczyć to może, że oprócz zadań dywersyfikacyjnych, terminale stanowią zabezpieczenie na wypadek przerw w gazociągowych dostawach gazu.

SŁOWA KLUCZOWE: gaz ziemny, LNG, bilans energetyczny