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The trade of energy commodities between the European Union and the United States – crude oil and natural gas

Introduction

Since July 2013, there negotiations are ongoing between the United States and the European Union on the Transatlantic Trade and Investment Partnership (TTIP). The agreement is designed to eliminate barriers to trade and capital (investment) flows between the two key economic areas. The agreement would strengthen the cooperation between partners from both sides of the Atlantic.

In the beginning of September 2015, the *US Energy Information Administration* (EIA) has announced that the elimination of restrictions on oil exports from the USA would not affect the difference (price competitiveness) between the price of WTI and Brent ([Biznes-alert... 2015](#)). When it comes to the negotiated TTIP agreement, both sides, the European Union and the United States, are concerned about the potential impact this agreement would have on their energy sectors.

Paradoxically, the cheapest gas currently imported to Poland is purchased on the European gas markets (e.g. Gaspool, Baumgarten). According to forecasts, this situation should change in the next few years, as the capacity of LNG plants in the United States is expected

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to increase. In this context, the validity period of the Yamal contract, up to the year 2022, and the Polish Government's declaration of no interest in future supplies of Russian gas under the current conditions (after the completion of this contract) should be taken into account. Taking the currently implemented projects aimed at diversifying the supply of natural gas into account, including in particular the commissioning of the LNG terminal in Świnoujście, an important part of the North – South Corridor Infrastructure, further changes in the structure of natural gas supplies to Poland can be expected. The importance of LNG in meeting the domestic demand for gas is likely to increase.

The signing of the TTIP agreement would open up other markets of natural gas from unconventional sources. The current relatively low prices in the closed US market can therefore increase. The price increase can cause a decrease in the difference between the prices of natural gas in the EU and the US markets, and thus reduce the competitive advantages of the American gas. It is worth noting that the development of the use of natural gas in the US could translate into an increase in exports of gas-based products, which will directly affect the chemical industry, including domestic chemical companies. In addition, low natural gas prices in the United States encourage European chemical concerns to invest in natural gas projects (Gross-Gołacka et al. 2013).

1. The dynamics of production of natural gas and crude oil in the EU and in the US in recent years

The dynamics of production of energy resources in the United States and in the EU member states varies significantly. The industrial use of fracturing technology to exploit unconventional sources in the United States has significantly reduced the prices of natural gas and the dependence of the US economy on import of this raw material. (point 1.2) (Nagy and Siemek 2011; Rychlicki and Siemek 2012; Szurlej and Janusz 2013; Kaliski et al. 2014; Siemek et al. 2011b). This technology has also allowed US companies to explore new, unconventional oil deposits (point 1.1). The success of the American “Revolution” was and is possible primarily thanks to the large number of companies, supported by adequate funds and policy (laws and regulations) which favor hydrocarbon exploration. In addition, the experience gained has allowed increasing the efficiency and productivity of new installations. The favorable geology of unconventional gas resources in the United States is also of key importance. These are shallow and relatively abundant deposits (Jędrzejczyk and Rychlicki 2014).

In the case of the EU member states, there is a different trend in the extraction of energy resources. The production of crude oil from conventional sources, mainly in the North Sea, is steadily decreasing. The European approach to the exploration of unconventional reservoirs, together with strong lobby against hydraulic fracturing and the extraction of shale gas are the reason why no new European reservoirs are being developed. Different geological structures in Europe and the difficulties of using American technological innovations are

unfavorable for the exploration of new gas resources. As a result, the European Union is becoming increasingly dependent on imported hydrocarbons (Szurlej et al. 2014).

The case of Poland, the most promising country to produce hydrocarbons from unconventional reservoirs (shale and tight gas) among European countries, is especially interesting. The development of new technology is complicated, costly, and time consuming, requires dedication, attention, time, clear rules and regulations, and, most importantly, support from the State. The experience gained during the activities conducted in Poland has confirmed the different geological structure of “Polish shales”, which are deeper situated than the US shales. As a consequence, simply transferring the technology developed in North America to Polish conditions – at least so far – was not possible. The difficulties encountered prevent the extraction of shale gas (Szurlej et al. 2015a). As a result, a number of companies from oil & gas sector have decided to withdraw from Poland, while the drop in oil prices on world markets, maintaining at a relatively low level, is the reason why the return of the mentioned companies to our country is unlikely.

1.1. Oil from unconventional deposits

In the years 2009–2014 more than 30 refineries with a total capacity of about 120 million tons/year were closed in Europe. This occurred primarily as a result of the recession and the economic crisis that began in 2009. Not without the significance was the development of renewable energy and the policy based on reducing the consumption of petroleum fuels. In addition, the competitiveness of European companies, including European refineries, considerably decreases (due to the high costs of energy production). As a consequence, the least profitable refineries are closed or converted to the production of biofuels. Sometimes they are used only as storage facilities. The gap in the demand for fuel is met by imports, mainly from the Gulf countries.

The production capacity was also reduced in the United States. However, it was the result of switching from imported heavy oil to light oil from unconventional sources. In the United States, the reduced production capacity amounts to about 80 million tons per year.

Currently, tens of thousands of exploration and production wells are being drilled each year in the area covering a large part of Canada and the United States. It is worth recalling that the US production of hydrocarbons from unconventional sources – shale oil and tight oil – has been taking place for several years now, and the first production wells for shale gas were drilled in 1996.

According to EIA, 95% of the increase in oil production comes from seven of the unconventional resources (tight oil) in the United States. The increase in the production is closely related to the increase in the number of wells and the effective increase of their productivity. As a result, crude oil production in the United States in the years 2008–2014 increased from about 5 Mboe/d to 8.57 Mboe/d in 2014 (over 70%) and 9.5 Mboe/d in 2015. According to the EIA, the upward trend in the production is expected to maintain in 2016. The monthly

volumes of total oil production in the United States in the years 2012–2016 are presented in Fig. 1.

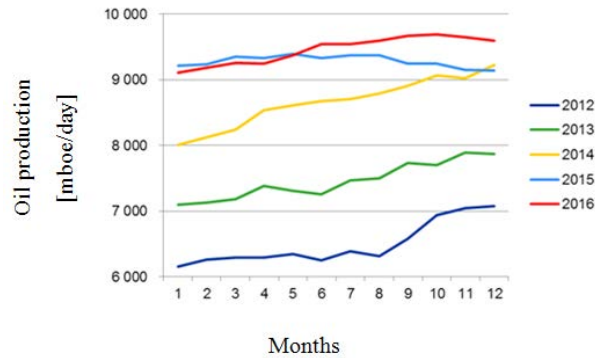


Fig. 1. The monthly volumes of total oil production in the United States in the years 2012–2016 (Mboe/d) (from March 2015 on – forecasted values)
Source: [Natural... 2015](#)

Rys. 1. Porównanie miesięcznych wielkości całkowitego wydobycia ropy naftowej na terenie Stanów Zjednoczonych w latach 2012–2016 (mboe/d) (od marca 2015 – wielkości prognozowane)

Crude oil from unconventional resources in the United States is the so-called light oil. Meanwhile, the US refineries were adapted to the refining of the so-called heavy oil, imported mainly from Canada and Venezuela. The result is a surplus of light crude oil in the North American market, which has a direct impact on the decline in oil prices in the US, but also in the global markets.

1.2. Natural gas from unconventional deposits

The “shale revolution”, a consequence of the extraction of natural gas from unconventional sources on an industrial scale, has changed the gas sector in the United States. The volume of natural gas production from the largest North American deposits is presented in Fig. 2.

The production of natural gas from: Marcellus, Haynesville, Bakken, and Fayetteville formations and, first and foremost, the technology of hydraulic fracturing have allowed natural gas production by American companies to increase from 10 billion m³ in 2005 and 40 billion m³ in 2007 to 320 billion m³ at the end of 2013. This accounted for more than 45% of total US natural gas extraction. In the years 2007 to 2015, the total gas production in the US increased from 546 million m³ to 767 billion m³ (BP 2016). The production of natural gas from unconventional formations has affected the production from other sources, i.e. conventional sources and coal seams, where a decline of almost 200 billion m³ can be observed (Fig. 3). According to the EIA forecast, a further decrease in methane production

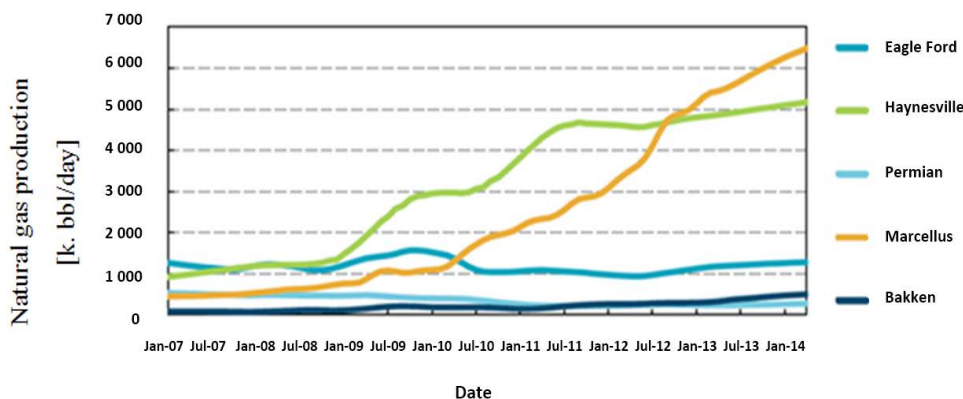


Fig. 2. The volume of natural gas production from the largest North American deposits [thousand bbl/d]
Source: EIA 2014

Rys. 2. Wielkość wydobycia gazu ziemnego z największych złóż północnoamerykańskich [tys. bbl/d]

from coal deposits and the upward trend in the case of shale gas and tight gas is expected by the year 2040 (EIA 2016).

Such a great increase in the production of natural gas from unconventional formations was possible thanks to a significant number of completed wells and thanks to increasing their average productivity. It is worth noting that by mid 2014 over 10,000 wells have been drilled in the Marcellus shale, of which 7,000 produced natural gas.

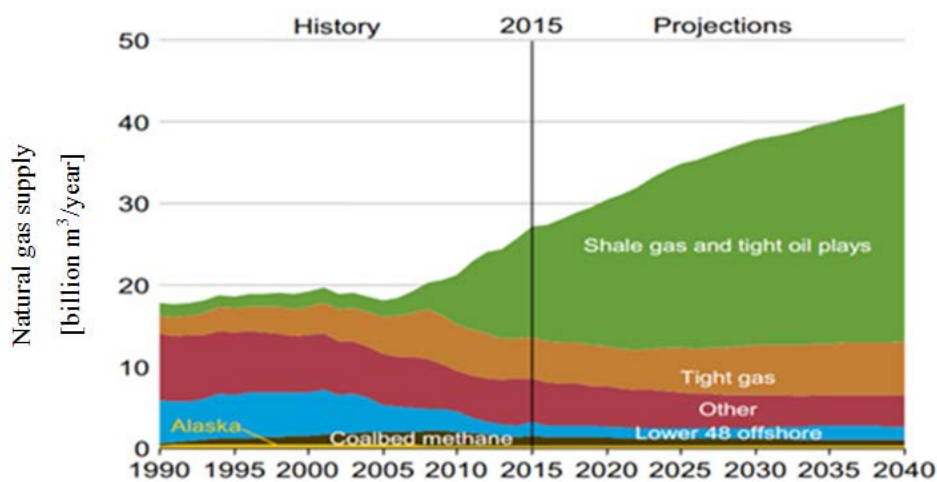


Fig. 3. Sources of supply of natural gas in the perspective of the year 2040 [billion m³/year]
Source: EIA 2016

Rys. 3. Źródła podaży gazu ziemnego w perspektywie do 2040 r. [mld m³/r]

2. The balance of flows – crude oil

The production and consumption of crude oil in the European Union gradually decreases. The difference amounts to about 450 million tons, which means that the demand is met mainly by imports. According to the data, it can be concluded that up to 2008 the consumption of oil was relatively stable. The year 2008 was a breakthrough, as it marked the beginning of the downward trend, which was strengthened by the economic crisis in 2009. The consumption decreases with the decreasing imports. The total balance of crude oil in the EU member states is presented in Table 1. In addition to data on the EU and the US, data on Norway is also included. This is due to its convergence with the economies of the EU member states. The presented results relating to the years 2015–2020 are estimated on the basis of data provided in the literature. The production and consumption of crude oil in the United States and the European Union in the years 2000–2020 is shown in Fig. 4.

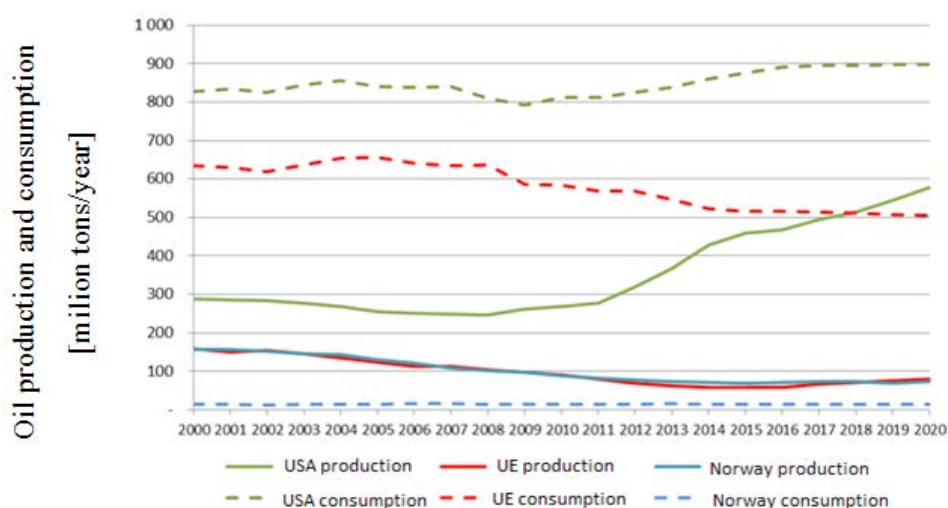


Fig. 4. The production and consumption of crude oil in the United States and the European Union in the years 2000–2020 [million tons/year]

Source: Opracowanie... 2015

Rys. 4. Wydobycie i konsumpcja ropy naftowej w Stanach Zjednoczonych i w Unii Europejskiej w latach 2000–2020 [mln ton/rok]

The situation in the United States is reversed, as the consumption of oil is increasing steadily, although it can be seen that the economic crisis has also affected the oil sector (Table 2). In addition, the increase in the production from unconventional deposits significantly reduces oil imports. As a result, in 2015 oil imports decreased by about 100 million tons compared to the year 2010, while the consumption increased by about 200 million tons.

Table 1. The balance of crude oil in the EU in the years 2000–2015 [million tons/year]

Tabela 1. Bilans ropy naftowej UE 2000–2015 [mln t/r]

Item	2000	2005	2010	2015	2020
Production	164	127	93	60	81
Import	608	632	569	518	480
Export	108	69	50	36	30
Consumption	663	684	612	542	531

Source: Opracowanie... 2015.

Table 2. The balance of oil in the EU in the years 2000–2015 [million tons/year]

Tabela 2. Bilans ropy naftowej Stanów Zjednoczonych 2000–2015 [mln t/r]

Item	2000	2005	2010	2015	2020
Total production	295	262	275	472	593
Including unconventional deposits	3	11	35	218	334
Import	460	511	467	364	365
Export	1	2	2	20	119
Consumption	764	771	746	814	832

Source: Opracowanie... 2015.

The movement of oil derivatives is presented below: These are:

- ◆ Gasoline: One of the most important products traded between Europe and North America. The gasoline deficit in the United States was a consequence of the significant consumption of fuel in transport and the lack of imports from Europe. The improved efficiency in the use of gasoline in transportation and the increased production of light crude oil from unconventional sources are the reason for the forecasted oversupply of gasoline in the United States (Fig. 5).
- ◆ For Europe, it means the need to look for new customers.
- ◆ JET A1 (aviation fuel): There is a market deficit for this product in Europe. However, it is not imported from North America (the relatively balanced market).
- ◆ Middle distillates (diesel oil and light fuel oil): the economic crisis has reduced the demand in both markets. Historical conditions are the reason why the European market is supplied primarily from the East (Russia). According to the forecast, competitively priced products from the United States could be imported into the European Union.
- ◆ Heavy fuel oil: limited intercontinental exchange for this product.

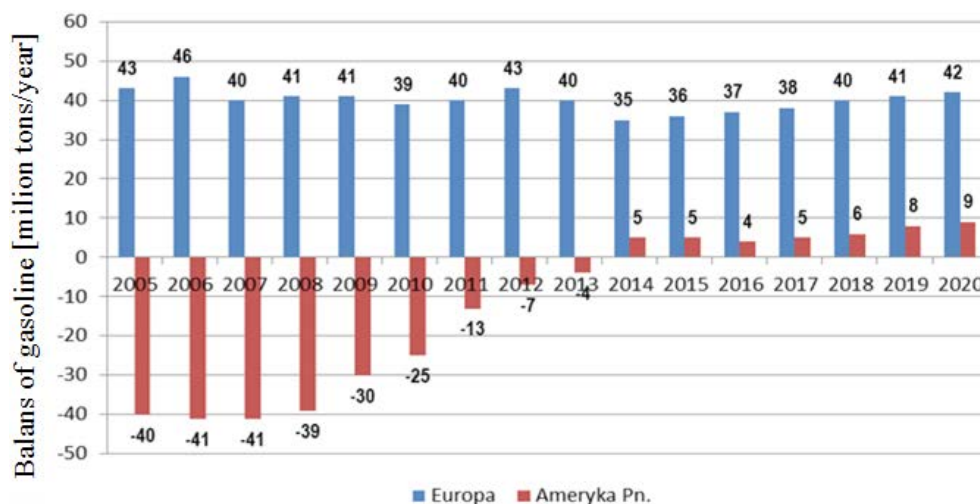


Fig. 5. The balance of gasoline for Europe and North America [million tons/year]

Source: Opracowanie... 2015

Rys. 5. Bilans benzyn dla Europy i Ameryki Północnej [mln ton/rok]

3. The balance of flows – natural gas

As in the case of crude oil, the production and consumption of natural gas in the European Union gradually decreases. The decrease in production should not surprise anyone because natural gas resources in the North Sea are being depleted every year, while the production at the Groningen gas field – the largest natural gas field in Europe – is being limited. By 2010, natural gas consumption in Europe remained stable. The decrease in consumption, which started in 2010, was reflected at the turn of 2013 and 2014. When it comes to the projections, the consumption should remain at about 450 billion m³ per year (Fig. 6). The figure also shows data on imports from Norway and Russia, countries with the largest share in gas imports to the EU countries.

Due to the fact that new unconventional reservoirs are not being developed, the demand is met mainly by imports from Norway and Russia (Table 3). Natural gas in LNG form is also imported by sea. In the first half of 2016, it was also imported from the United States (Szurlej et al. 2015b; Blacharski et al. 2016).

As a result of the development of unconventional resources, the consumption and production of natural gas in the United States has clearly increased since 2009. Large amounts of inexpensive gas are a threat to the position of hard coal. As a result, the consumption of natural gas for energy purposes in the USA has increased. The “shale revolution” had a significant impact on strengthening the position of natural gas in the US electricity generation sector and in increasing coal exports from the USA (Gawlik et al. 2016). According to

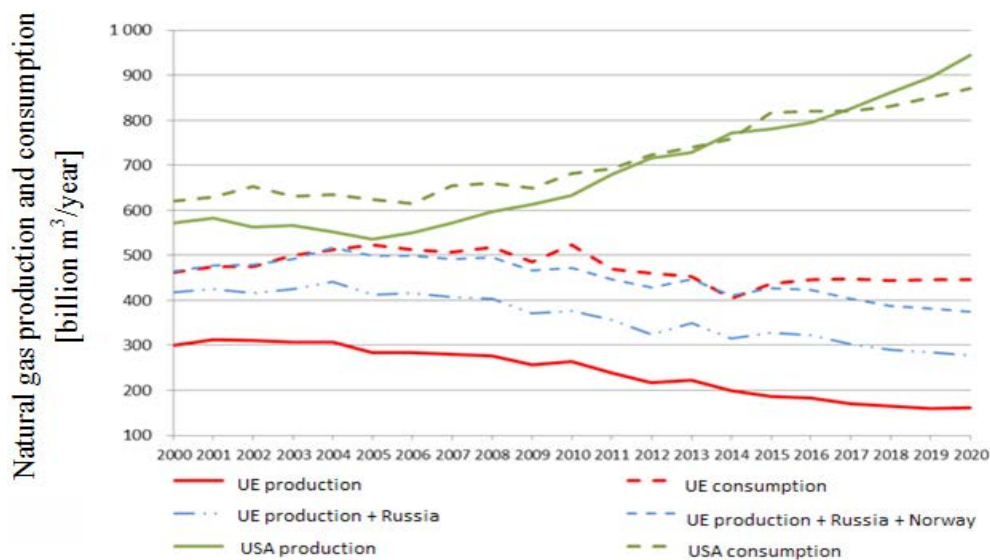


Fig. 6. The production and consumption of natural gas in the United States and the European Union in the years 2000–2020 [billion m³/year]

Source: Opracowanie... 2015

Rys. 6. Wydobycie i konsumpcja gazu ziemnego w Stanach Zjednoczonych i Unii Europejskiej w latach 2000–2020 [mld m³/rok]

Table 3. The balance of natural gas in the USA in the years 2000–2015 [billion m³/year]

Tabela 3. Bilans gazu ziemnego UE 2000–2015 [mld m³/r]

Item	2000	2005	2010	2015	2020
Production	301	283	264	186	161
Import	226	304	331	311	334
Export	50	68	86	64	50
Consumption	462	522	523	437	445

Source: Opracowanie... 2015.

Table 4. The balance of natural gas in the USA in the years 2000–2015 [billion m³/year]

Tabela 4. Bilans gazu ziemnego USA 2000–2015 [mld m³/r]

Item	2000	2006	2008	2010	2014	2015
Production	543	524	574	604	729	737
Import	107	118.5	113	106	76	77
Export	7	20.5	28.5	32	43	50.5
Consumption	661	623	659	682	756	778

Source: BP 2016; IEA 2015.

forecasts, the 2017 surplus gas production can be exported to neighboring countries or, in the form of LNG, to Europe.

Liquefied natural gas – LNG

Currently, LNG (Liquefied Natural Gas) is becoming more and more important in the global natural gas trade (Łaciak 2015; Gałczyński et al. 2015; Ruszel 2014; Siemek et al. 2011a). However, it requires appropriate liquefaction (export) and regasification (import) installations. The regasification capacity in Europe is now used in less than 30% although the total capacity is about 200 billion m³ per year, which is guaranteed by 20 LNG terminals (all re-gasification (receiving) terminals are built with built with excess capacity) (Fig. 7). LNG is imported into the European Union mainly from the Gulf countries, Algeria, Trinidad, and Nigeria (Table 5). Spain, which has as many as six regasification terminals, is the

Table 5. Liquefied natural gas (LNG) imports to the EU member states [billion m³/year]

Tabela 5. Wielkość importu gazu skroplonego przez kraje UE [mld m³/rok]

Year	2000	2005	2010	2015	2020
Import	30	42	78	42	80

Source: Opracowanie... 2015.

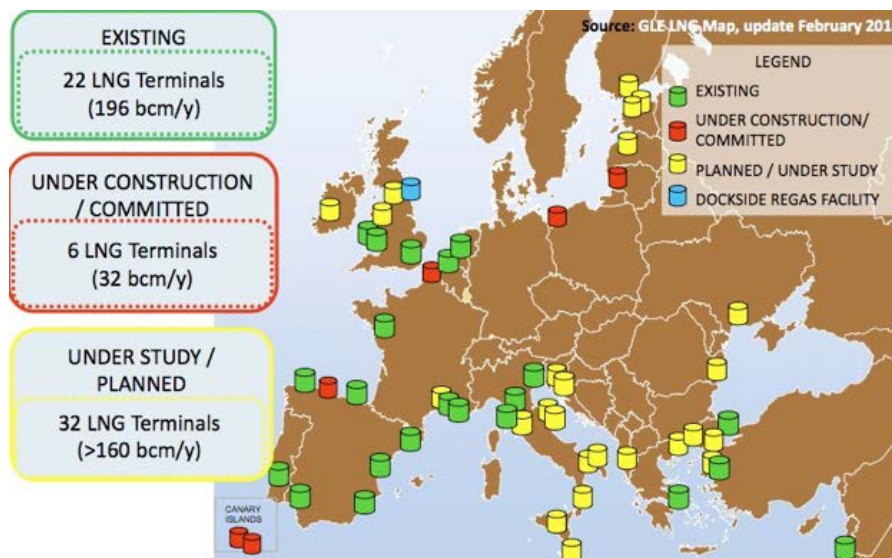


Fig. 7. LNG re-gasification terminals in Europe
Source: Breaking... 2014

Rys. 7. Terminale regazyfikacyjne LNG w Europie

leading importer of gas in Europe. However, part of the gas is reexported due to the inability to use such large quantities in the crisis-ridden country (Olkuski and Szurlej 2015).

The United States has four terminals on the east coast with a total regasification capacity of 41 billion m³ / year. Four liquefaction (export) terminals, with a total capacity of 30 billion m³ per year, are currently under construction (Fig. 8). The currently operating liquefaction (export) terminal (Kenai LNG) is located in Alaska.



Fig. 8. LNG re-gasification terminals in the United States
 Source: Oil&Gas 2014

Rys. 8. Terminale LNG w Stanach Zjednoczonych

Until now, the volume of LNG imports from the United States was relatively low (Table 6). It should be noted, however, that the current 30 liquefaction (export) terminals are at various stages of construction (it is not sure whether or not they will be commissioned). This means that the forecasted surplus gas production from shale formations (approx. 100 billion m³ in 2020) will probably be exported as LNG, also to the EU countries, where the first two deliveries arrived in the first half of 2016.

Table 6. Liquefied natural gas (LNG) imports by the United States [billion m³/year]

Tabela 6. Import skroplonego gazu przez Stany Zjednoczone [mld m³/rok]

Year	2000	2005	2010	2015	2020
Import	2.7	7.4	5.0	0.9	1.8

Source: Opracowanie... 2015.

Summary

LNG terminals that are currently under construction and the planned development of LNG terminals show a large scale involvement of US companies to increase the liquefaction capacity. It is estimated that the total liquefaction capacity can reach up to 110 million tons of LNG (150 billion m³ after regasification). When analyzing the investments in liquefaction installations, which were under construction in mid-2016, special attention should be paid to investments in Australia – their total capacity is over 40 billion m³/year. The implementation of these investments will place Australia among the leading exporters of LNG (IEA 2016).

In addition to LNG, the signing of the TTIP agreement would have a significant impact on the chemical industry, refining industry, metallurgical industry, mineral industry, and other energy sectors. TTIP may turn out to be a very interesting solution for Poland. Increased opportunities for diversification of gas supplies to Poland after the commissioning of the liquefied natural gas import terminal in Świnoujście (when it comes to oil, a similar role is played by the Naftoport Oil Terminal in Gdańsk), may be a strong argument in future negotiations of new long-term natural gas purchase contracts. It is worth noting that LNG does not have to be physically imported from the United States. Nevertheless, LNG imports from the US may be useful in building a strong negotiating position of Poland and can help to obtain competitive prices for gas imported by pipelines. Increasing the importance of natural gas and renewable energy sources in the structure of electricity generation, undoubtedly would reduce CO₂ emissions, which has been one of the main objectives of the EU energy policy for many years (Schmitz et al. 2011; Olkuski et al. 2015; Kamiński 2014). In addition, technologically advanced generation units based on coal are characterized by significantly lower CO₂ emissions compared to conventional coal-fired units dominant in the domestic electricity generation sector (Bartela et al. 2015).

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ANALIZA PRZEPLYWÓW SUROWCÓW ENERGETYCZNYCH POMIĘDZY UNIĄ EUROPEJSKĄ A USA – ROPA NAFTOWA I GAZ ZIEMNY

Słowa kluczowe

surowce energetyczne, ropa naftowa, gaz ziemny, gaz ziemny ze złóż niekonwencjonalnych, produkty ropopochodne

Streszczenie

Od wielu lat daje się zauważyć dążenie do globalizacji. Przejawia się ono znoszeniem barier celnych pomiędzy państwami, a także wprowadzaniem wspólnych ujednoliconych standardów produkcyjnych. Najlepszym przykładem jest Unia Europejska, gdzie w wielu dziedzinach udało się stworzyć wspólny rynek. Taki wspólny rynek istniał już wcześniej w Stanach Zjednoczonych Ameryki Północnej i właśnie dlatego w 2013 roku podjęto negocjacje w sprawie połączenia tych największych i najlepiej rozwiniętych gospodarek świata. Negocjowane obecnie porozumienie, nazwane Transatlantyckie Partnerstwo w dziedzinie Handlu i Inwestycji (ang. *Transatlantic Trade and Investment Partnership – TTIP*), ma pomóc w zniesieniu barier w przepływach towarowych i kapitałowych pomiędzy tymi rynkami. W artykule podjęto próbę analizy przepływów surowców energetycznych, a konkretnie ropy naftowej i gazu ziemnego, pomiędzy Stanami Zjednoczonymi i Unią Europejską. Na podstawie danych historycznych oraz obecnego stanu przedstawiono prognozy na najbliższe lata. Pokazano dynamikę wydobycia gazu ziemnego i ropy naftowej w Unii Europejskiej i w Stanach Zjednoczonych, a także zmiany w zakresie importu i eksportu tych surowców energetycznych. Analizie poddano również wielkość wydobycia gazu z największych złóż północnoamerykańskich. Zwrócono szczególną uwagę na gaz ze złóż niekonwencjonalnych, którego wydobycie ma wzrastać nieprzerwanie aż do 2040 roku. Spadać natomiast będzie wydobycie gazu ze złóż konwencjonalnych. W dalszej części artykułu przeanalizowano bilanse przepływów dla ropy naftowej i gazu ziemnego. Zwrócono uwagę, że zarówno dla jednego jak i dla drugiego surowca sytuacja na obu rynkach jest odmienna. W Unii Europejskiej wielkość wydobycia i konsumpcji zarówno ropy naftowej, jak i gazu ziemnego stopniowo spada, natomiast w Stanach Zjednoczonych trend jest odwrotny. Podobieństwo wykazuje za to przemysł rafineryjny. Zarówno w Unii Europejskiej, jak i w Stanach Zjednoczonych w ostatnich latach zamknięto wiele rafinerii, ale w Europie zjawisko to wystąpiło na większą skalę. Jeśli chodzi o gaz skroplony (LNG) to należy spodziewać się ekspansji amerykańskiego surowca do Europy. Obecnie Stany Zjednoczone budują około 30 terminali eksportowych i nadwyżki produkcyjne na pewno będą eksportowane również do Europy. Sądząc po tempie rozbudowy terminali eksportowych można przypuszczać, że już w niedługim czasie moc skraplania może osiągnąć 110 mln ton i gaz ziemny w formie LNG zasili rynek europejski.

**THE TRADE OF ENERGY COMMODITIES BETWEEN THE EUROPEAN UNION AND THE UNITED STATES –
CRUDE OIL AND NATURAL GAS****Key words**

energy resources, crude oil, natural gas, natural gas from unconventional deposits,
petroleum products

Abstract

The trend towards globalization can be observed for many years. It is reflected by the ongoing elimination of trade barriers between countries and the introduction of a system of mutual recognition of quality standards. The best example is the European Union, where a common market for many industries has been developed. Such a common market has already existed before in the United States of America and that this is why the negotiations on the merger of the largest and most developed economies in the world started in 2013. The currently negotiated agreement, the Transatlantic Trade and Investment Partnership (TTIP) is designed to eliminate barriers to trade and capital flows between the two mentioned markets. The article attempts to evaluate the trade of energy commodities, namely crude oil and natural gas, between the European Union and the United States. The estimates for the next years are based on historical data and the current state. The dynamics of natural gas and crude oil production in the European Union and the United States, as well as changes in the import and export of these energy resources, have been shown. The volume of gas production from the largest North American deposits was also subjected to analysis. Special attention was paid to natural gas from unconventional deposits, as its production is expected to grow continuously until 2040. Meanwhile, the production of gas from conventional deposits is expected to decrease. The rest of the paper is focused on the balance sheets of cash for oil and natural gas. It was pointed out that the market situation for both commodities is different. In the EU, the production and consumption of both crude oil and natural gas gradually decreases, while in the United States this trend is reversed. On the other hand, some similarities can be seen in the refining industry. In recent years, many refineries were closed both in the European Union and in the United States. However, though this trend was more pronounced in Europe. In the case of liquefied gas (LNG), the expansion of US gas to Europe can be expected. Currently, the United States is building about 30 export terminals and production surpluses will certainly be exported to Europe. Judging by the pace of development of export terminals, it can be assumed that the power of condensation can reach up to 110 million tons in the near future and, as a consequence, natural gas in the form of LNG will be supplied to the European market.

