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The oil refining industry in Central European countries: conditions, challenges, prospects



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Lublin 2022

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■ Propositions

The countries of Central Europe are dependent on crude oil supplies from Russia due to a range of factors, such as infrastructure and technology limitations. As a consequence, in the current political climate, it will be a major challenge to build a more diversified structure of commodity supplies through the development of individual plants.

The refining industry in Central European countries is now facing numerous challenges that are connected not only with the direction of crude oil imports and the source of their origin. Rising prices of natural gas and electricity (costs of fuel production), as well as the development of the segment of cars with drive systems alternative to internal combustion engines, will affect the refining margins and the volume of fuels sold in the long term.

Russia's aggression against Ukraine in 2022 led to the reorganization of the supply logistics of many plants, and the sanctions imposed on the aggressor will affect the financial profits. Granting a derogation for crude oil imports from Russia via the *Przyjaźń* pipeline to some refineries from Central European countries may lead to large disproportions in the functioning of the refining industry in the region. These refineries, taking into account the technological advantages and the price discount, can gain a significant advantage in this highly competitive sector.

The war in Ukraine caused the level of refining margins to rise to a historically high level, e.g. due to the limited availability of diesel oil and components for gasoline production. Nevertheless, the funds accumulated during this period should be allocated to further investments to enable the production of, for example, synthetic fuels in refineries or to expand petrochemical installations, as the proposed and gradually implemented regulatory solutions at the EU level are aimed at reducing the share of fossil fuels in the energy mix of the EU member countries.

Introduction

The refining industry plays an important role in the economy of Central European countries. The individual refineries in this region had a high reliance on crude oil supplies from Russia for many years, resulting in low levels of energy security. In the coming years, refineries of this type will face numerous challenges resulting from international conditions (e.g. the war in Ukraine, regulations at the EU level, rising fuel production costs, competition from other plants) and regional conditions (the changing demand for fuels). As part of the energy transition, it will be necessary to modernize and develop refineries, which will have to adapt

to the growing pressure related to climate protection. This pressure is a result of the abandonment of fossil fuel usage in European economies.

The study analyses the situation of refineries operating in Central European countries (Lithuania, Poland, Czech Republic, Slovakia, Hungary, Bulgaria, Romania and Croatia) belonging to the European Union. In total, there are 12 refineries operating in these countries, which differ in terms of processing capacity and installations used, and thus the production of individual products is carried out differently. In addition, the refineries operate in slightly different market environments (micro environments) and, for example, the level of demand for fuels in individual countries is different. Nevertheless, many challenges are also common to these refineries, such as the changing prices of crude oil and natural gas, the EU-level regulations and competition with refineries from the Middle East and the Asia-Pacific region.

The purpose of the study is to analyse the conditions, challenges and prospects for the functioning of the refining industry in Central European countries. The structure of the study is objective. As a result, the conditions of operation of refineries in Central European countries are presented in terms of infrastructure, i.e. import possibilities, including the diversification of sources and directions of crude oil supplies, and in terms of technological conditions, i.e. the ability to process various types of crude oil grades (first chapter).

An important part of the study covers the challenges faced by such refineries in Central European countries, i.e. the changing demand for fuels and the growing number of cars with drive systems alternative to internal combustion engines, which may eventually lead to a decrease in fuel consumption (second chapter). The key part of the study includes a presentation of the prospects for the development of this industry in Central European countries in the context of the war in Ukraine and a description of the financial position of the refineries (third chapter). For the purpose of the study, the main hypothesis adopted is that the refining industry in Central European countries requires structural changes, which results from new conditions of a fundamental nature, i.e. primarily the expected decline in importance of fossil fuels in the world in an era of energy transition, which will force refineries to invest in synthetic fuels and petrochemical products.

The research discussed in this paper was conducted through the analysis of existing data, analysing statistical data (databases of *Joint Organisations Data Initiative*, *BP Statistical Review of World Energy* reports of the *International Energy Agency*) as well as comparative analyses.

The further functioning of the refining industry in Central European countries should be assessed in different time frames. In the short term, the high level of margins will probably be maintained, taking into account the political and economic conditions in Europe.

However, in the long term, individual refineries will face numerous challenges, including regulations at the EU level, which will cause the need to both reduce CO₂ emissions from the refineries themselves, as well as produce and sell fuels with a smaller carbon footprint. The future of the transport sector in Europe is primarily vehicles with low exhaust emissions or all-electric vehicles. Modern refineries, including those from Central European countries, will have to adapt to such challenges.

1. Conditions

1.1. Infrastructural conditions

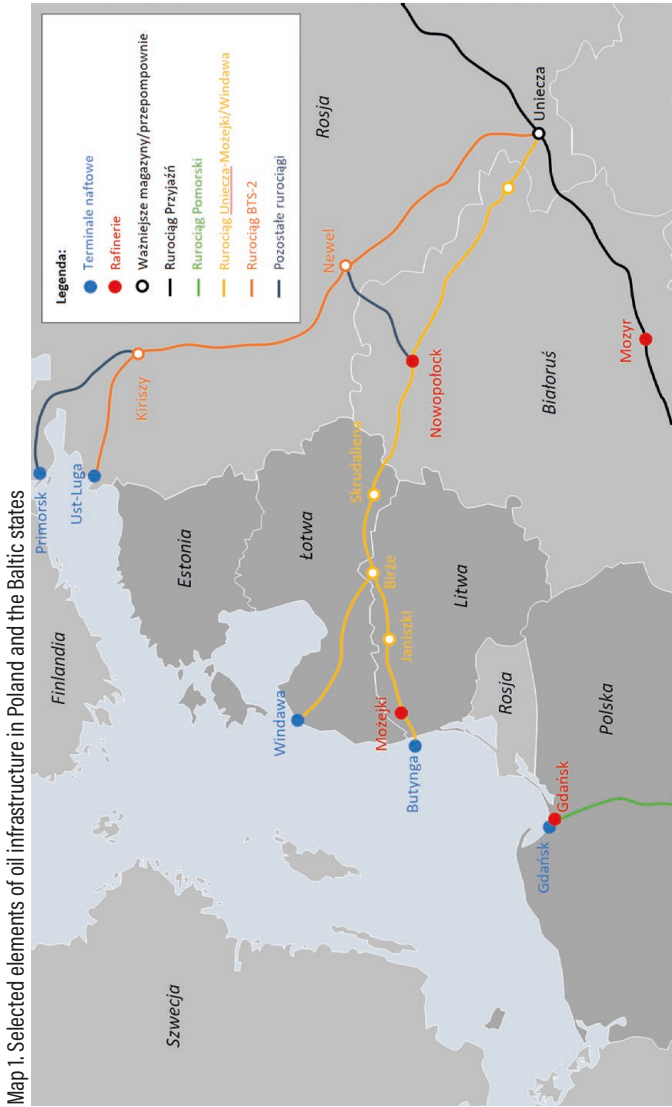
There are a total of 12 refineries operating in the EU's Central European countries, most of which primarily process crude oil from Russia. This is due to infrastructural conditions (crude oil supplied via the *Przyjaźń* pipeline), technological conditions (capacity to process crude oil grades containing sulphur) and price conditions (most often there was a price discount for crude oil from Russia as compared to other crude oil grades). Changing conditions in the environment of enterprises will force, in some cases, the need to modify the

functioning of supply logistics, which may turn out to be extremely important for the profitability of business activity.

There is currently only one operational refinery in the Baltic States, located in Mažeikiai, Lithuania. This refinery has the ability to process up to 204,000 barrels per day. Crude oil is delivered via the buoy terminal at Būtingė, on the Baltic Sea, and the refinery has processed mainly crude oil grades from Russia for years. In the past, crude oil was supplied via the *Przyjaźń* pipeline (northern branch, Nowopołock-Mažeikiai section) from Russia, but when the plant in Mažeikiai was taken over by PKN ORLEN S.A., deliveries were halted. This was undoubtedly a reaction to the decision by the Lithuanian government, which consented to a take-over of the refinery by a company from Poland rather than Russia (the seller was the collapsing OAO Jukos). As a result, due to the infrastructural conditions, crude oil supplies are only delivered using the infrastructure at Būtingė¹.

There are two refineries in operation in Poland – one in Płock (326,000 barrels per day) and another in Gdańsk (216,000 barrels per day) – both owned by PKN ORLEN S.A. These refineries are of key importance for the domestic fuel market. Deliveries are made both by land (the *Przyjaźń* pipeline), and by sea (crude oil terminal in Gdańsk).

¹ M. Paszkowski, *Wielki Brat nie ustępuje: wysiłki państw Europy Środkowej na rzecz zmniejszenia uzależnienia od dostaw surowców energetycznych z Rosji* [Big Brother does not give up: efforts by Central European countries towards reducing dependence on supplies of energy resources from Russia], Lublin 2021, p. 17.



Source: Author's own work based on the following: International Energy Agency, Poland 2022, p. 15; International Energy Agency, Lithuania 2021, p. 153; Oxford Institute for Energy Studies, *The Druzhba Pipeline Crisis: The Lessons for Russia and for Europe*, June 2019, <https://www.oxfordenergy.org/wpcms/wp-content/uploads/2019/06/The-Druzhba-Pipeline-Crisis-The-Lessons-for-Russia-and-for-Europe.pdf> [24.06.2022].

The plants process different kinds of crude oil, and for many years steps have been taken towards changing the structure of the crude oil input in the installations². In Poland, analyses are being carried out to evaluate the viability of expanding the import infrastructure by constructing a second line for the *Pomorski* pipeline (two-way pipeline), supplying both the refinery in Gdańsk with crude oil from Russia (from south to north) and the refinery in Płock as part of deliveries by sea via the oil terminal in Gdańsk (from north to south). Considering the reloading capacity of this terminal, it should be noted that it is possible to completely replace supplies via the *Przyjaźń* pipeline with imports of crude oil by sea (this was already the case in 2019 during the oil crisis). With the change in international conditions, in the coming years, the refineries in Poland will begin utilizing various types of crude oil exclusively transported via sea routes, as an alternative to the *Urals* oil³. Thus, the *Pomorski* pipeline will only be used to supply the refineries in Płock, Schwedt and Spergau (two refineries in Germany),

² T. Olkusiński, A. Szurlej, B. Tora, M. Karpiński, *Polish energy security in the oil sector*, [in:] M. Dudek, W. Suwała, S. Łopata, J. Leszczyński (eds.), *Energy and Fuels*, Kraków 2019, DOI: 10.1051/e3sconf/201910802015.

³ On sanctions, see M. Paszkowski, *Brak konsensusu: państwa Europy Środkowej wobec embarga na zakup surowców energetycznych z Rosji* [No consensus: Central European countries towards the embargo on the purchase of energy resources from Russia], "Komentarze IEŚ" 2022, no. 565, <https://ies.lublin.pl/komentarze/brak-konsensusu-panstwa-europy-srodkowej-wobec-embarga-na-zakup-surowcow-energetycznych-z-rosji/> [18.06.2022].

and not, as before, also the refinery in Gdańsk with crude oil from Russia delivered via *Przyjaźń* and *Pomorski* pipelines.

In the Czech Republic, there are two refineries in operation: in Kralupy and Litvínov, owned by Unipetrol a.s. (a daughter company of PKN ORLEN S.A.). The specific nature of these refineries is that they process different types of crude oil grades as input for the installations and that they are supplied with crude oil in a different way. The refinery in Litvínov (108,000 barrels per day) processes mainly crude oil from Russia, which is supplied via the *Przyjaźń* pipeline (southern branch). The refinery in Kralupy (66,000 barrels per day) processes other crude oil grades with lower sulphur content (e.g. *Azeri Light*, *CPC Blend*), and deliveries are made via the *TAL* pipeline (deliveries start at the Italian port of Trieste) and then via *IKL* pipeline. In the case of the refinery in Litvínov, the crude oil is supplied via the *Przyjaźń* pipeline, but it is possible to provide alternative supplies via the *Adria* pipeline (280,000 barrels per day in Hungary) and then via the *Šahy-Százhalombatta* pipeline (120,000 barrels per day). Importantly, this pipeline was modernized in 2015 (the work lasted a year) and its transmission capacity was increased to 120,000 barrels per day (compared to the earlier capacity of 70,000 barrels per day)⁴. Supplying

⁴ A. Tatarenko, S. Czarnecki, Ł. Lewkowicz, D. Héjj, *Wpływy Federacji Rosyjskiej w Republice Czeskiej, Republice Słowackiej oraz na Węgrzech [Influence of the Russian Federation in the Czech Republic, the Slovak Republic and Hungary]*, Lublin 2020, p. 75.

crude oil to refineries so far away from ports is an extremely difficult and complicated process, while the transmission capacity of the *IKL* pipeline alone (200,000 barrels per day) ensures full supplies of crude oil to the refinery in Kralupy.

The problem, however, is the *TAL* pipeline (850,000 barrels per day), which supplies a total of seven refineries (in Austria: Schwechat; in the Czech Republic: Kralupy; in Germany: Burghausen, Neustadt/Vohburg, Ingolstadt and Karlsruhe). The processing capacity of all refineries is 1,057,000 barrels per day. Therefore, in theory, if all refineries supplied via the pipeline processed the crude oil at their maximum capacity, the pipeline would not be able to provide full supplies.

There is one refinery in operation in Slovakia, in Bratislava, in Bratislava (124,000 barrels per day), owned by Slovnaft a.s. (a daughter company of the MOL Group). Crude oil is supplied to the refinery only through the *Przyjaźń* pipeline, and thus only crude oil grades from Russia (*Urals*) are processed there. As far as supplies from alternative sources are concerned, it is possible to supply the refinery with crude oil via the *Adria* pipeline (280,000 barrels per day in Hungary) and the *Šahy-Százhalombatta* pipeline (120,000 barrels per day), whose capacity is optimal for the refinery.

There is one refinery in operation in Hungary, in Százhalombatta (165,000 barrels per day), owned by the MOL Group. Crude oil is supplied to the refinery via the *Przyjaźń* pipeline (160,000 barrels per day in Hungary) and the *Adria* pipeline (280,000 barrels per day in Hungary). As a result, the refinery

has two independent directions of crude oil supply, and the purchase and route of delivery for specific grades of crude oil depend on business-related factors.

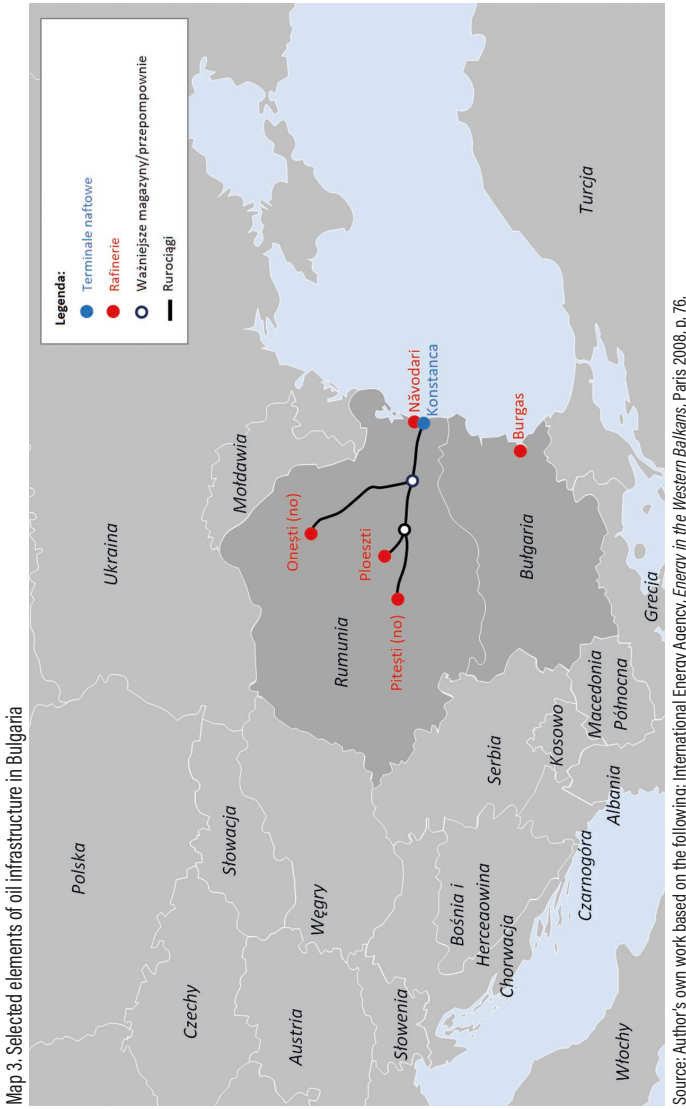
The reloading capacity of the oil terminal in Omišalj is optimal for the refinery, as it can fully supply all refineries with access to the *Adria* pipeline.

There is only one refinery in Croatia, in Rijeka (90,000 barrels per day), located on the Adriatic Sea, owned by INA d.d., the main shareholder of which is the MOL Group. In the past, the refinery in Sisak also operated in this country (66,000 barrels per day), but in 2019 the processing of crude oil at this refinery was stopped⁵. The refinery is in the process of converting into a biorefinery⁶. Crude oil is supplied to the refinery in Rijeka via the oil terminal in Omišalj and a short (7 km) pipeline between the terminal's storage facilities and the refinery. As a result, the refinery in Rijeka, in terms of logistics, has the ability to import various crude oil grades.

There is also one refinery in operation in Bulgaria, located in Burgas (140,000 barrels per day) and owned by the Russian company Lukoil PJSC.

⁵ M. Paszkowski, *Grupa MOL: strategia i plany inwestycyjne* [MOL Group: strategy and investment plans], "Komentarze IEŚ" 2022, no. 503, <https://ies.lublin.pl/komentarze/grupa-mol-strategia-i-plan-y-inwestycyjne/> [15.06.2022].

⁶ R. Brelsford, *Croatia's INA weighs shutdown of Sisak refinery's FCC plant*, Oil & Gas Journal, 26 January 2018, <https://www.ogj.com/refining-processing/refining/operations/article/17296006/croatias-ina-weighs-shutdown-of-sisak-refinerys-fcc-plant> [14.06.2022].



Thanks to its very favourable location, the refinery is able to import crude oil from multiple directions. Nevertheless, due to the easy access to crude oil from the Black Sea, the dominant role in the structure of input for refinery installations is played by crude oil grades exported by Russia and Azerbaijan. Crude oil is supplied to the refinery via the oil terminal in the port of Rosenets⁷.

There are three refineries in operation in Romania: Petro-midia in Năvodari (100,000 barrels per day), Petrobrazi in Ploiești (84,000 barrels per day) and Petrotel also in Ploiești (50,000 barrels per day). They process various crude oil grades. The major player on the domestic fuel market is the Petromidia refinery in Năvodari, owned by Rompetrol Rafinare which belongs to Romanian government (44.7%) and KMG International (54.63%) (a daughter company of the Kazakh company KazMunayGas)]. The refinery mainly processes crude oil from Kazakhstan. The Petrobrazi refinery in Ploiești, owned by OMV Petrom S.A. (a daughter company of the Austrian company OMV AG), processes various crude oil grades. The Petrotel refinery in Ploiești belongs to the Russian company Lukoil PJSC, which means that most of the processed crude oil comes from Russia. Romania imports the largest amounts of oil from Kazakhstan (approx. 50%) and Russia (30%). The remaining crude oil supplies come from various directions, including Iraq (*Kirkuk* grade).

⁷ Lukoil PJSC, *Services*, <https://neftochim.lukoil.com/en/Services> [25.06.2022].

Logistics is not a problem for individual refineries as the Năvodari refinery can import crude oil via its own terminal located in the port of Midia as well as via the oil terminal in Constanța. The other two refineries located in Ploiești receive crude oil from the Constanța terminal via a pipeline with a transmission capacity appropriate for these refineries.

To summarise, it should be noted that all refineries have infrastructural capabilities that create opportunities to diversify the sources and directions of crude oil supplies. The refineries located by the sea are in the most favourable position (Gdańsk, Rijeka, Năvodari, Burgas), while refineries located far inland are in the least favourable position (Litvínov, Kralupy, Bratislava).

1.2. Technological conditions

Refineries in Central European countries import various types of crude oil, with Russia's dominant position as the main supplier being conditioned primarily by historical, infrastructural and technological considerations. Over the years, modernization processes in the refineries have been focused on increasing the profitability of processing crude oil from the East. Only the increase in the depth of crude oil processing and in the amount of high-margin fractions (e.g. gasoline, diesel oil) made it possible to obtain positive refining margins.

Nevertheless, the refineries in operation differ in their levels of technological advancement.

The Mažeikiai refinery in Lithuania is a typical semi-complex fuel refinery⁸, but it is not one of the most modern enterprises. The depth of crude oil processing is low, and heavy fuel oil, which is a low-margin product (sold below the cost of crude oil), constitutes a large share of the products. As a result, in accordance with international standards, the Nelson Complexity Index (a measure of the complexity of the refinery's technological configuration) is at a level of 7.4 points (the higher the coefficient, the more technologically advanced the refinery is). In these circumstances, in 2021 a decision was made to modernize the existing facility by building, among other things, a hydrocracking installation. The new installations are to ultimately increase the share of high-margin products in the production structure from the current level of 72% (the lowest among all refineries of PKN ORLEN S.A. in Poland, the Czech Republic and Lithuania) up to 84%. The process of building new installations is expected to be completed by the end of 2024⁹.

⁸ H. Syrek, D. Rogowska, *Mieć energię i żyć w czystym środowisku* [To have energy and live in a clean environment], "Rynek Polskiej Nafty i Gazu" 2010, no. 5, p. 36.

⁹ M. Paszkowski, *Orlen Lietuva: nowe instalacje w rafinerii niezbędne do poprawy efektywności zakładu* [Orlen Lietuva: new installations in the refinery necessary to improve its efficiency], "Komentarze IEŚ" 2021, no. 458, <https://ies.lublin.pl/komentarze/iesk-458/> [28.05.2022].

As a result, the refinery will reduce its production of fuels such as heavy fuel oil, for which market demand has decreased since the entry into force of new regulations of the International Maritime Organization (IMO) in 2020 regarding the sulphur content in marine fuel.

The two refineries operating in Poland are characterized by high processing capacity and complexity – both are characteristic semi-complex plants, the refinery in Płock is a petrochemical and fuel plant, and the refinery in Gdańsk is a fuel plant. The refinery in Płock is the largest of all in Central Europe, with a solid Nelson Complexity Index (9.5 points). It is a typical plant focused on the production of light and medium fractions (gasoline, aviation fuel, diesel oil), as well as petrochemical products. The refinery processes various types of crude oil grades, with crude oil from Russia being the main input for many years. However, as part of the activities aimed at diversifying the sources and routes of crude oil supplies, the refinery also imports other crude oil grades, for example from Saudi Arabia (a favourable share of petrochemical fractions). The second of the Polish refineries, located in Gdańsk, is one of the most modern and energy-efficient plants of this type in the world, with the Nelson Complexity Index of 11.1 points.

Thanks to the individual investment programs implemented over the years (e.g. 10+, EFRA), the refinery not only has a processing capacity of 216,000 barrels per day but also

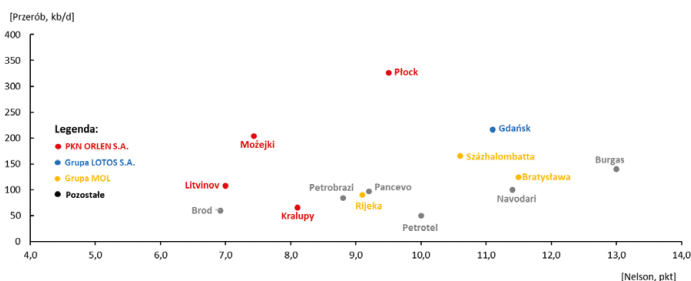
ranks among the best in terms of margin¹⁰. The production of fuels from these two refineries is not sufficient due to the growing demand for diesel oil in Poland, shortages of which are supplemented by imports.

There are two refineries in the Czech Republic: in Kralupy and in Litvínov. These process different types of crude oil (light/sweet crude oil is processed in Kralupy, heavy/sour crude oil is processed in Litvínov). Both refineries are small plants with a low Nelson Complexity Index (Litvínov: 7.0 points, Kralupy: 8.1 points), and thus the processing capacity (at the appropriate level of profitability) for other crude oil grades is limited. Both plants are semi-complex refineries, but the plant in Litvínov is a petrochemical and fuel refinery, and the plant in Kralupy is a fuel refinery. The Kralupy refinery mainly processes light crude oil delivered via pipeline from Croatia, which results in high delivery costs. In the case of the refinery in Litvínov, the level of crude oil conversion is lower, and in addition to the production of motor fuels (e.g. LPG, gasoline, diesel oil), the refinery also produces products necessary for petrochemical production.

Basically, these are not very advanced plants, but they produce high-octane petrol and low-sulphur fuels.

¹⁰ Grupa LOTOS S.A., *EFRA – Efektywna Rafinacja, czyli więcej produktów z każdej baryłki ropy* [EFRA – Effective Refining, i.e. more products from every barrel of crude oil], https://www.lotos.pl/2524/bip_-_strona_glowna/przedmiot_dzia_lalnosci/rafineryjna/projekt_efra [24.06.2022].

Graph 1. Refineries in Central Europe (processing capacity vs. Nelson Complexity Index)

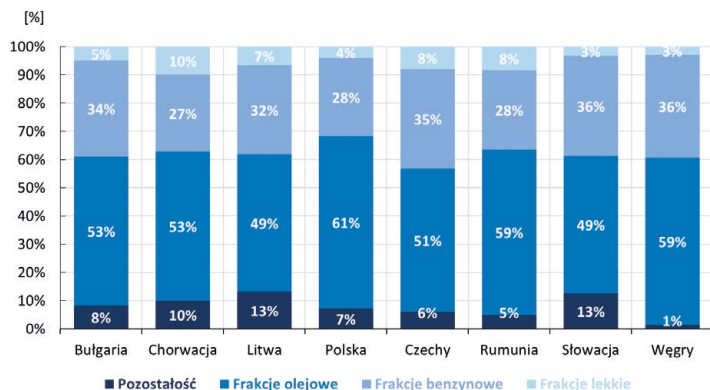


Source: Author's own work based on the following: Grupa LOTOS S.A., *Integrated Annual Report of the LOTOS Capital Group. Crude oil refining*, <https://raportroczny.lotost.pl/dzialalnosc-grupy-lotos-w-2020-roku/segment-produkcja-i-handel/grupa-lotos-s-a-rafinacja-ropy-naftowej/> [25.06.2022].

Among the refineries from Central European countries, one of the most modern plants is the refinery in Bratislava, with a high Nelson Complexity Index (11.5 points). It is a complex petrochemical and fuel refinery. Interestingly, for years no crude oil other than from Russia was processed there, and renovation and modernization works were aimed at increasing the depth of crude oil processing. As a result, along with this modernization process, the range of crude oil grades that the refinery is able to process has increased, but it is more profitable to process crude oil from Russia because modernization activities were carried out with this crude oil grade in mind.

The refinery is therefore able to process other types of crude oil, but the yield of products in this case would be less favourable. In these conditions, the most profitable solution would be to mix different types of crude oil with *Urals*, and not to completely replace this crude oil grade.

Graph 2. Yield of products in refineries in Central European countries (2021)



Source: Author's own work based on the following: *Joint Organisations Data Initiative*, <https://www.jodidata.org/> [26.06.2022].

Note: data from Poland include refineries in Płock and Gdańsk; data from Romania refer to refineries in Năvodari and two refineries in Ploiești; data from the Czech Republic refer to refineries in Litvínov and Kralupy.

The refinery in Százhalombatta, Hungary, is a modern petrochemical, fuel and oil plant with total conversion and a high Nelson Complexity Index (10.5 points).

The refinery processes crude oil from Russia (delivered via the *Przyjaźń* pipeline) and crude oil from other directions delivered via the *Adria* pipeline from the terminal in Omišalj. As a result, the refinery is able to process other crude oil grades, but of course the yield of individual products varies (in most cases, the refinery most likely introduces mixtures of appropriate crude oil grades with *Urals* into the distillation installations).

The refinery in Rijeka, Croatia, owned by INA (a daughter company of the MOL Group), is one of the smaller refineries

in Central European countries, with a low Nelson Complexity Index (7.7 points). It is a semi-complex, typical fuel refinery. For years, it was not known in which direction MOL Group would develop its refining industry in Croatia, but at last the plant is undergoing a modernization process involving the construction of a delayed coking installation. As a consequence, the efficiency of the crude oil conversion process will increase, and thus the yield of high-margin fractions will increase (a favourable change in the product structure). Importantly, thanks to its convenient geographical location, the refinery processes various crude oil grades, and after the completion of the investment process, its situation will improve (the complexity and efficiency will increase). The modernization works are to be completed in 2023. The second refinery, located in Sisak, still in operation until 2019 (it no longer processes crude oil), will focus on the production of asphalts, logistics operations and, most likely, the production of biofuels.

In Bulgaria, the largest refinery in the area can be found in Burgas, and it is owned by the Russian company Lukoil PJSC. It is a semi-complex fuel refinery. The refinery is responsible for supplying the domestic market with fuels, and the refinery itself is one of the most modern plants of this type in Europe with a Nelson Complexity Index of 13 points. As a result, the depth of processing and the production of light and medium distillates is at a level of 91%. In addition,

the products produced are utilized as inputs to the petrochemical installations at the refinery.

In Romania, the refineries in operation are technologically advanced plants with a high Nelson Complexity Index: Năvodari (11.4 points), Petrobrazi (8.8 points), Petrotel (10.0 points). Primarily, these are semi-complex fuel refineries. The largest of these refineries belongs to the Kazakh company KazMunayGas and the Romanian government; therefore, in most cases the refinery processes crude oil from Kazakhstan. It is a modern refinery, where numerous modernization works have been carried out over the years (the yield of high-margin products is at a level of 85%). The latest repair works were carried out after a fire in 2021. The second largest refinery, owned by the Austrian company OMV AG, is Petrobrazi in Ploiești, which is a modern plant capable of producing various products (the refinery established in 1934 was modernized and transformed over the years).

Since 2020, works have been carried out to increase the production of biofuels. The smallest refinery in operation in Romania is Petrotel, owned by the Russian company Lukoil PJSC. The refinery primarily processes crude oil from Russia (delivered via pipeline from the oil terminal in Constanța), and over the years it has been modernized to meet the highest standards of fuel production.

Summing up, the refineries operating in Central European countries differ in terms of processing capacity and technological advancement. While they are able to produce

fuels that meet high quality standards (in line with EU requirements), the range of crude oil that they are able to process is diverse. On the one hand, there are modern complex petrochemical and fuel refineries (Plock, Bratislava, Burgas, Százhalombatta), and on the other hand, most of the refineries are semi-complex, typically fuel plants. However, it must be acknowledged that with the increasing level of complexity, the capacity to process heavy crude oil grades with a higher sulphur content increases. Therefore, if it is necessary to replace the currently dominant Russian crude oil grade (*Urals*) in these refineries, most plants will look for comparable substitutes (e.g. *Arab Light*, *Iran Heavy* etc.).

It is precisely for such crude oil grades, which are more difficult to process, that investment processes have been implemented in complex and some semi-complex plants for years to increase the production of high-margin products (e.g. gasoline, diesel oil) and reduce the number of low-margin products (e.g. heavy fuel oil).

2. Challenges

The operation of a refinery is affected by many factors that determine the profitability of business operations. In the coming years, it can be expected that these types of plants will be under pressure not only from the changing demand for fuels but also from structural changes taking place in the oil industry. There will be several potential challenges, which can be divided into five groups. First, the unfavourable prices of energy resources processed in refineries (mainly crude oil, but also natural gas needed to produce, among others, hydrogen), as well as electricity prices.

Second, the changing demand for fuels resulting from the economic situation. Third, growing competition from refineries in the Middle East, the Asia-Pacific region and the USA. Fourth, the increasing efficiency of internal combustion engines, resulting in a decrease in fuel consumption, and the development of the market for cars with drive systems alternative to internal combustion engines. Fifth, regulations at the EU level that may change the position of refineries on the continent.

The changing prices of crude oil are of fundamental importance for the operation of refineries. Taking into account international conditions, such as the war in Ukraine, the unstable situation in oil-producing countries (e.g. Venezuela, Libya, Nigeria), the US sanctions imposed on Iran, the actions of OPEC and non-OPEC countries that seek to reduce availability of crude oil, and the low level of investments in the upstream sector (impact of low crude oil prices during the COVID-19 pandemic), a possible increase in crude oil prices in the coming years can be assumed. It is extremely difficult to forecast crude oil prices, especially in the long term. According to the International Energy Agency (IEA), the prices of crude oil, depending on the scenario, in 2050 may range from USD 24 per barrel to USD 88 per barrel¹¹. Bearing in mind the policy of EU countries aimed at abandoning the use of fossil fuels and the still important role of

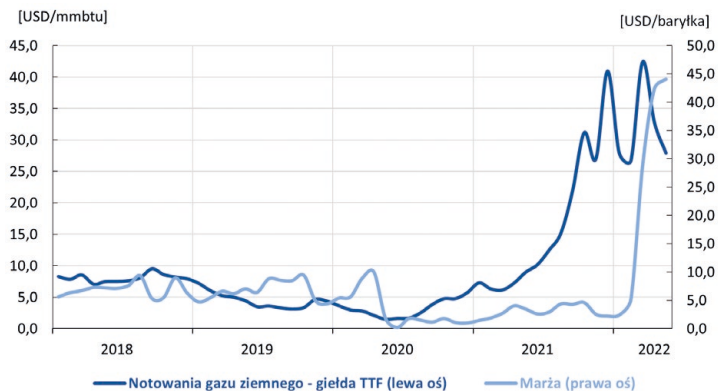
¹¹ International Energy Agency, *World Energy Outlook 2021*, Paris 2021, p. 101.

this commodity, high prices of crude oil can be expected on international markets, at least in the next few years, which will affect the operation of refineries, including the refineries in Central European countries.

If such conditions are met, the economic situation and the changing prices of crude oil, including fuel prices, may lead to a decline in fuel consumption. The level of natural gas prices is also extremely important for refineries, as this commodity is used in numerous technological processes. In times of high prices, many refineries try to either “swap” the natural gas and instead use products necessary in the hydrogen production process (e.g. light petrol, LPG), or burn fuel oil with low sulphur content in their installations. Electricity prices have a significant impact on the operation of refineries as there is a high demand for energy in all technological processes. High prices of both natural gas and electricity require the use of appropriate optimization processes that would not be used in other, more favourable conditions. The prices of these products thus affect the level of refining margins.

The economic situation will be a major challenge for refineries in Central European countries. Very high fuel prices at petrol stations may ultimately lead to an economic crisis and a decrease in demand for fuels. Importantly, the price of fuel at petrol stations is influenced by many factors, such as the availability of individual fuels and components for their production or seasonal demand for fuels, including,

Graph 3. Natural gas prices and margins of selected refineries in Central European countries (2018–2022)



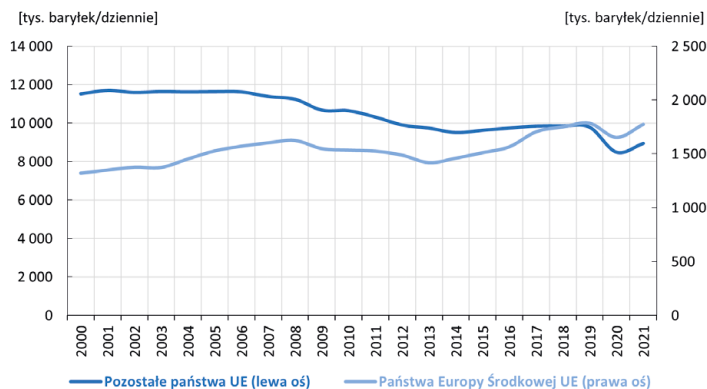
Source: Author's own work based on the following: PKN ORLEN S.A., *Macro data*, <https://www.orklen.pl/pl/relacje-inwestorskie/informacje-finansowe/dane-makro/2021> [21.06.2022]; Grupa LOTOS S.A., *Model refining margin*, https://inwestor.lotos.pl/1439/strefa_inwestora/modelowa_marza_rafineryjna [21.06.2022]; MOL Group, *Macro figures*, <https://molgroup.info/en/investor-relations/publications/macro-figures> [21.06.2022].

for example, in the USA (which is why a large part of fuels is sent from Europe to the USA). International conditions (the policy of OPEC+ countries, the political situation in crude oil and fuel exporting countries) have a significant impact on the market situation. In these circumstances, the costs of fuel purchases by both individual customers and enterprises tend to increase, which translates into an already high level of inflation.

As a consequence, a slow decline in demand for fuels can be expected, including in Central European countries. As a result, lower fuel consumption means limited profits for refineries, which in turn may have a negative impact

on the investment process. However, it is difficult to determine what impact the macroeconomic situation will have in 2022 on the demand for fuels and whether the potential recession will lead to permanent changes on the fuel market in Central Europe because unlike Western European countries, Central European countries have been recording an increase in demand for fuels for many years.

Graph 4. Demand for fuels in EU countries (2000–2021)



Source: Author's own work based on the following: BP, *Statistical Review of World Energy 2022*, <https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html> [29.06.2022].

There are almost 100 refineries across Europe. They differ in many respects, such as location (at the seaside, inland), size (processing capacity), technological capabilities (depth of crude oil processing) and production (share) of individual products. Basically, they are mostly old and less efficient refineries compared to similar, competitive refineries in the

Middle East and the Asia-Pacific region. In addition, such plants in other parts of the world are not subject to so many environmental restrictions. In many cases, fuel production costs are also lower due to access to cheap crude oil (e.g. in the Middle East), natural gas (e.g. in the USA) and electricity. As a consequence, the production potential is different and only the most advanced plants, where optimization of operations is at a high level, will be able to face the numerous challenges and strong competition from refineries from other regions in the coming years. Therefore, there is a real threat that the rising costs of fuel production in Europe will result in a decrease in the profitability of individual products, a decrease in the overall profitability of refineries and, ultimately, the closure of the least efficient of them. Such a situation may result in the need to increase imports and reduce the margins of individual producers. Such a threat is real, especially in the case of refineries from Central European countries, which, without modernization and increased optimization of their operations, will face market difficulties.

Such difficulties may affect, among others, the refinery in Mažeikiai in Lithuania (the situation may change with the completion of the investment process) and the refinery in Kralupy in the Czech Republic (due to the difficult logistics of crude oil supplies).

One of the most important factors, which will determine the shape of the transport sector in Central European

countries in the future, is the promotion of cars with drive systems alternative to internal combustion engines (i.e. gasoline or diesel engines). This trend is caused especially by the actions of many governments striving to reduce the greenhouse gas emissions (e.g. CO₂, SO₂, NO). As a result, for many years one of the key challenges facing the refining industry has been related to the EU climate policy, which manifests itself on the one hand in imposing numerous legal regulations on industrial sectors, and on the other hand in promoting cars with drive systems other than internal combustion engines. The introduced solutions are aimed at improving air quality, but without actions on a global scale, and only on a European scale, there will be no improvement in living conditions in EU countries, nor any improvement in air quality. It should be emphasized once again that one of the most important trends in the modern automotive industry is the promotion of cars with drive systems alternative to internal combustion engines. For many years, vehicles powered by electric motors (Battery Electric Vehicle, BEV) and hybrid vehicles (powered by an internal combustion engine and an electric motor) (Plug-in Hybrid Electric Vehicle, PHEV) have been increasingly popular on the car market.

Many institutions and analytical agencies in the world forecast an increase in the number of these types of vehicles (according to the IEA, the number of electric cars in the world will increase every year, and in 2030 it will amount to

200 million)¹², although currently their share in the car fleet is still limited. In Central European countries, the number of cars with drive systems alternative to internal combustion engines in 2020 amounted to approx. 9.1 million (mostly LPG-powered cars), but the current upward trend in newly registered cars suggests that the number of such vehicles will systematically grow¹³ (the share of cars with drive systems alternative to internal combustion engines in individual Central European countries in the total car fleet is on average 0.9%). At the same time, it should be borne in mind that the cost of buying an alternatively powered car is still high, the batteries are imperfect (the range of the car on one charge is relatively short), and the number of electric car charging points is small. In addition, support from the governments of individual countries is limited (e.g. no promotional leasing offers, tax reliefs, etc.). All this will contribute to the fact that cars with internal combustion engines will continue to play a decisive role in Central European countries in the coming years, although their decreasing number will affect the functioning of refineries.

¹² International Energy Agency, *Global EV Outlook 2022*, Paris 2022, p. 5.

¹³ On the development of the electric car market in Poland, see K. Tomaszewski, *Problemy rozwoju elektromobilności w Polsce w kontekście krajowej polityki energetycznej* [Problems of electromobility development in Poland in the context of the national energy policy], "Przegląd Politologiczny" 2019, no. 2, pp. 153-165, DOI: 10.14746/pp.2019.24.2.11.

Currently, the car fleet in Central European countries is very old, as the average age of passenger cars is 15.3 years, while the average age of such cars in the other EU countries is 11.1 years. As a consequence, along with the replacement of the car fleet in Central European countries, the demand for fuels will decrease, which will affect the operation of refineries. Interestingly, the scandal that resulted from the installation of software in cars manufactured by Volkswagen AG that allows the manipulation of the results of measurements of emissions from the exhaust system affected the level of sales of diesel and gasoline cars (the long-term trend of increasing sales of diesel cars was reversed). This scandal had a big impact on social expectations regarding the need to protect the environment and thus not only translated into higher sales of gasoline cars but also had an impact on the growing popularity of alternatively-driven cars.

Undoubtedly, the EU-level regulations to protect the environment will be an important factor influencing the operation of refineries. A new legislative package proposed on 14 July 2021 under the name *Fit for 55* under the provisions of the so-called European Green Deal will have a significant impact on the level of demand for fuels produced in refineries.

The implementation of the ambitious goal of reducing greenhouse gas emissions by at least 55% by 2030, compared to the 1990 level, and ultimately achieving climate neutrality by 2050 will significantly redefine the fuel market in Europe. In this context, as part of the aforementioned package, a set

of a total of 13 draft regulations was proposed for various sectors of the economy. All solutions are to constitute a coherent and logical legal framework for the implementation of climate goals. The European Commission anticipates that the implementation of individual regulations should result in strengthening the innovativeness and competitiveness of industry in EU countries while ensuring environmental protection¹⁴. Such solutions will affect refineries both directly (increasing the tax burden) and indirectly (decreasing demand for fuels and increasing the number of cars with drive systems alternative to internal combustion engines). In general, it is expected that more and more sectors of the economy (transport sector, maritime sector) will be covered by the CO₂ emission reduction system (EU ETS). However, taking into account the prices of CO₂ emission allowances in the period from 2018 to the first half of 2022, which increased from EUR 15.7/tonne to EUR 83.0/tonne, further macroeconomic difficulties can be expected for the refining industry in Europe, which may cause the least profitable refineries to be liquidated/shut down.

Without denying their importance for climate protection, the proposed solutions will therefore cause negative consequences, such as an increase in the tax burden on

¹⁴ M. Gołębiowska, M. Paszkowski, D. Szacawa, *Neutralni dla klimatu: zielona transformacja państw Europy Środkowej w dobie pandemii COVID-19* [Climate neutral: green transition of Central European countries in the era of the COVID-19 pandemic], Lublin 2021, pp. 43-58.

fuels produced from fossil fuels and fuel prices, due to the need to reduce emissions in transport and the introduction of the EU ETS system for the transport sector. In addition, along with the process of energy transition and the decline in demand for fossil fuels, companies operating in the refining industry will have to look for new business models. On the one hand, they will invest in electricity generation (primarily in renewables (RES))¹⁵, and on the other hand, they will develop the petrochemical sector (to reduce their exposure to the demand for engine fuels and increase the share of prospective petrochemical products)¹⁶. According to the IEA, the consumption of crude oil in the coming years may decrease depending on market conditions, and the Agency expects a stable increase in the use of this commodity in the petrochemical industry, mainly in the Middle East, China and India¹⁷.

To recapitulate, it should be pointed out that the operation of refineries in Central European countries will be affected by various factors of varying intensity and importance. In the short term, it is primarily the economic situa-

¹⁵ S. Mrozowska, J. Wendt, K. Tomaszewski, *The Challenges of Poland's Energy Transition*, "Energies" 2021, vol. 14, no. 23, pp. 65-69, DOI: 10.3390/en14238165; K. Tomaszewski, *The Polish road to the new European Green Deal – challenges and threats to the national energy policy*, "Polityka Energetyczna/Energy Policy Journal" 2020, vol. 23, no. 2, pp. 5-18, DOI: 10.33223/epj/123411.

¹⁶ K. Wolff, *Quo vadis polish oil & gas*, 23 May 2022, <https://www.gazetaprawna.pl/wia-domosci/kraj/artykuly/8423229,quo-vadis-polish-oil-gas.html> [15.06.2022].

¹⁷ International Energy Agency, *World...*, p. 215.

tion (not only in Central European countries, but also the global economic situation) that will affect the possibility of locating refinery products on the market. In the long term, any changes, including legislative ones, aimed at abandoning the use of fossil fuels will be a significant limitation for the operation of refineries due to both increasing fiscal burdens and the changing demand for fuels (e.g. due to the development of the market for cars with drive systems alternative to internal combustion engines).

3. **Prospects for the operation of refineries in the future**

3.1. **War in Ukraine**

The prospects for the refining industry in Central European countries are different for individual refineries, although numerous challenges must be taken into account. In addition to a possible change in the economic situation, the level of demand for fuels and legislative changes at the EU level, the armed conflict in Europe was an extremely important factor in 2022 affecting the entire crude oil sector. Russia's aggression against Ukraine led to significant changes on the commodity markets (growing crude oil, natural gas and

coal prices) and fuel markets (limited availability of gasoline and diesel oil).

As the conflict developed, EU countries, the USA, Great Britain and other countries introduced a number of sanctions on Russia, and at the same time, steps were taken to reduce energy dependence on this country. Various types of sanctions of key importance for the refining industry will force refineries in Central European countries to take measures to diversify the sources and directions of crude oil supplies. It will therefore be important to ensure the availability of crude oil with appropriate parameters, which will also depend on logistic conditions.

The war in Ukraine demonstrated the high level of dependence of Central European countries on crude oil and natural gas supplies from Russia. Actions taken by EU countries to change the structure of crude oil imports will be a major challenge for refineries from Central European countries and will force the need to ensure proper logistics (infrastructure, storage facilities, pipelines) and the availability of alternative crude oil grades. Russia is one of the world's largest crude oil producers and a key exporter of this commodity to Central European countries. While some refineries will still be able to import crude oil from Russia (refineries in the Czech Republic, Slovakia and Hungary), the remaining refineries will look for alternative crude oil grades. Considering the importance of Russia on the crude oil market (exports at a level of about 4.5 million barrels

a day) and the fuel market (about 2.7 million barrels a day), it is impossible to completely replace the crude oil from this country in a short time.

As a result, refineries from Central European countries (like other refineries from EU countries) will look for alternative crude oil grades, such as *Johan Sverdrup* (Norway), *Azeri Light* (Azerbaijan), *WTI* and *Mars* (USA), *Es Sider* (Libya), *Forcados*, *Qua Iboe* (Nigeria), *Basrah Medium*, *Kirkuk* (Iraq), *Arab Light* (Saudi Arabia), *Oman Blend* (Oman), *Iranian Light/Heavy* (Iran)¹⁸. In these conditions, the availability of crude oil tankers, the refinery's ability to process specific crude oil grades and the level of fractions obtained will also be a challenge (the key will be the selection of those fractions that enable the production of the largest possible volumes, primarily of diesel oil and aviation fuel).

Thus, refineries from Central European countries will be forced to make a huge effort to change the structure of crude oil processing. With the introduction of various sanctions¹⁹ and thus the obligation to limit/stop imports of crude oil and fuel products from Russia, there will be a need to reorganize import logistics, adapt the refineries technolog-

¹⁸ Vortexa, *European refiners can live without Russian Urals*, 2 March 2022, <https://www.vortexa.com/insights/european-refiners-can-live-without-russian-urals/> [19.05.2022].

¹⁹ Council of the EU and the European Council, *Russia's aggression against Ukraine: EU adopts sixth package of sanctions*, 3 June 2022, <https://www.consilium.europa.eu/pl/press/press-releases/2022/06/03/russia-s-aggression-against-ukraine-eu--adopts-sixth-package-of-sanctions/> [18.06.2022].

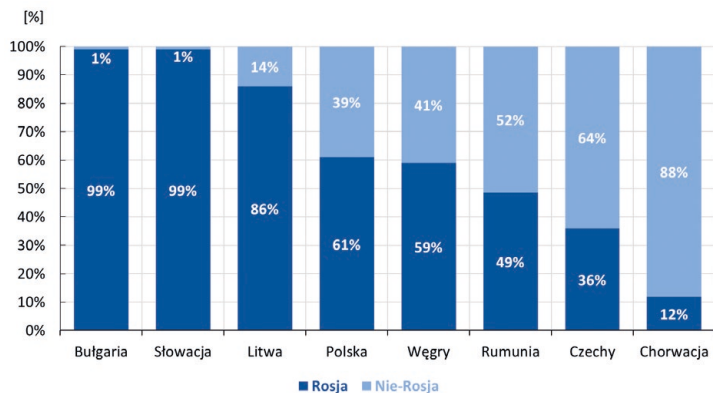
ically to process crude oil from other suppliers and obtain access to crude oil grades of appropriate quality.

In terms of infrastructure, refineries located at the seaside (Mažeikiai, Gdańsk, Rijeka, Nāvodari and Burgas) should not have any problems. In their case, due to their location and access to crude oil terminals, import logistics will not change significantly. Inland refineries (Litvínov, Kralupy, Bratislava, Százhalombatta and Płock) may face greater difficulties, although most of them have an appropriate import system. It is possible to supply crude oil from alternative sources to refineries in the Czech Republic (via the *TAL* and *IKL* pipelines), Slovakia and Hungary (via the *Adria* pipeline) and Poland (via the *Pomorski* pipeline). In addition, some refineries in Central European countries will still be able to import crude oil from Russia via the *Przyjaźń* pipeline for a certain period of time (as part of the exclusion from the package of sanctions).

The derogation to the regulations on the ban on crude oil imports from Russia will most likely be in force for several years and is necessary for the refineries in the Czech Republic to operate²⁰. Otherwise both refineries would have major

²⁰ On the justification for introducing a derogation, see M. Paszkowski, *Zasadność wprowadzenia derogacji na dostawę ropy naftowej z Rosji dla Republiki Czeskiej, Słowacji oraz Węgier* [Justification for introducing a derogation for crude oil supplies from Russia to the Czech Republic, Slovakia and Hungary], GreenLab, 23 May 2022, <https://www.fgreenlab.org/publikacje/analiza-zasadnosc--wprowadzenia-derogacji-na-dostawy-ropy/> [25.05.2022].

Graph 5. Dependence of Central European countries on crude oil supplies from Russia (2021)



Source: Author's own work based on the following: International Energy Agency, *Which countries are most reliant on Russian energy*, <https://www.iea.org/reports/national-reliance-on-russian-fossil-fuel-imports/which-countries-are-most-reliant-on-russian-energy> [25.06.2022].

problems with securing alternative crude oil supplies. The refinery in Litvínov can use the *Adria* pipeline (280,000 barrels per day in Hungary) and then the *Šahy-Százhalombatta* pipeline (120,000 barrels per day). The transmission capacity of these pipelines should be increased to supply all refineries located in Hungary, Slovakia and the Czech Republic.

The refinery in Kralupy imports crude oil via the *TAL* pipeline (850,000 barrels per day) and the *IKL* pipeline (200,000 barrels per day), but the bottleneck is the *TAL* pipeline (850,000 barrels per day in the Italy–Austria–Germany pipeline section) supplying a total of seven refineries. The refinery in Bratislava, Slovakia, can receive crude oil from alternative directions via the existing infrastructure, i.e.

the *Adria* pipeline (280,000 barrels per day in Hungary) and the *Šahy-Százhalombatta* pipeline (120,000 barrels per day).

The same is true of the refinery in Százhalombatta (165,000 barrels per day), which has so far been supplied with crude oil via the *Przyjaźń* pipeline (160,000 barrels per day in Hungary) and the *Adria* pipeline (280,000 barrels per day in Hungary). It should therefore be pointed out that the logistics of crude oil supplies, taking into account the existing conditions, is ensured for almost all refineries via the *Przyjaźń* pipeline and the *Adria* pipeline.

In Poland, analyses are being carried out regarding the reasonability of expanding the *Pomorski* pipeline (constructing a second section of the pipeline) as the existing infrastructure is not optimal for the refineries in Germany (Schwedt, Spergau), which import crude oil via both the *Przyjaźń* pipeline and the *Pomorski* pipeline. Importantly, with the suspension of crude oil supplies from Russia via the *Przyjaźń* pipeline, the existing *Pomorski* pipeline would be used only for reverse deliveries (crude oil can be transported in two directions). The transmission capacity on the route from Gdańsk to Miszewko Strzałkowskie near Płock is 600,000 barrels per day, and the transmission capacity on the route from Miszewko Strzałkowskie to Gdańsk is 540 thousand barrels per day. With the processing capacities of the refineries in Płock (326 thousand barrels per day), Schwedt (240 thousand barrels per day) and Spergau (240 thousand barrels per day), i.e. 806 thousand barrels per day in total, the

existing import infrastructure does not ensure that these refineries can be fully supplied with crude oil.

In such circumstances, it is necessary to build the second section of the *Pomorski* pipeline or to increase its capacity (through, among other things, the modernization of pump systems, installation of new pump units). If oil supplies from Russia to Poland and Germany were stopped, the Adamowo–Miszewko Strzałkowskie section of the *Przyjaźń* pipeline would not be fully used, and thus the profits of the transmission pipeline operator (PERN S.A.) would decrease. This section would be used (in the absence of a reverse flow on this section) only for the supply of crude oil to Adamów, i.e. for the operation of the internal transmission system (the base in Adamów would be used only for the storage of crude oil).

Taking into account the technological capabilities, the refineries in Central European countries should be able to process crude oil grades other than those from Russia without the need for major modernization works. The vast majority of these refineries (e.g. the Százhalombatta refinery) process alternative crude oil grades or are able to switch to processing other crude oil grades due to the high complexity of the refineries (e.g. the Bratislava refinery). The only problem may be the production optimization level resulting from different levels of production of individual fractions. The key problem in this case, however, will be the availability of other crude oil grades (comparable to *Urals*).

With the departure of crude oil imports from Russia, the refineries in Central European countries will have to develop a new supply system (logistics system), adapt plants to process other types of crude oil (technology) and purchase appropriate crude oil.

However, due to the limited availability of alternative crude oil grades, this will be an extremely complex process, further hampered by the fact that many refineries across Europe will be looking for alternative supplies.

The war in Ukraine and the sanctions imposed on Russia have sparked a debate on the involvement of Russian capital in Europe. Companies from this country own many assets in Europe, and in Central European countries this is the case with refineries in Bulgaria (in Burgas) and Romania (Petrotel in Ploiești). Both plants are owned by the Russian company Lukoil PJSC. While the refinery in Romania is the smallest of the three refineries in operation in this country and accounts for 21.4% of the crude oil processing capacity, in Bulgaria it is the refinery that accounts for the entire production of fuels. Of course, the level of demand for fuels in these countries is so high that fuel products are also imported, but domestic refineries are an important pillar of energy security. However, with the imposition of sanctions on Russia, the problem is to ensure alternative supplies of crude oil. In other EU countries (e.g. Italy, Germany) the process of taking control over refineries by the state is being considered.

Military operations launched by Russia in Ukraine led to a sharp increase in fuel prices, with a relatively stable situation on the crude oil market, as a result of which the financial condition of oil companies improved significantly.

Consequently, the level of refining margins increased to a historically high level. The profits achieved in this situation sparked a debate about the high fuel prices at petrol stations and the resulting financial means. For example, a special tax was introduced in Slovakia and was applied to a refinery in Bratislava owned by Slovnaft a.s. (a daughter company of the MOL Group). According to the assumptions, the state budget will receive about EUR 300 million from the new tax (the tax is to be in force until 2024), and the funds obtained are to be used to finance the so-called anti-inflation package²¹. However, taking into account the ongoing process of energy transition, it is necessary for the refineries to implement investment projects in order to change the range of fuels produced (e.g. to synthetic fuels).

To summarise, it should be pointed out that the war in Ukraine is a great challenge but also an opportunity for refineries in Central European countries. On the one hand, ensuring the availability of alternative crude oil grades and reorganizing the logistics of supplies may be a problem, but

²¹ Ł. Lewkowicz, M. Paszkowski, *Słowacja: gra wokół dostaw ropy naftowej z Rosji* [Slovakia: the game about crude oil supplies from Russia], "Komentarze IEŚ" 2022, no. 613, <https://ies.lublin.pl/komentarze/slowacja-gra-wo-kol-dostaw-ropy-naftowej-z-rosji/> [22.05.2022].

on the other hand, the existing conditions are favourable and generate significant profits due to the high fuel prices. Therefore, along with the process of energy transition and abandoning the use of fossil fuels, refineries in Central European countries should allocate significant financial resources to investments in the production of synthetic fuels or in the petrochemical sector.

3.2. Financial position

The war in Ukraine has led to an increase in the prices of energy resources in the world and an increase in the prices of fuel products. Such conditions will affect the financial position of energy companies and their ability to generate profits in the coming years. This is important from the point of view of both the various sanctions imposed on Russia (the need to look for alternative sources of crude oil) and the ongoing energy transition (the need to modernize refineries).

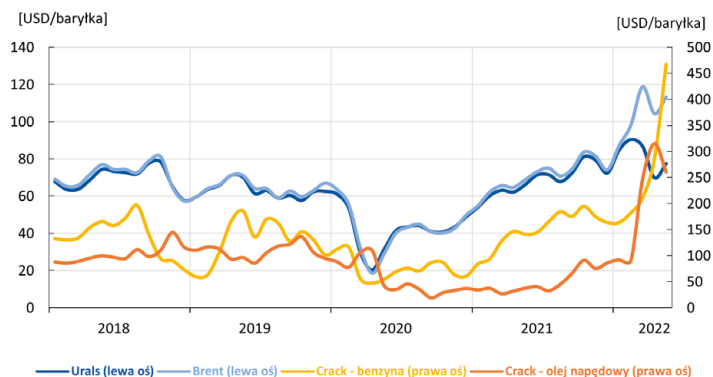
Oil sector companies in Poland and Hungary are among the largest enterprises in Central European countries, and PKN ORLEN S.A. and the MOL Group have for years been among the top companies in Central and Eastern Europe in the Coface TOP 500 CEE ranking (the directory shows the condition of the 500 leading companies from this region measured by turnover). On the one hand, PKN ORLEN S.A. and the MOL Group have assets in many countries of the region, which makes them compete with each other, while on the other hand, they are in a similar situation in

the context of upcoming challenges. With the imposition of various sanctions on Russia, these companies may achieve different positions in the coming years, especially considering the fact that the MOL Group will be able to continue importing crude oil from Russia to the refineries in Százhalombatta and Bratislava.

Such conditions in the context of imported crude oil will affect financial profits. In addition, taking into account the spread during the war in Ukraine, i.e. the difference between the prices of such crude oil grades as *Urals* and *Brent* (approx. USD 30-35/barrel), the benefits resulting from further processing of Russian crude oil by the MOL Group will be significant. Thus, the financial position of this company will improve in the context of competition with PKN ORLEN S.A.

In 2021, the financial condition of oil companies in Central European countries was very good, especially taking into account the ongoing economic recovery after the COVID-19 pandemic and the growing demand for fuels. In 2022, the situation should improve even more due to high fuel prices on international markets (mainly in the ARA fuel hub, i.e. Amsterdam–Rotterdam–Antwerp). Pricing difference between the purchase of crude oil and the sale of fuels (crack spread) produced historically high financial results for these companies in the first quarter of 2022. This was due to the increase in crack spread for products, which in May 2022 increased by 330% (gasoline) and 618% (diesel oil) compared to May 2021. Thanks to the high flexibility of the

Graph 6. Prices of *Brent* and *Urals* crude oil grades and crack spread* for gasoline and diesel oil (2018–2022)

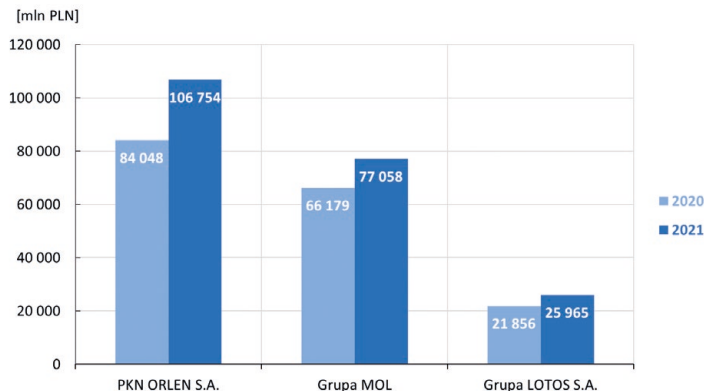


Source: Author's own work.

* Crack spread is the overall pricing difference between a barrel of crude oil and the petroleum products refined from it.

refineries in Płock, Gdańsk, Bratislava and Százhalombatta, and thus the ability to reduce the consumption of natural gas in technological processes, the increase in the price of this commodity (to USD 27.9/MMBtu in May 2022 compared to USD 9.0/MMBtu in May 2021) will not have a major impact on the operation of the refineries. The problem may only occur in less complex refineries. Taking into account the macroeconomic situation, a further increase in revenues generated by refineries in Central European countries can be expected. In 2021, compared to 2020, the sales revenue generated by PKN ORLEN S.A., Grupa LOTOS S.A. (part of PKN ORLEN S.A. since 2022) and the MOL Group was very high and increased by 52%, 58% and 47%, respectively.

Graph 7. Total assets of selected oil companies in Central European countries (2020–2021)



Source: Author's own work.

As shown, the ability to generate funds, despite difficult market conditions, is very high. It is worth noting that the importance of PKN ORLEN S.A. on the Central European market (the company invests in many countries of this region) and the ability to generate additional profits increased in 2022 with the completion of the acquisition of Grupa LOTOS S.A.²² However, the fuel prices at petrol stations in 2022 and the level of inflation may ultimately be factors that will contribute to the recession of the global economy.

²² Ministry of State Assets, *Coraz bliżej koncernu multienergetycznego* [Getting closer to a multi-energy concern], 12 May 2021, <https://www.gov.pl/web/aktywa-panstwowe/coraz-blizej-koncernu-multienergetycznego> [2.06.2022].

Such a situation would also have negative consequences for refineries in Central European countries. The expected decrease in demand for fuels in the event of a recession, with increasing fiscal burdens (e.g. the *Fit for 55* package) and the ongoing transition of the car fleet (the development of the market for cars with drive systems alternative to internal combustion engines), would have a negative impact on the funds that refineries could allocate for their energy transition.

To sum up, it should be pointed out that refineries in Central European countries have prospects for development, although they also face numerous challenges and problems resulting from the war in Ukraine. The financial position of such enterprises is stable, and the largest refineries in the region have a chance to generate high profits. Although it was pointed out in the past that it might be necessary to close down the least profitable refineries, the existing macroeconomic conditions (margins) should ensure stable growth of the refineries, at least in the short term.

Summary

The refining industry in Central European countries has to face numerous challenges, both of a structural nature (new EU regulations, possible decrease in demand for fuels) and of a technological and logistic nature (as a result of the war in Ukraine). Numerous sanctions imposed by EU countries on Russia after the aggression against Ukraine will force the refineries to diversify the sources and directions of crude oil supplies. The derogations to these regulations obtained by some refineries in Central European countries, and thus the possibility of importing crude oil from Russia via the *Przy-*

jażń pipeline, will hinder competition in the region and make the position of some refineries disproportionately better.

This type of situation, i.e. business inequality, can hinder the operation of some refineries. One solution is the introduction, as was the case in Slovakia, of taxes on refineries in connection with deriving significant financial benefits, due not only to the existing international conditions (high prices of refinery products) but also to the possibility of further imports of crude oil from Russia, which is sold at a significant discount. Undoubtedly, the MOL Group, which is still allowed to import crude oil via the *Przyjaźń* pipeline from Russia, will gain a significant advantage in this extremely competitive market.

The refineries in Central European countries still face numerous challenges resulting from international conditions, i.e. the prices of crude oil (the key commodity being the input for installations), natural gas and electricity. The prices of these commodities will affect the level of profits from business activity. The war in Ukraine led to an increase in the prices of not only energy resources but also fuel products, which caused the crack spreads for products to increase by 330% (gasoline) and by 618% (diesel oil) in May 2022 compared to May 2021. However, over the same period, the commodity trading price for crude oil was only 81% higher in May 2022 compared to May 2021. This means that the problem is not crude oil prices, but the prices of fuels.

Therefore, we can expect further favourable conditions that will affect the margins obtained by refineries in Central European countries. Nevertheless, the availability of crude oil is still crucial for refineries in Central European countries. Suspending or even limiting imports of crude oil from Russia forces the refineries to reorient their logistics of supplies. In this context, a well-functioning infrastructure (pipelines, storage facilities, oil terminals) is essential. However, the change in the directions of crude oil supplies also means lower budget revenues for some oil companies (e.g. for PERN S.A. due to the suspension of crude oil supplies via the *Przyjaźń* pipeline to the refineries in Poland and Germany).

In Central European countries, there are still favourable conditions resulting from the demand for fuels. The markets in these countries, unlike those in Western Europe, (apart from in crisis periods) have been recording an increase in consumption for many years. Also, the older car fleet means that the demand for fuels is relatively higher than in Western European countries. Although it should be noted that the economic situation, as well as high fuel prices at petrol stations and high inflation may lead to a decrease in fuel consumption.

Another problem for refineries in Central European countries is the strong competition from refineries in the Middle East, the Asia-Pacific region and the USA. Before the war in Ukraine, the process of modernizing the refineries in Rus-

sia was also problematic, but due to the existing conditions, fewer and fewer enterprises import fuels from this country. In principle, the fuel market is extremely competitive, and its high liquidity and transport capabilities (ships, pipelines, road tankers and rail tankers) make the rivalry more and more intense. Only the process of modernization and optimization of technological and logistic processes can ensure that the refineries in this region will still be able to compete with refineries in other European and non-European countries.

The refineries in Central European countries face the need to make structural changes in order to meet the requirements resulting from the increasing efficiency of internal combustion engines and from regulations at the EU level, which may ultimately limit the operation of refineries. The new regulations and actions aimed at reducing greenhouse gas emissions will have a negative impact on the level of margins (due to increasing environmental restrictions) and will cause a decrease in the demand for fuels (as a result of the development of the market for cars with drive systems alternative to internal combustion engines and the development of synthetic fuels). As a result, also in the refineries in Central European countries, the lack of further modernization activities may mean that favourable refining margins will not be allocated to investments, and thus the development of refineries will be hindered.

The change in the business profile of the refining industry companies towards the generation of electricity (mainly RES) as part of the energy transition process, the development of the production and sale of synthetic fuels and investments in the petrochemical sector will be of key importance. Only such solutions can ensure the continued operation of refineries in Central European countries in different political and economic conditions.

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