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Change in the status of coking coal on the EU list of critical raw materials (2017)

ABSTRACT: Ensuring access to a stable supply of a number of raw materials has become a serious challenge for domestic and regional economies with limited production, the EU economy alike.

Reliable and unconstrained access to certain raw materials is an ever more serious concern. In order to tackle this challenge, the European Commission has established a list of Critical Raw Materials (CRMs) for the EU, which is regularly reviewed and updated.

In its Communication COM(217) 490 final of September 13, 2017, the European Commission presented an updated list of 27 critical raw materials for the EU as a result of a third assessment based on a refined methodology developed by the Commission.

Economic Importance (EI) and Supply Risk (SR) have remained the two main parameters to determine the criticality of a given raw material. The list of critical raw materials for the EU includes raw materials that reach or exceed the thresholds for both parameters set by the European Commission. The only exception is coking coal (included in the list of critical raw materials for the first time in 2014) which, although not reaching the economic importance threshold, has been conditionally kept on the 2017 list for the sake of caution. Should it not fully meet this criterion, it will be withdrawn from the list during the next assessment.

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The article discusses the most important changes to the methodology used in the third review and their impacts on the coking coal criticality assessment. It presents the geographical structure of coking coal global production and consumption as well as the degree to which the EU is reliant on coking coal imports.
Raw materials, even if not classified as critical raw materials, are essential for the European economy as they are at the beginning of manufacturing value chains. Their availability may change rapidly due to developments in trade flows or trade policy, which reveals the general need for the diversification of supply.

KEYWORDS: EU, critical raw materials, coking coal, the international market

Introduction

Given the continued strategic importance of raw materials for the EU manufacturing industry, the European Commission is implementing a wide range of actions within the framework of the EU Raw Materials Initiative to ensure their safe, sustainable and affordable supply. The list of critical raw materials for the EU is a central element of this initiative.

In the European Union, the first comprehensive report and preliminary list of critical raw materials were published in June 2010 by the European Commission Enterprise and Industry, titled "Critical raw materials for the EU – Report of the Ad-hoc Working Group on defining critical raw materials". The research carried out at that time identified 14 raw materials of high economic importance as the most critical for the EU economy. They were characterized in particular by a high risk of supply shortfalls due to a limited number of production and supply sources (Communication COM(2011) 25 final on raw materials, 2011).

The first review (since the adoption of the list in 2011) was carried out in 2013 with three main objectives in mind: (i) widen the scope of raw materials for analysis, (ii) further analysis and use of additional data, and (iii) preserve comparability with the 2010 study. A selection of 54 raw materials was analyzed using the same methodology as in the previous study. The 2014 list of critical raw materials (Communication COM(2014) 297 final) included 13 raw materials from the previous list and six new raw materials, including coking coal (Blaschke and Ozga-Blaschke 2015). Rare earth elements were split into two categories, heavy and light, and listed as separate entries. The twenty raw materials listed in the document were considered critical because the risks of supply shortage and their impacts on the EU economy are higher than in the case of other raw materials.

Following the recommendations of the 2014 report of the Ad-hoc Working Group on defining Critical Raw Materials, a third assessment of critical raw materials has been carried out based on a refined methodology developed by the Commission, preserving comparability with the previous methodological approaches (Methodology for Establishing the EU list of Critical Raw Materials).

The two basic parameters used to define the criticality of a raw material have been maintained:

- **EI** (economic importance) – calculations are based on the importance of a given material in EU end-use applications and the efficiency of its substitutes in those applications;
- **SR** (supply risk) – calculations are based on factors that measure the risk of disruption in the supply of a given material (e.g. supply mix and import reliance, management performance measured by global management indicators, trade restrictions and agreements, availability and criticality of substitutes).

The list of critical raw materials is established on the basis of raw materials which reach or exceed the thresholds for both parameters defined by the European Commission. The calculations are based on average data from the last 5 years (previous criticality assessments would use only the latest available year).

New and improved items introduced in the revised methodology relate, in particular, to:

- trade (import reliance and export restrictions in calculating supply risk);
- substitution as a factor correcting both economic importance and supply risk;
- a more detailed allocation of raw materials to adequate end-use applications and their respective manufacturing sectors rather than to mega sectors; moreover, the allocation is based on official sectoral statistics or classifications of products;
- introduction of an initial review of bottlenecks to determine which stage (extraction/harvesting or processing/refining) entails the highest risk in raw material supply for the EU, taking the availability and quality of data into account.

The 2017 review assessed the criticality of 78 raw materials (58 individual materials and 3 groups of materials containing 20 rare earth elements (REE) and platinum group metals (PGMs)). A higher number of raw materials assessed affects the overall results as they are scored and weighted on the basis of the number and results of each of the assessed individual materials. Of the 78 individual raw materials assessed, 50 were assessed at the stage of extraction of ores and concentrates, and 28 at the stage of processing/refining. Of these 28 materials assessed at the processing stage, 14 have were found critical.

In the two previous assessments, the criticality thresholds were set at **SR≥ 1** and **EI ≥ 5**. In the third assessment, several elements introduced into the revised methodology had an impact on calculations, which was reflected in particular in the values of the EI parameter.

In the previous version of the methodology, the EI assessment was based on the allocation of end-use applications of a raw material to large sectors defined as a "set of related NACE sectors", e.g. NACE 3-digit and 4-digit levels. This analysis is achieved by assessing the proportion of each material associated with industrial megasectors at an EU level. These proportions are then combined with the megasectors' gross value added (GVA) to the EU's GDP. This total is then scaled according to the total EU GDP to define an overall economic importance for a material.

The revised methodology bases the EI assessment on the allocation of primary end-use applications of the material to the relevant manufacturing sector at the NACE Rev.2 2-digit level, allowing for a more precise and disaggregated allocation of end-use applications of the material. The application of a revised formula to calculate the EI resulted in an overall decrease in the EI

value for most of the materials assessed, so that on the basis of the average shift in the results for the materials covered by all three assessments, the threshold of economic importance was set at **EI ≥ 2.8** while the threshold of **SR ≥ 1** remained unchanged (Study on the review of the list of Critical Raw Materials).

The Statistical Classification of Economic Activities in the European Community (NACE) represents a set of economic activities divided in such a way that the NACE code can be linked to a statistical unit which carries it out. Economic activity occurs when resources such as capital goods, labour, manufacturing techniques or intermediate products are combined to produce specific goods or services. Economic activities are therefore characterised by resource input, the production process and the production of goods or services (NACE Rev.2 Eurostat Methodologies and Working papers).

NACE consists of a hierarchical structure described in the NACE Regulation:

- a first level consists of headings identified by an alphabetical code (sections),
- a second level consists of headings identified by a two-digit numerical code (divisions),
- a third level consists of headings identified by a three-digit numerical code (groups),
- a fourth level consists of headings identified by a four-digit numerical code (classes).

1. The 2017 list of critical raw materials for the EU

In its Communication COM(217) 490 final of September 13, 2017, the European Commission published an updated 2017 list of critical raw materials for the EU. Compared to the 2014 list, nine new raw materials have been added to the list, while three raw materials (chromium, coking coal and magnesite) have not been considered critical as a result of the 2017 assessment.

However, coking coal has been considered a borderline case. Although it narrowly misses the EI threshold, it has been kept on the EU list of critical raw materials for the sake of caution. Should it not fully meet the criteria, it will be withdrawn from the next list. The list of EU critical raw materials is updated regularly – at least every three years – in order to take account of changes in production, market and technological developments.

In the list of 27 critical raw materials (including coking coal) shown in Table 1, nine new raw materials, which have appeared for the first time, are highlighted in grey.

The diagram in Figure 1 shows the overall results of the assessment of EU-listed raw materials against the criticality thresholds set for SR and EI parameters.

Table 2 compares the results of the two criticality assessments of coking coal (2014 and 2017).

In the 2017 study, the EI parameter value for coking coal does not meet the minimum criticality threshold (EI = 2.8). This is due to the application of a modified calculation formula that proposes a more precise and disaggregated allocation of the main end-use applications to manufacturing sectors, rather than to a large metallurgical sector (Megasector Metals), which was

TABLE 1. EU Critical Raw materials (2017)

TABELA 1. Wykaz surowców krytycznych dla UE (2017)

List of 2017 Critical Raw Materials (CRMs)							
Antimony	Sb	Fluorspar	Fl	Light rare earth elements	LREEs	Phosphate rock	Phs
Baryte	Brt	Gallium	Ga	Magnesium	Mg	Scandium	Sc
Beryllium	Be	Germanium	Ge	Natural graphite	Gr	Silicon metal	Si
Bismuth	Bi	Hafnium	Hf	Natural Rubber	Nr	Tantalum	Ta
Borate	Bo	Helium	He	Niobium	Nb	Tungsten	W
Cobalt	Co	Heavy rare earth elements	HREEs	Platinum group metals	PGMs	Vanadium	V
Coking coal	CC	Indium	In	Phosphorus	P		

Source: Communication from the Commission... on the 2017 list of Critical Raw Materials for the EU, COM(2017)490, 13.09.2017.

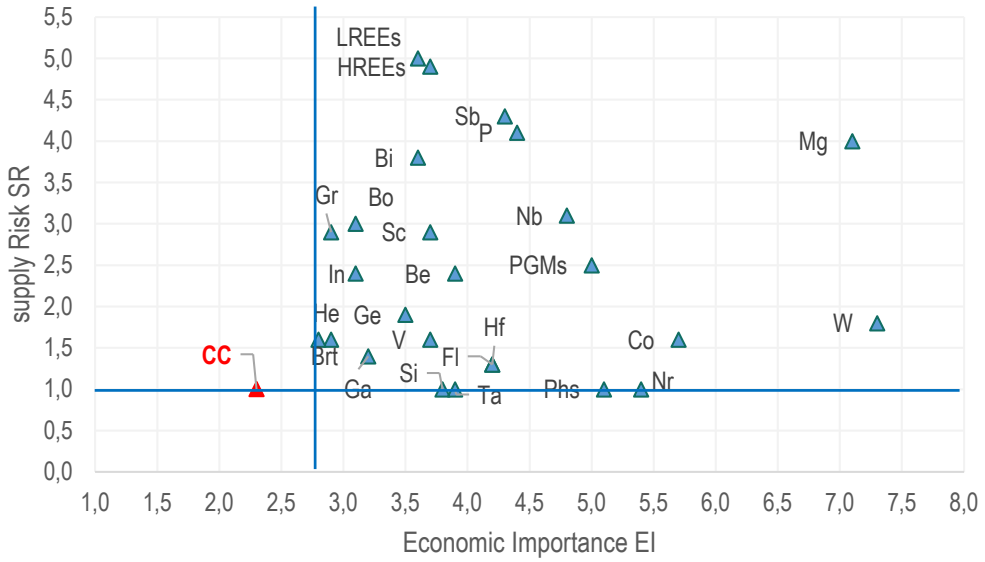

Fig. 1. SR and EI results for 27 critical raw materials (RM) 2017
Source: based on data from Study on the review of the list of Critical Raw Materials Final Report

Rys. 1. Wyniki SR i EI dla 27 krytycznych surowców (RM) 2017 r.

used in the 2014 assessment. The calculation of economic importance is based on the use of the NACE 2-digit codes and the value added at factor cost for the identified sectors (Table 3). This results in lower total gross value added (GVA) and thus affects the outcome of the economic importance of coking coal (Study on the review of the list of Critical Raw Materials).

The results of supply risk have changed little, mainly due to minor changes in supplier countries – the value of SR = 1 meets the minimum criticality threshold.

TABLE 2. Comparison of 2014 and 2017 assessment results

TABELA 2. Porównanie wyników oceny z lat 2014 i 2017

Criticality studies	2014		2017	
Coking coal	SR	EI	SR	EI
	1.2	8.9	1.0	2.3

Source: study on the review of the list of Critical Raw Materials. Non-Critical Raw Materials Factsheets.

TABLE 3. Coking coal application, 2-digit NACE sectors, 4-digit NACE sectors

TABELA 3. Zastosowanie węgla koksowego, 2-cyfrowe i 4-cyfrowe sektory NACE

Applications	2-digit NACE sector	4-digit NACE sector
Non-metal applications 5%	C23 – Manufacture of other non-metallic mineral products (This division includes manufacturing activities related to a single substance of mineral origin. This division includes the manufacture of glass and glass products (e.g. flat glass, hollow glass, fibers, technical glassware etc.), ceramic products, tiles and baked clay products, and cement and plaster, from raw materials to finished articles).	C23.99 – Manufacture of other non--metallic mineral products n.e.c. (This class includes: – manufacture of friction material and unmounted articles thereof with a base of mineral substances or of cellulose, manufacture of mineral insulating materials, manufacture of articles of diverse mineral substances, manufacture of articles of asphalt or similar material, e.g. asphalt-based adhesives, coal tar pitch etc., manufacture of carbon and graphite fibers and products (except electrodes and electrical applications). manufacture of artificial corundum).
Base metal 95%	C24 – Manufacture of basic metals (This division includes the activities of smelting and/or refining ferrous and non--ferrous metals from ore, pig or scrap, using electrometallurgical and other process metallurgic techniques).	C24.10 – Manufacture of basic iron and steel and of ferroalloys (24.1 – This group includes activities such as direct reduction of iron ore, production of pig iron in molten or solid form, conversion of pig iron into steel, manufacture of ferroalloys and manufacture of steel products).

Source: study on the review of the list of Critical Raw Materials. Non-Critical Raw Materials Factsheets; NACE Rev.2.

The EU's import reliance rate (IR) takes proportionally the 2 sets of the producing countries – the global suppliers and the countries from which the EU is sourcing the raw materials into account. SR is measured at the bottleneck stage (extraction/harvesting or processing/refining), which represents the highest supply risk for the EU. Substitution and recycling are considered risk reducing measures.

Other coking coal assessment parameters such as the recycling rate or substitution options have not changed compared to the 2014 assessment.

The results of the coking coal criticality assessment in terms of supply risk (including the degree to which the EU countries rely on imports, geographical structure of production) are summarized in Table 4 (the data in the table are consistent with the EU Communication; it is interesting to note, though, that the UK is a source of coking coal supply to the EU on an equal footing with Poland or the Czech Republic).

TABLE 4. Criticality assessment results for coking coal

TABELA 4. Wyniki oceny krytyczności węgla koksowego

Main global producers (average 2010–2014)	Main importers to the EU (average 2010–2014)	Sources of EU supply (domestic production + imports) (average 2010–2014)	Import reliance rate IR*	Substitution indexes SI EI/SR**	End-of-life recycling input rate***
China (54%) Australia (15%) United States (7%) Russia (7%)	United States (39%) Australia (36%) Russia (9%) Canada (8%)	United States (38%) Australia (34%) Russia (9%) Canada (7%) Poland (1%) Germany (1%) Czech Republic(1%) United Kingdom (1%)	63%	0.92/0.92	0%

Source: Communication from the Commission… on the 2017 list of Critical Raw Materials for the EU, COM(2017)490, 13.09.2017.

* IR (Import Reliance) – the import reliance rate takes into account global supply and actual EU sourcing in the calculations of supply risk, and it is calculated as follows:

$$IR = \frac{EU\ net\ imports}{EU\ domestic\ production + EU\ net\ imports}$$

** SI (Substitution Index) – the substitution index is a measure of the difficulty in substituting the raw material, scored and weighted across all applications, calculated separately for both economic importance and supply risk parameters. Values are between 0 and 1, with 1 being the least substitutable.

*** The 'End-of-life recycling input rate' measures the ratio of recycling from old scrap to EU demand of a given raw material, the latter equal to primary and secondary raw material supplies to the EU.

The most important supply risk factors include: the political and economic stability of the producing countries, the level of production concentration, the potential for substitution and the level of recycling.

Keeping coking coal on the list of Critical Raw Materials shows its importance to the economy of the European Union.

The results of the assessment are intended to help the European Commission identify (i) where are the risks associated with the supply of materials important to the EU economy, (ii) where the supply of materials to European industry should be supported, and (iii) what are the main levers to ensure the security of supply and the efficiency and competitiveness of EU industry.

2. The position of the European Union in the global market for coking coal

Coking coal is sometimes also referred to as metallurgical coal – hard coking coal (HCC), semi-soft coking coal (SSCC).Coke produced from coking coal is the basic raw material in the metallurgical industry which in turn is one of the most important branches of the processing industry.

The largest and key recipient of coke is the steel sector where it is used for the production of pig iron in the blast furnace process, but also for the production of agglomerates from iron ore and for the production of ferroalloys. Foundries using foundry coke also belong to this group. Other types of produced coke are used as fuel or chemical raw material in industries such as: non-ferrous metal metallurgy (zinc, lead, copper), construction materials (lime, insulation materials), food industry (sugar factories, drying plants), or the chemical industry.

Despite many years of research and implementation work on other methods of steel production, the blast furnace process still remains the dominant technology; currently the global share of steel produced using this system is nearly 71% (via worldsteel). In the European Union, more than half (nearly 59%) of crude steel is produced using the following system: coking plant – blast furnace – oxygen converter.

Since Europe is relatively poor in natural resources, most raw materials for steel production must be imported.

The European Union has historically been and continues to be a major importer of coking coal – the demand from the steel industry far exceeds the production capacity of the mining industry in Member States. The largest producer of coal among the EU countries is Poland (with its output at 12–13 million tons/year). The production is also still taking place in the Czech Republic (around 3 million tons) and Germany (around 2 million tons in 2017; in 2018 the last two hard coal mines were closed). As a result, in 2017 the EU share in worldwide coking coal production was around 2% (Fig. 2).

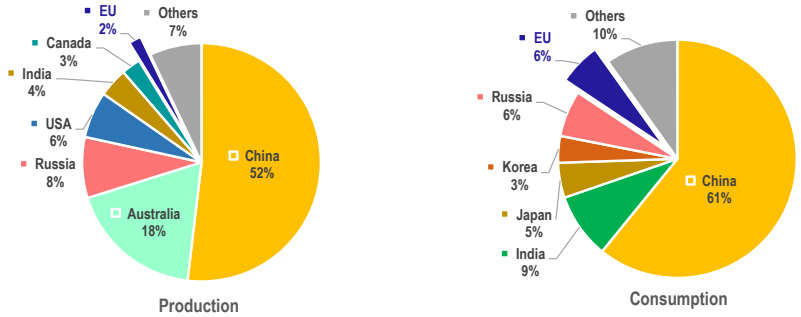

Fig. 2. The share of the EU-28 in the global coking coal production and consumption, 2017
Source: based on data from Coal Information 2018

Rys. 2. Udział UE (28) w światowej produkcji i zużyciu węgla koksowego w 2017 r.

Both the production and consumption of coking coal in Europe has a decreasing trend. A decreased consumption results both from lower and lower production of pig iron in the EU (in the years 2000–2018 it decreased by 20%), as well as from the improvement of blast furnace technology and the use of substitute fuels on an increasing scale; this resulted in a lower ratio of specific coke consumption per ton of produced pig iron. The share of the EU-28 in global coking coal consumption decreased from 18% in 2000 to 6% in 2017.

Apart from China, the ranking of the largest producers includes Australia, the US, Russia and India – almost 90% of worldwide coking coal production is concentrated in these five countries. The world region with the highest coking coal consumption is Asia, with China alone accounting for 61%. This is due to the concentration of crude steel production in Asian countries accounting for 70% of worldwide production; the share of blast furnace technology in Asia is 80% (via World steel... 2019).

In international trade, the coal market on the suppliers' side is slightly diversified – among the leaders are countries such as Australia: (about 55% share in total trade, and about 62% in seaborne trade), USA, Canada and Russia (Fig. 3). For several years now, Mongolia has joined the group of exporters, supplying land-based coal only to China; what is more, coal from new investments in Mozambique, Indonesia and Colombia has appeared on the market.

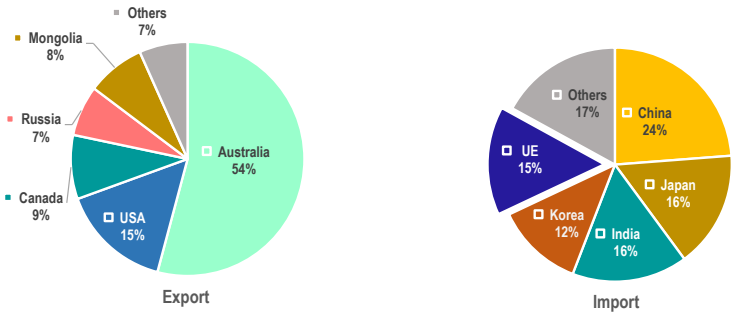

Fig. 3. Major world coking coal exporters and importers (2017)
Source: based on data from Coal Information 2018, Eurostat: Dataset:nrg_101a, ICR Coal Statistics, Resources and Energy Quarterly DIIS

Rys. 3. Główni światowi eksporterzy i importerzy węgla koksowego (2017 r.)

Australia's dominant position on the coking coal market is related not only to the volume of coal sold, but also to its quality (the share of the best hard coals is over 60%).

On the demand side, the main importers are traditionally steel companies from Japan, India and South Korea; in 2009 China joined the group, becoming the world's largest importer of coking coal in a short period of time. As a result, the Asian market currently manages about two thirds of the world coking coal trade.

The EU-28 imports around 40 million tons of coking coal from third countries and has a market share of ~15%. The majority of coking coal imported to the EU is from Australia and the US.

Conclusions

Critical raw materials (CRMs) are those raw materials which are essential to the EU economy and whose supply involves a high risk of not responding adequately to industrial needs. The two main parameters, Economic Importance (EI) and Supply Risk (SR), are used to determine the criticality of the raw materials assessed. The list of critical raw materials for the EU includes the raw materials that reach or exceed the thresholds of both parameters set by the European Commission. The only exception is coking coal (included in the list of critical raw materials for the first time in 2014) which, although not reaching the economic importance threshold, has been conditionally kept on the list in 2017 for the sake of caution.

In Europe, the manufacturing industry (i.e. the manufacture of end products and applications) and the refining industry (metallurgy, etc.), are more important than the extractive industry (e.g. mining activities). The value chain of raw materials is not fully and homogeneously covered by the European industry, with a pronounced imbalance between the upstream steps (extraction/harvesting) and the downstream steps (manufacturing and use). The need for primary materials, such as ores and concentrates, and also for processed and refined materials is huge and crucial for the European industries and their associated jobs and economy.

In the last decade, the reduced availability of raw materials on international markets and the dynamic increase in their prices have revealed the risks arising from the EU's reliance on raw materials.

It is important for the European steel industry to secure a stable supply of basic raw materials on competitive terms. The lack of own sufficient sources of supply means that the European Union is almost entirely dependent on imports of both iron ore and coking coal. After the closure of hard coal mines in Germany, coking coal producers in the EU will only remain in Poland, and, on a much smaller scale, in the Czech Republic which also plans to have the mines closed by 2023.

Users who rely on coal imports are interested in the availability of this raw material in international trade which covers about 30% of the worldwide demand for coking coal. On the supply side, the number of participants in this market segment is limited to a few major exporters, with the first three (Australia, the US and Canada) jointly accounting for over 80% of coal supply to the international market.

The risks associated with a high concentration of production are in many cases compounded by low substitutability and low recycling rates. In the case of coking coal, there is no possibility of recycling it, and there are currently no technically possible and economically viable alternatives for its full substitution in the iron and steel industry.

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Urszula OZGA-BLASCHKE

Zmiana statusu węgla koksowego na unijnej liście surowców krytycznych (2017)

Streszczenie

Zapewnienie dostępu do stabilnej podaży szeregu surowców stało się poważnym wyzwaniem dla gospodarek krajowych i regionalnych o ograniczonej produkcji, podobnie jak gospodarki UE. Niezawodny i nieograniczony dostęp do niektórych surowców stanowi coraz poważniejszy problem. Aby sprostać temu wyzwaniu, KE opracowała listę surowców krytycznych (CRM) dla UE, która jest regularnie weryfikowana i aktualizowana. W komunikacie COM (217) 490 wersja ostateczna z 13.09.2017 r. KE przedstawiła zaktualizowany wykaz 27 kluczowych surowców dla UE w wyniku trzeciej oceny opartej na dopracowanej metodologii opracowanej przez Komisję. Znaczenie ekonomiczne (EI) i ryzyko podaży (SR) pozostały dwoma głównymi parametrami określającymi krytyczność danego surowca. Lista surowców krytycznych dla UE obejmuje surowce, które osiągają lub przekraczają progi dla obu parametrów określonych przez KE. Jedynym wyjątkiem jest węgiel koksowy (po raz pierwszy zawarty na liście surowców krytycznych w 2014 r.), który, choć nie osiąga progu znaczenia ekonomicznego, został warunkowo umieszczony na liście z 2017 r.

W artykule omówiono najważniejsze zmiany metodologii zastosowanej w trzecim przeglądzie i ich wpływ na ocenę krytyczności węgla koksowego. Przedstawia strukturę geograficzną światowej produkcji i zużycia węgla koksowego, a także stopień, w jakim UE jest uzależniona od importu węgla koksowego. Surowce, nawet jeśli nie są klasyfikowane jako surowce krytyczne, są niezbędne dla gospodarki europejskiej, ponieważ znajdują się na początku łańcuchów wartości w produkcji. Ich dostępność może się szybko zmieniać ze względu na zmiany w przepływach handlowych lub polityce handlowej, co ujawnia ogólną potrzebę dywersyfikacji podaży.

SŁOWA KLUCZOWE: UE, surowce krytyczne, węgiel koksowy, rynek międzynarodowy