
EUROPEAN CHEMICAL INDUSTRY – CURRENT STATE AND CHALLENGES

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Abstract: The European chemical industry is one of the major and most important industrial sectors of the Community economy. The present paper **aims** to present an analysis of its current state and, on this basis, to highlight the main challenges it must address in the coming years. The presentation of the main characteristics of the chemical industry on a global scale, which gives a clearer idea of the state of the industry as a whole also plays an important role in the study. The following main conclusions are drawn from the analysis made. **First**, an increase in the share of chemical substances and products in the EU's total exports and imports, which determines the growing importance of the sector to the European Union. **Second**, the European chemical industry is still lagging behind China on a global scale due to a variety of reasons, including the country's industrial policy and sector reforms. **Third**, in the future, the industry will have to cope with a number of challenges in areas such as the environment, international competitiveness, sustainable development and the circular economy.

Keywords: European chemical industry, trade in chemical products, circular economy.

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Introduction

The chemical industry with chemicals and substances it produces has been an integral part of the economic development of the EU member states. The first chemical plants were built in Europe during the

Industrial Revolution with a core business of producing concrete and waterproof clothing¹. Since then, the industry has been continuously evolving, a fact reflecting in the increasing variety of chemical substances and products. Today, no industrial process exists which does not use chemicals. Intermediate and end products valuable for the world development are obtained by processing various raw materials such as coal, oil, natural gas, air, water, salt, minerals, metals, wood and sulphur. These products, in turn, find application in a number of economic sectors, some of which are agriculture, automotive, construction, metallurgical and pharmaceutical industries.

Within the EU, the sector accounts for a significant share of Europe's economic infrastructure, and is responsible for the employment of more than 3 million people and a turnover of EUR 507 billion. The European chemical industry is one of the sectors heavily relied on to be leading and to help the Community to achieve its objectives in a number of fields, including the environment, competitiveness, sustainable development and the circular economy, not only regionally but also on a global scale. Therefore, the **main objective** of the present study is to analyse the current state of the chemical industry in the EU and to highlight the main challenges it has to address in the coming years. The **research thesis** defended in the study can be defined as follows: the European chemical industry faces complex challenges and issues, the solution of which is decisive for the development of the industry as a leader both within the Community and worldwide. The extent to which the sector will cope with them depends on joint efforts and close cooperation between Community institutions, member states and the companies operating in the sector.

1. Assessment of the global chemical industry

The chemical industry is a sector of significant economic importance to countries and people all over the world. The globalization of the industry took off in the 1960s when numerous companies, based in various countries, began investing in production facilities in foreign countries. (American Chemistry Council, 2019, p. 37). The reasons that have led to the globalization of this industrial sector include: world economic growth, policies that support industrial growth and competitiveness, as well as advances in technology, logistics and the distribution of industrial goods. (American Chemistry Council, 2019, p. 37).

¹ See: Oxford Economics "The Global Chemical Industry: Catalyzing Growth and Addressing Our World's Sustainability Challenges", 2019, p.4

Today's chemical industry is characterized by being one of the largest and most diversified economic sectors, comprising many sub-sectors of the manufacturing industry. By using a wide variety of modern technologies, raw materials, substances and a complex combination of chemical processes, they produce more than 70 thousand products. The value of the products produced annually reaches about four trillion US dollars (OECD, 2011, p. 2). Some of them are purchased directly by consumers (cosmetics, batteries, paints, laundry and cleaning products, electronic equipment, rubber and plastic products, motor oils, tires, clothes, shoes, paper, toys, medicines, creams, toothpaste, soap, etc.) while others are used as intermediates in other economic sectors, including agriculture, food, metallurgy, construction, woodworking, pulp and paper, perfumery, cosmetics, pharmaceuticals, glass, petroleum, and car industry.

Globally, the need for and the use of chemical products increases, with UN data indicating this. According to it, the manufacture of products gradually increases, rising from 1.2 to 2.3 billion tonnes between 2000 and 2017 (United Nations, 2019, p. 24). Not only is this industry responsible for the production of a great number of products widely used in all aspects of modern life, but it is also an important source of employment. According to a survey carried out by Oxford, the industry directly employs 15 million people and every job created in it contributes to the creation of seven others in the global economy (Oxford Economics, 2019, p. 5). According to recent data, the sector has contributed USD 1.1 trillion to the global GDP. This makes it fifth-largest global industrial sector by this indicator (Oxford Economics, 2019, p. 5).

A number of changes in international trade in chemical substances and products has taken place over the past decade. What is striking is the ongoing increase in the value of products sold, as well as the development of the industry in Asian countries, especially in China, where the sector has been developing very successfully. Data from the European Chemical Industry Council (CEFIC) shows that in 2017 there was a global increase of 4.6% in the sales of chemical substances and products as compared to the previous year, amounting to EUR 3.475 billion (CEFIC, 2018, p. 6). In 2017 China was the largest producer of chemical products with sales reaching EUR 1.293 billion or 37.2% of the international trade in goods in the sector. The European Union ranked second, followed by the United States of America, Japan and South Korea.

We should note that in 2009, the EU lost its leading position as a major manufacturer of chemical substances and products to China, which still ranks first by this indicator. There are a number of reasons why the Chinese chemical industry is a few steps ahead of everyone else, including: *the*

country's industrial policy, reforms and investments in the sector, technology development, the rapid expansion of markets in Asia, access to millions of suppliers and consumers, as well as the advantage of production this region of the world have due to lower labour costs.

In the long run, annual sales of chemical products are expected to continue to grow and to reach EUR 6.3 trillion in 2030 (CEFIC, 2018, p. 34). If the current trend continues, China will continue to be the country with the largest share of international sales of products in the industry. Production in other countries such as India, Brazil, South Africa and Indonesia is also strong, and they are anticipated to have a growing share of the trade in chemical products.

Increasing production, international trade and the use of more and more chemical substances and products have a positive as well as a negative impact on global development. Some of the positive effects include the following: contribution to the economic growth of countries, increase in competition, emergence of new products and services, creation of new jobs, emergence of new markets, improvement of production efficiency by investing in research and development. One of the negative effects is the ongoing pollution of the environment, through discharging hazardous chemicals, plastic waste, etc. in large quantities into the air, water and soil. (United Nations, 2019, p. 6).

Among the major challenges facing the development of global chemical industry continue to be the environmental issues caused to some extent by the activities of chemical companies. The fact that we still do not have complete information on all types of chemicals and the effects they have on human health and the environment can be accounted for as an omission.

A great number of the so-called 'hazardous chemicals' such as arsenic, asbestos, cadmium, dioxins and dioxin-like substances, fluorine, lead, mercury, highly hazardous pesticides are still used all over the world (World Health Organization, 2010). We can also add carbon monoxide, sulphur oxide, nitrogen oxides and particulate matter to them (World Health Organization, 2016, p. 5). All these, and many others, including nickel and polycyclic aromatic hydrocarbons, are among the major pollutants of the air, water and soil and pose a serious threat to ecosystems, wildlife and human health. Sound chemicals and waste management plays a key role in avoiding and minimizing the risks posed by them. In response to the growing demand, the production, exports, imports and consumption of chemicals, a number of international agreements and voluntary tools have been adopted to stimulate the development of the industry on the one hand and to reduce its negative environmental impact on the other. However, more serious measures are

needed to reduce their use in order to be able to live in a better and more secure environment in the future.

As a result of the research done so far, it can be summarized that chemical industry products have become an integral part of our daily lives. There is almost no industry that does not use chemicals in its business. They find application in a great number of end products. The production volume in the sector increases each year, leading to a number of challenges that need to be addressed and resolved. In the coming years, the global chemical industry will continue to be crucial yet pursuing safer and more responsible product development and production that will make the industry more efficient, thereby reducing its negative impact on different aspects of people's lives. The key is to achieve a better and closer international cooperation between countries and companies in the industry.

2. Current state of the EU chemical industry

The European chemical industry is a fundamental and integral part of the European economy. Within the Community, its importance is justified by its contribution to production, trade, employment and investment. It is the fifth largest sector within the EU responsible for 7% of the industrial production (European Commission, 2019, p. 13). Its contribution to the total EU GDP is 1.1% (CEFIC, 2018, p. 14). There are 28,000 active micro-, small-, medium- and large-sized enterprises, which annually manufacture and sell chemical substances and products worth EUR 507 billion (see Table 1). They represent 1.4% of the total number of industrial enterprises within the Community and provide direct and indirect employment to 3.3 million people (11% of those employed in the industry).

The industry is extremely diverse and some of its main sub-sectors are: petrochemicals production, polymer production, basic inorganic substances production, specific chemicals production, consumer chemical products (European Commission, 2016, p. 7). What is distinctive about the sector is that companies operating in it are suppliers on the one hand and consumers of chemical substances and products on the other.

The EU chemical industry is geographically concentrated in seven of the Community member states. These are Germany, France, Italy, the Netherlands, Belgium, Spain and the United Kingdom, accounting for 85% of the total industry turnover.

Table 1

Number of EU chemical enterprises and persons employed

	Number of enterprises	Number of employees
	(thousands)	
All enterprises	28,6	1.160,0
All SMEs	27,3	510,5
Microenterprises	18,1	55,0
Small-sized enterprises	6,4	145,5
Medium-sized enterprises	2,8	310,0
Large enterprises	0,9	650,0

Source: Das, S., Icart, I. (2016). Innovation policy of European chemical companies. Rovira and Virgili University, p.39

These countries include most of the leading manufacturers in the industry, including: BASF (Germany), Ineos (Great Britain), LyndellBasell (the Netherlands), Air Liquide (France), Evonik Industries (Germany), Covestro (Germany), Bayer (Germany), Linde (Great Britain), Solvay (Belgium), DSM (the Netherlands) and Borealis (Austria) (American Chemical Society, 2019). According to the European Commission, over 65% of the companies operate within the following five manufacturing sub-sectors of the industry: *perfumes and toilet preparations, paints and varnishes, printing ink, soaps and cleaning preparations, plastics and organic basic chemicals* (European Commission, 2016, p. 26).

One of the aspects judging the economic state and importance of an industry is the volume of production, consumption and the ability to sell its output on international markets. In this context, we can say that the higher the output and export volumes are over time, the better the industry's position is in a particular economy. Industry analysis takes into account both outbound and inbound trade flows thus complementing the overall picture of the state and importance of the chemical industry within the Community.

International trade in chemical substances and products plays an important role in the EU foreign trade. According to final data by the European Commission, in 2018 the relative share of the chemical sector in total exports, imports and trade amounted to 18.2%, 10.3% and 14.2% (see Table 2). Growth in the total share of trade in chemical substances and products was observed in 2018, with an increase in both exports and imports as compared to 2008.

Table 2

Percentage of chemical products in the EU foreign trade for 2008 and 2018

Year	2008		Percentage of chemical products	2018		Percentage of chemical products
	Total for the EU	Chemical products		Total for the EU	Chemical products	
Exports	€ 1 309,10	€ 197,60	15.1%	€ 1 956,50	€ 355,80	18.2%
Imports	€ 1 585,40	€ 124,30	7.8%	€ 1 980,00	€ 203,60	10.3%
Trade in goods	€ 2 894,50	€ 321,90	11.1%	€ 3 936,50	€ 559,40	14.2%

Source: the table is compiled according to data by the European Commission, https://trade.ec.europa.eu/doclib/docs/2013/may/tradoc_151348.pdf

For the 2008–2018 period, an increase in the trade in chemical substances and products was observed in absolute value, both in terms of exports and imports. As a result, the total trade in goods also went up. Data shows that export growth rates outpaced those of chemical imports, forming the positive balance in trade in these types of products (see Table 3). On average, exports and imports rose by about 6.3% and 5.2%. There was a 1.8-fold increase in exports over the period considered as compared to 2008. A 1.6-fold increase in the imports of chemical products was also observed, amounting EUR 203.6 billion in 2018 as compared to EUR 124.3 billion in 2008.

Table 3

EU foreign trade in chemical substances and products for the 2008-2018 period, in EUR billion

Year	Exports	Imports	Balance	Trade in goods
2008	197,6	124,3	73,3	321,9
2009	195,6	112,5	83,1	308,1
2010	232,7	137,3	95,4	370,0
2011	254,9	155,3	99,6	410,2
2012	275,5	163,4	112,1	438,9
2013	273,3	157,9	115,4	431,2
2014	278,1	165,4	112,7	443,5
2015	314,7	185,6	129,1	500,3
2016	312,1	184,1	128,0	496,2
2017	332,9	196,3	136,6	529,2
2018	355,8	203,6	152,2	559,4

Source: the table is compiled according to data by the European Commission, https://trade.ec.europa.eu/doclib/docs/2013/may/tradoc_151348.pdf

The percentage of chemical substances and products in the total EU exports and imports also went up. The data presented shows that there was a rise in the share of exports, increasing from 15.1% to 18.2% in 2018, although, as apparent from the data above, it happened at a higher rate than imports. This means that trade in this type of products occupied a growing share in exports. Therefore, the importance of the sector to the Community increased. The share of chemical products in imports also rose from 7.8% in 2008 to 10.3% in 2018.

Next, exports and imports of major commodity groups for the period 2008 and 2018 are studied (see Table 4 and Table 5). Commodity subgroups 54 (Pharmaceutical and medical products), 51 (Organic chemicals), 59 (Chemical materials and products) and 57 (Plastics in primary forms) had the highest value in exports of chemical products in 2008, while subgroups 53 (Dyeing, tanning and colouring materials) and 56 (Fertilizers other than group 272) had the lowest values. For the 2008-2018 period, there was an increase in the annual average values of exports for all commodity subgroups, the most significant being for commodity subgroups 54 (Pharmaceutical and medical products), 55 (Essential oils, resinoids and perfumes) and 59 (Chemical materials and products). In 2018, the leading commodity subgroups were the same as in 2008, with an increase in exports of commodity subgroup 54 (Pharmaceuticals and medical products), where there was more than a 2-fold rise amounting to EUR 169,285 million.

Table 4

Exports of major commodity groups of chemical products for the period 2008 and 2018 (EUR million)

Commodity groups	Exports (EUR million)		Average annual increase in the value of exported chemical products for the 2008-2018 period (%)
	2008	2018	
5	197 608	355 848	6.1%
51	36 364	49 393	3.1%
52	9 100	10 300	1.2%
53	8 927	11 830	2.9%
54	72 685	169 285	8.8%
55	18 756	33 954	6.1%
56	2 770	3 091	1.1%
57	19 102	27 508	3.7%
58	9 584	14 947	4.5%
59	20 320	35 540	5.7%

Source: Eurostat²

² See: Eurostat. (2019). Production and international trade in chemicals. https://ec.europa.eu/eurostat/statistics-explained/index.php/Production_and_international_trade_in_chemicals

The annual average values of imports of chemical products show an increase of 5.1% over the period studied. Imports of chemical products show the same trend as exports. The major commodity subgroups leading in imports for 2008 were subgroup 54 (Pharmaceutical and medical products), 51 (Organic chemicals) and 59 (Chemical materials and products). The lowest was the value of imported chemical products from commodity subgroups 56 (Fertilizers other than group 272) and 53 (Dyeing, tanning and colouring materials). Data shows that for the 2008-2018 period the highest increase was in the value of imports for subgroups 54 (Pharmaceutical and medical products) and 55 (Essential oils, resinoids and perfumes) by 7.4% and 6.3% respectively, while subgroups 52 (Inorganic chemicals) and 56 (Fertilizers other than group 272) had the lowest value.

Table 5

Imports of the main commodity groups of chemical products for the period 2008 and 2018 (EUR million)

Commodity groups	Imports (EUR million)		Average annual increase in the value of imported chemical products for the 2008-2018 period (%)
	2008	2018	
5	124 287	203 590	5,1%
51	32 796	48 334	4,0%
52	11 484	12 471	0,8%
53	3 314	4 981	4,2%
54	38 209	78 020	7,4%
55	5 516	10 116	6,3%
56	4 274	4 320	0,1%
57	10 783	18 141	5,3%
58	5 460	9 146	5,3%
59	12 451	18 062	3,8%

Source: Eurostat³

Exports and imports of goods can also be studied according to their geographical orientation. This makes it clear how much trade flows are concentrated to and from particular countries. The figures that follow show foreign trade flows in cash volumes, depending on the countries to which they

³See: Eurostat. (2019). Production and international trade in chemicals. https://ec.europa.eu/eurostat/statistics-explained/index.php/Production_and_international_trade_in_chemicals

are exported and the countries from which chemical substances and products are imported for 2008 and 2018, respectively. In 2008, the largest export market in which European chemical companies sold their products turned out to be the United States, where goods worth EUR 52.761 million were sold. Other markets important for the EU were those of Switzerland, Russia and Turkey, followed by Japan and China. Total exports to the first six countries amounted to EUR 110.712 million.

Some changes occurred over the period up to 2018, with the USA retaining its position of a major market, while at the same time export values to the country increased by EUR 46.523 million as compared to exports in 2008. It is also noteworthy that China was an increasingly preferred market for trading this type of products, with exports to the country increasing from EUR 8.353 million in 2008 to EUR 26.758 million, thereby displacing Russia and becoming the third most preferred market. Exports to the six largest markets increased, reaching EUR 205.739 million. Russia, Japan, Turkey, Brazil, Canada, South Korea and Australia continued to be among the top ten preferred destinations.

In 2008, the USA was the largest supplier of chemical substances and products to the EU, followed by Switzerland, China, Japan, Singapore and Russia. Imports from all countries mentioned amounted to EUR 88.237 million. In 2018, the USA remained a top of list of major importers, followed by Switzerland, China, Singapore, India and South Korea. Imports from these countries amounted to EUR 142.948 million, which was higher as compared to the beginning of the period.

In summary we could draw the following conclusions. **First**, an increasing importance of the industry to the Community is observed. The data presented that shows an increase in the chemical substances and products produced as well as an increase in the total commodity turnover of this type of goods and their percentage in both EU total exports and imports gives evidence of this. **Second**, a positive feature in the development of the sector is the reduction of manufactured total quantities of chemical substances and products hazardous to human health and the environment. **Third**, the main partner countries of the European Union to which foreign trade in this type of products is oriented to are the USA, Switzerland and China.

3. Challenges and future development of the European chemical industry

Since it was established, the European chemical industry has been and continues to be one of the sectors with a tremendous impact on economic development, both in individual member states and in the Community as a

whole. From the analysis made and the data presented in the study, we can see that in recent years there has been an increase in foreign trade flows, as well as in the share of chemical substances and products in the overall European Union exports and imports. This means that the sector develops in a positive direction and this trend is expected to continue during the following year.

Despite the positive results achieved, this sector is currently facing a number of challenges covering a wide range of areas. In a European Commission study, we find out that the sector faces the most serious difficulties with regard to increased *international competition, rising prices of basic resources needed for its activity, rising electricity prices, pressure to improve resource efficiency, dealing with new regulations and the need for innovation* (European Commission, 2019). To these challenges, we can add others resulting from policies and objectives that the EU has set at global and regional levels, such as those in the field of environmental protection (Zaharieva, 2014), the circular economy and the UN global objectives in the field of sustainable development⁴.

Global competition between manufacturers of chemical substances and products increases every year. The Community-wide sector faces the difficult task of retaining its second position as a major global chemical producer on the one hand, and of handling the sector development in countries such as China and the USA on the other. According to the European Chemical Industry Council, there are several reasons for the better state of the sector in other non-EU countries, including *less stringent regulation, more favourable tax policies and lower cost of energy sources* (CEFIC, 2019, p. 12).

Environmental issues are both regional and global. In the field of environment, one of the EU and chemical industry's goals is to reduce greenhouse gas emissions in the atmosphere with 50% below the current levels by 2050. (CEFIC, 2019, p. 8). To achieve this, investments in new technologies and cooperation with other sectors are required. By 2050 it is expected to reduce greenhouse gas levels by 80% as compared to 1990 values. These objectives seem difficult, yet achievable because billions of euros are spent annually in the sector on research and development, which helps the sector to be more energy efficient and to reduce its carbon footprint in the environment.

⁴ Note. In 2015, the UN General Assembly adopted the 2030 Agenda for Sustainable Development. It sets 17 key objectives to be achieved by 2030 in various areas, such as poverty eradication, planet conservation, world peace, sustainable consumption and production, etc. The chemical industry is considered to be one of the sectors that can make the greatest contribution to meeting the above objectives.

The European chemical industry plays a key role in meeting the EU's **circular economy** objectives. This is a concept whereby the value of products and materials is retained as long as possible; waste generation and resource utilization are minimized, and resources are retained in the economy when products reach the end of their life cycles and are repeatedly used to create added value (European Commission, 2015). One of its main goals is to use all raw materials, products and waste optimally, which will lead to increased energy savings and reduced greenhouse gas emissions (European Commission, 2018). Among the main factors impeding the achievement of the goals set in this field by the European chemical industry are: **the need for legislative changes, the lack of enough highly qualified specialists and the need for considerable financial resources to help enterprises in their transition to a circular economy**. The EU's main ambition is through legal reforms to achieve full coordination between legislation on implementing waste and chemical policies. Thus, the materials used are expected to be safe and have minimal impact on the environment. In addition to the regulatory changes in Community legislation, the transition to a circular economy also relates to the need to allocate immense financial resources for investing in new green and resource-saving technologies, research and development, etc. with the aim to create new business models for better product and waste management. Insufficient funding is one of the major factors impeding the transition of small and medium-sized enterprises in the chemical industry to a circular economy. Other challenges facing chemical companies in the field of circular economy also include: *finding highly qualified specialists and changing the production process so that better resource and waste management is achieved*. Other challenges are: insufficient awareness among managers and entrepreneurs, and a number of business representatives who are still conservative (afraid of the new, the unknown, the desire to avoid risks) (Ivanova, 2019, p.150).

The **circular economy** is one of the areas that will dictate a large number of the EU's policies in the coming years. This is because achieving the objectives in this area is expected to have a positive effect on the economic development of the Community and of the chemical enterprises within it in particular. The **positive effects** that will be achieved are as follows: *modernizing the industrial base of chemical enterprises, increasing their profits, investing in new technologies and innovations, which will stimulate the competitiveness of the industry in domestic as well as in external markets, creating new jobs, avoiding waste generation, creating products that will be more sustainable and economical while protecting and restoring the Community's natural capital at the same time*. Other positive effects are: *reducing the use of materials that are hazardous or difficult to recycle*;

developing products with better characteristics and longer life cycles; more efficient production processes that turn waste into resources by using new technologies, and providing incentives to reduce waste (Ivanova, 2019). All these can only be achieved through joint cooperation between the EU member states and the companies in the industry. Both regulatory and non-regulatory measures covering the entire product cycle are needed. We should mention that the transition to a low carbon and circular economy also requires the allocation of large amount of funding which is beyond the powers of particular companies. Governments of individual countries should also be involved and create projects and programmes stimulating enterprises in this direction. In our opinion, the EU efforts need to be consolidated in order to close the loop completely and to take full advantage of the benefits that circular economy offers to Community enterprises.

On a global scale, the chemical sector is part of the UN sustainable development goals, some of which include achieving the following: *environmentally friendly management of chemicals and waste throughout their life cycles; minimizing the release of hazardous chemicals and materials into the environment; reducing the negative effects of chemicals that are hazardous to human health and the environment; significantly reducing the number of deaths and diseases caused by the use of hazardous chemicals*. The European chemical industry has the responsibility to be one of the industries playing a key role in the transition to a more sustainable society. With the investments made in the sector each year, it can substantially contribute to achieving the global objectives in this area.

The challenges facing the European chemical industry presented in this part of the study show the direction it will orient to in the coming years and decades. Overcoming them is a complex process and requires ongoing and wide-ranging cooperation between the EU institutions, member states and the industry.

Conclusion

The following conclusions can be drawn as a result of the study carried out:

First, there is an increase in the share of chemical substances and products in the EU's overall exports and imports, which determines the growing importance of the sector to the European Union.

Second, Globally, the European chemical industry is still lagging behind China due to a variety of reasons, including the country's industrial policy and sector reforms.

Third, in the future, the industry will have to address a number of challenges in areas such as the environment, international competitiveness, the circular economy and sustainable development. They will also be among the main priorities when making various decisions for the development of the industry in the coming years. Overcoming them requires legislative changes, as well as joint efforts and close cooperation between the European Union, its institutions, the member states and the manufacturing companies. This is the only way that the EU will be able to continue to be among the global forces dictating the development of the chemical industry worldwide.

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