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DEPENDENCE ON CHEMICAL INDUSTRY PRODUCTS MADE FROM OIL AND GAS – ON THE WAY TO THE ANNIHILATION OF HUMANITY

UZALEŻNIENIE OD PRODUKTÓW PRZEMYSŁU CHEMICZNEGO WYTWARZANYCH Z ROPY NAFTOWEJ I GAZU ZIEMNEGO – W DRODZE DO ZAGŁADY LUDZKOŚCI

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Abstract: The study presents the consequences of economy's dependence on chemical industry products made from oil and gas. It is reported that the economy is becoming increasingly dependent on the specified products. Based on the NACE Rev2 classification, the author lists the possible implications for all sectors of the economy of the cutting-off of the supplies of chemical industry products made from oil and gas It is demonstrated that the major consequences of the shortage of such products will be borne by agriculture, health protection, transport, automotive industry and construction. The paper lists the oil and gas processing products which are strategic in terms of the economy. The absence of the products may create a global economic crisis and make human development regress by 250 years.
Keywords: chemical industry, oil, gas, peak oil, world economy, NACE Rev2

Streszczenie: W artykule przedstawiono konsekwencje uzależnienia gospodarki od produktów przemysłu chemicznego wytwarzanych z ropy naftowej i gazu ziemnego. Stwierdzono, że gospodarka w coraz większym stopniu uzależnia się od tych produktów. Bazując na klasyfikacji NACE Rev2 określono konsekwencje, jakie mogą ponieść wszystkie działy gospodarki w związku z odcięciem ich od dostaw produktów przemysłu chemicznego wytwarzanych z ropy naftowej i gazu ziemnego. Stwierdzono, że największe konsekwencje braku tych produktów poniesie rolnictwo, ochrona zdrowia, transport, przemysł samochodowy i budownictwo. Wskazano, jakie są strategiczne – z punktu widzenia gospodarki – produkty pochodzące z przetwórstwa ropy naftowej i gazu ziemnego. Stwierdzono, że brak tych produktów może spowodować globalny kryzys gospodarczy i cofnąć rozwój ludzkości o 250 lat.
Słowa kluczowe: przemysł chemiczny, ropa naftowa, gaz ziemny, peak oil, gospodarka światowa, NACE Rev2

Introduction

The Chemical Industry is presented as one of the most important sectors of the global economy. Its rapid growth compared to other branches and its speedy recovery following the pandemic is a source of pride on the part of the sector's enterprise managers. On the other hand, it has been subject to many attacks from environmental activists. One of the products of chemical processing – plastics – is the reason for which the Chemical Industry is considered to be one of the biggest polluters of the environment. Those attacking the Chemical Industry are right, for out of 8.3 billion m^3 tonnes of plastics produced so far, 6.3 billion have been turned into waste and only 9% of this figure has been recycled (Scruggs, 2019). This data, although alarming, provides an excellent backdrop for further considerations.

Since the term 'oil and gas processing' products will be used throughout the paper, the abbreviation OGPP (oil and gas processing products) is applied. The term should be understood as the products of the Chemical Industry derived from the processing of oil and gas, excluding fuels.

The term 'Peak oil' (Delannoya et al., 2021), coined by M.K. Hubbert, which is primarily associated with the lack of hydrocarbon fuels to power internal combustion engines, must necessarily be supplemented by the concept of 'peak plastic'. This term is derived from the

concept of peak oil; and it is imperative that it is introduced as the lack of OGPP would have a devastating impact, as will be demonstrated, on the entire global economy.

The aim, material and research methods

The paper is of a review nature. The aim of this paper is to show the extent to which the global economy is dependent on chemical processing products made from oil and gas. A hypothesis was put forward that a shortage of products manufactured by the Chemical Industry from oil and gas would, sooner than a shortage of fuels, lead to the collapse of the world economy and could be the cause of the annihilation of a significant part of humanity. An additional aim of this paper is to make the reader aware that every piece of plastic thrown into the rubbish not only pollutes the environment, but, above all, is another step on the way to self-destruction.

Based on the Polish Classification of Economic Activities (PKD, 2007), it was shown what the consequences would be for all sectors of the economy if they were suddenly deprived of OGPP[1]. This assumption is drastic, as we are not in danger of being cut off from oil and gas supplies overnight. However, it is certain that this will be the case in the future, as the resources of these raw materials will be exhausted. The global economy will face the problem of replacing chemical processing products derived from oil and gas with other products. The assumption of immediate cutting-off of the economy from OGPP was used to demonstrate the scale of an economy's dependence on the same.

Bibliography overview

1. Oil and gas processing products

The Chemical Industry produces materials that are essential to the functioning of the entire economy, hence it is linked to all industrial and service sectors (Mierzejewski, 2019). Analyss of the Chemical Industry is not easy because its structure is very complex and has been shaped by customs rather than logic. For example, petroleum processing (No. 19 in PKD) and production of chemicals (No. 20 in PKD) are considered separate industries, although they are based on a processing of the same raw material.

There is currently no sector of the economy that can operate regularly without chemical processing products (Scruggs, 2019, Sturz et al. 2018, Van Thien et al., 2016). The vast majority are highly processed products, although consumers also use unprocessed products. A good example is urea, which in its pure form serves as a nitrogen fertiliser used in agriculture and, after further processing, is used to obtain cleaning products, adhesives, building materials and cosmetics. Another of the products, ethylene glycol, is commonly used as a coolant and brake fluid in cars, heat exchange and air conditioning systems. Its processing yields many derivatives, used in the Textile, Pharmaceutical and Cosmetic industries and as emulsifiers in plant protection products. In the form of fibreglass, it forms the sheathing of scooters, yachts, bathtubs. It is also used to separate oil into individual fractions (demulsifier). Ethylene glycol is just one example of how products manufactured in chemical processing are used by the same Chemical Industry to produce other products. Hence, the Chemical Industry itself is a significant consumer of the products it produces.

Average consumers do not notice that the goods they are buying are the end result of many chemical and technological processes. They are also unaware of how many of the final chemical processing products are included in the equipment they buy, such as computers, home appliances, household appliances, cars and many other everyday products. Figures 1-4 show the main products manufactured by chemical synthesis from oil and gas.

According to the current classification, the Chemical Industry comprises 4 basic production areas (Mierzejewski, 2019):

1) production of bulk chemicals (so-called "large-scale chemistry") – includes high-volume and mass-use products (excluding fuels), consisting of plastics, fertilisers and nitrogen compounds, technical gases, chemical fibres, dyes and pigments, synthetic rubber, other basic organic and inorganic chemicals;
2) chemical processing – involves the manufacture of end products based on high-volume products, including plastic and synthetic rubber products, paints, varnishes, adhesives, fragrances;
3) fuels;
4) low-volume chemistry – includes high-margin products manufactured in small quantities, which include pharmaceuticals, household chemicals (e.g. soaps, cosmetics), plant protection products.

[1] PKD 2007 is compliant with the division of the world economy. It is based on the statistical classification of economic activities NACE Rev2, introduced by Regulation (EC) No 1893/2006 of the European Parliament and of the Council of 20 December 2006 on the statistical classification of economic activities NACE Rev 2.

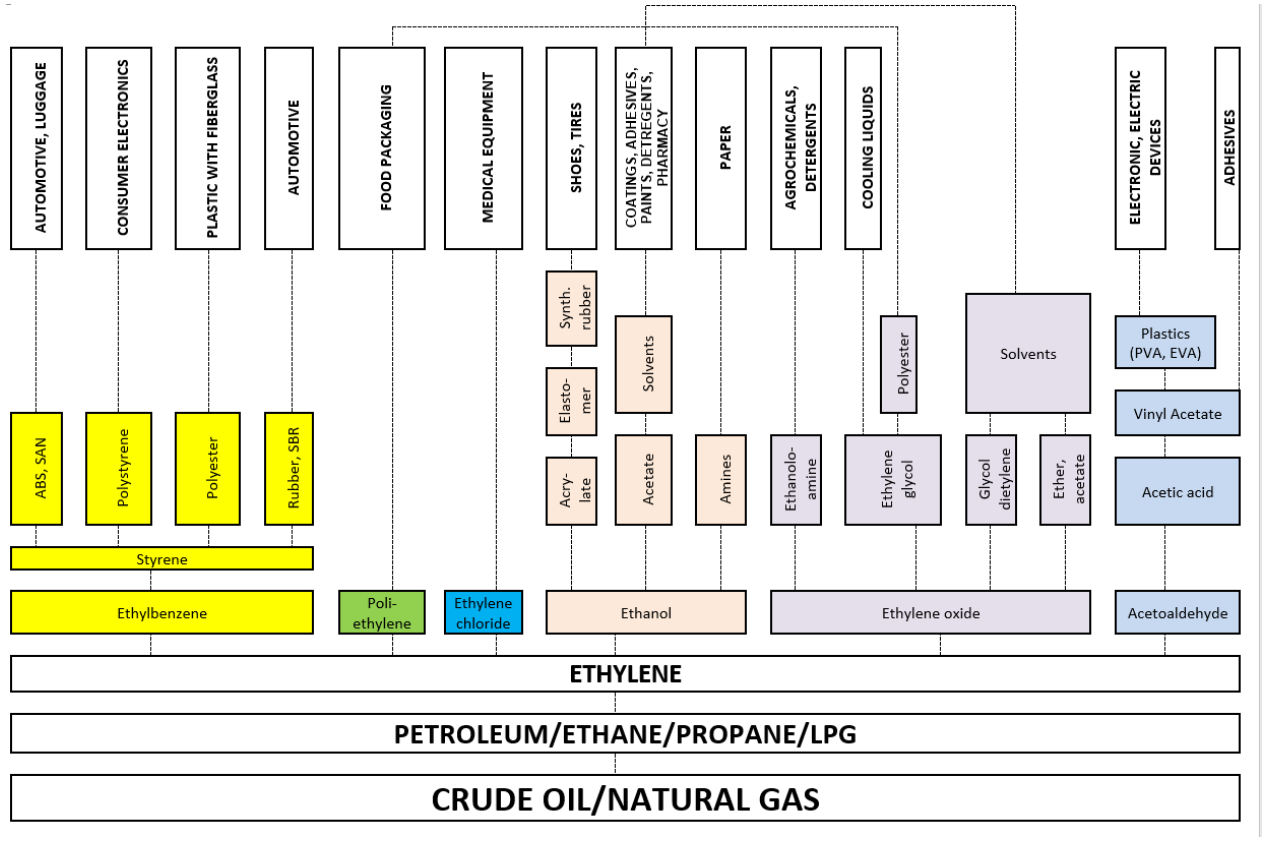

Figure 1. Ethylene processing products

Source: author's own studies based on: Chemical Industry in Poland. Position, challenges, prospects. PIPC, Warsaw 2017.

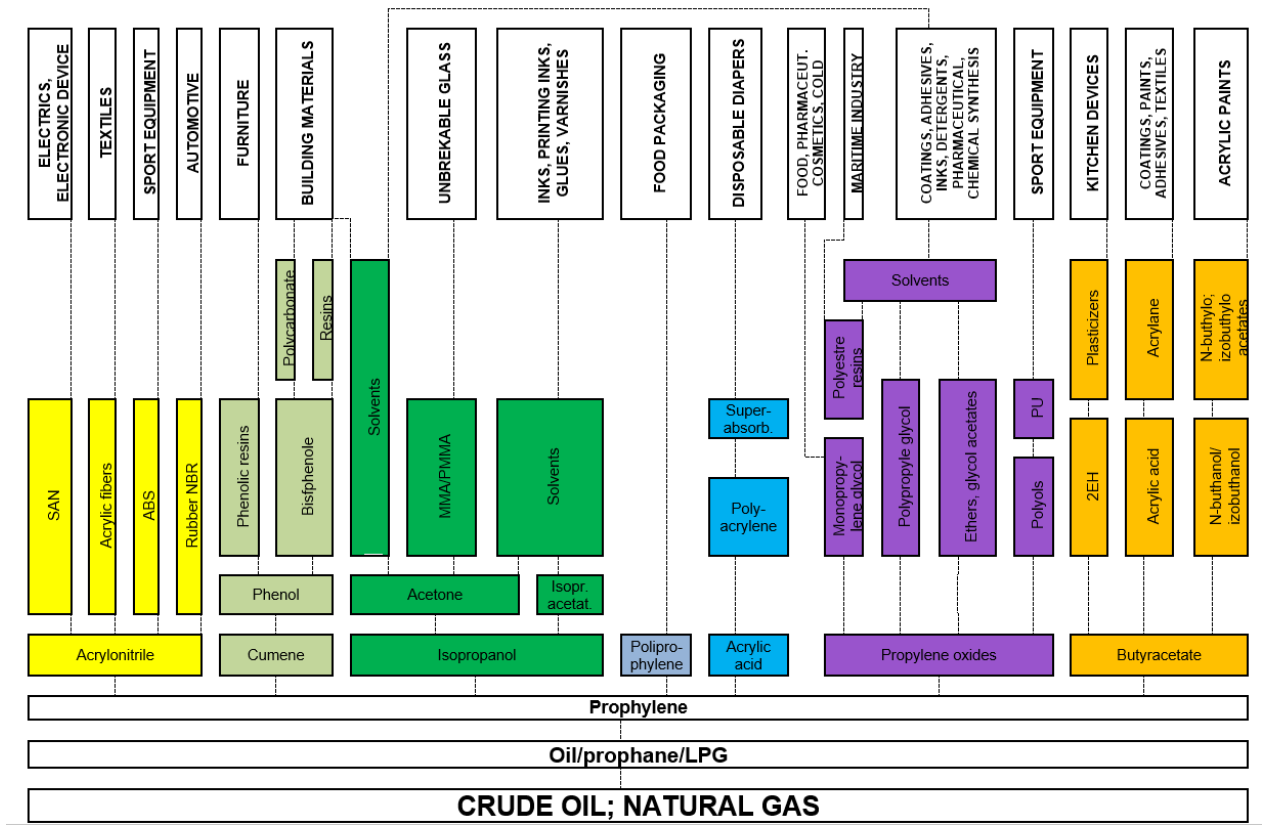

Figure 2. Propylene processing products

Source: author's own studies based on: Chemical Industry in Poland. Position, challenges, prospects. PIPC, Warsaw 2017.

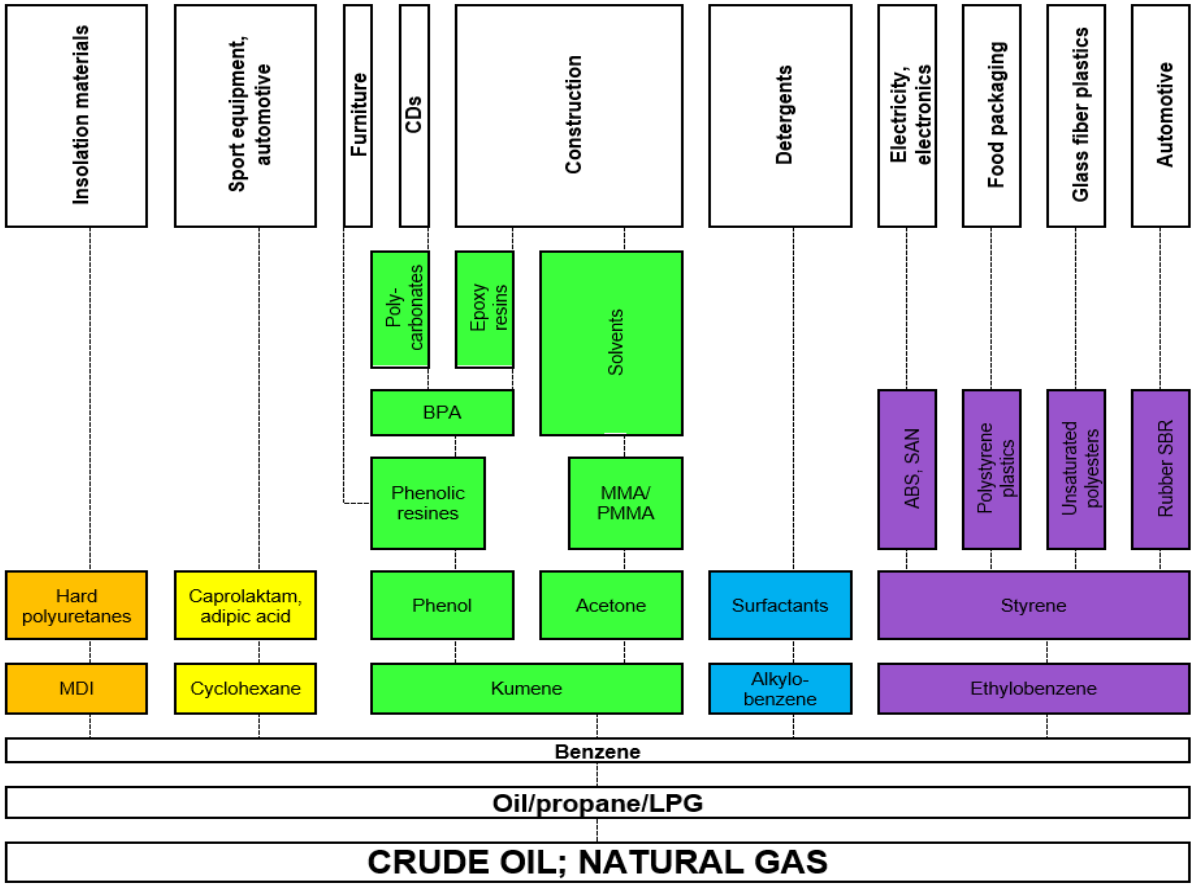

Figure 3. Benzene processing products
Source: author's own studies based on: Chemical Industry in Poland. Position, challenges, prospects. PIPC, Warsaw 2017.

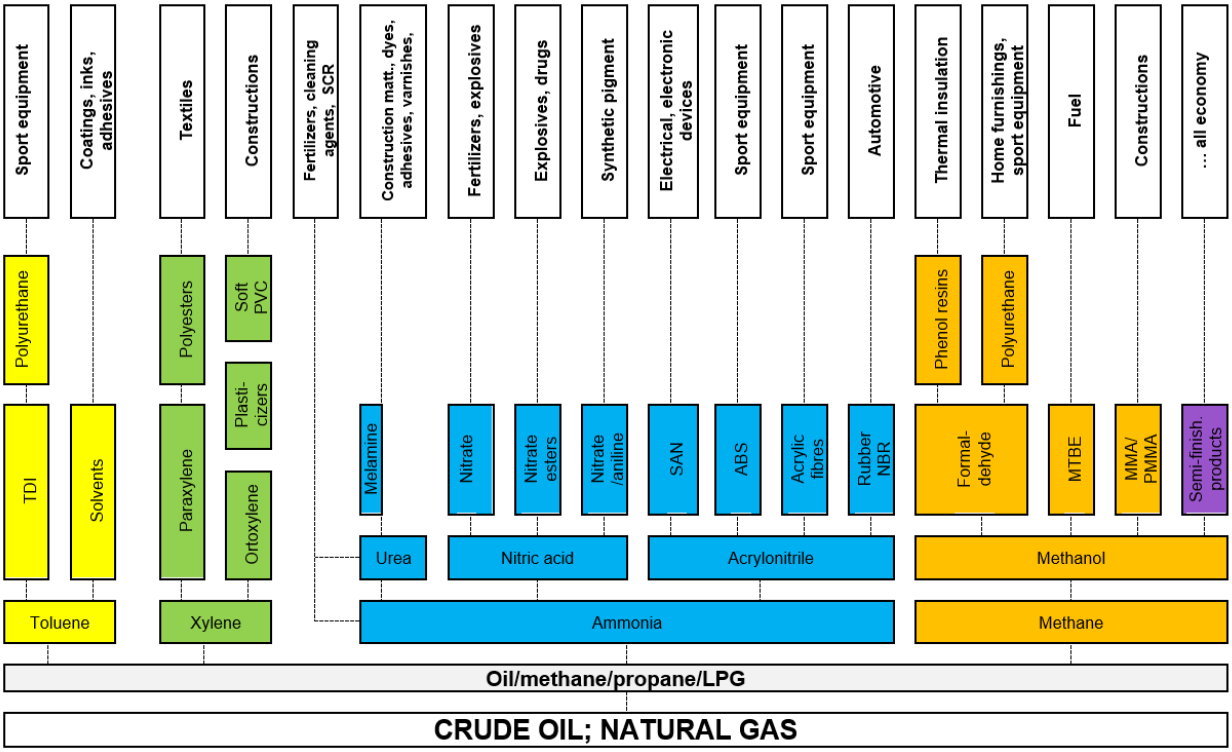

Figure 4. Toluene, xylene, ammonia and methane processing products
Source: author's own studies based on: Chemical Industry in Poland. Position, challenges, prospects. PIPC, Warsaw 2017.

The basis of chemical production is mineral raw materials. Globally, about 85% of all substances produced in the Chemical Industry across the value chain are organic chemicals based on hydrocarbons derived from natural gas and oil. The basis substances used in this production include the following (PIPC, 2017):

1) ethylene, used to produce ethylbenzene, polyethylene, ethyl chloride, ethanol, ethylene oxide and acetaldehyde,
2) propylene, used to produce acrylonitrile, cumene, isopropanol, polypropylene, acrylic acid, propylene oxide and butyric aldehyde,
3) benzene used to produce MDI, cyclohexane, cumene, alkylbenzene and ethylbenzene,
4) methane and propane which are the basis for the production of toluene, xylene, and ammonia.

The main raw materials, semi-finished products and final products from the processing of these hydrocarbons are shown in figures 1-4. Other mineral raw materials such as phosphorus, sulphur, potassium, etc. are also used for the needs of chemical production. Coal is also an important raw material from the point of view of chemical processing (Allardice, Newell, 1991).

2. The Chemical Industry around the world

The growth of the Chemical Industry worldwide must be considered from the perspective of human population size and energy consumption (Johnstone, 2020; Worldwatch...) Human population growth over the last 200 years has been very dynamic. The population increased from 888 million in 1810 to 7,794 million in 2021 (Fig. 6). Since the beginning of the 20th century, there has been an exponential increase in energy consumption in all forms (Fig. 5). It can be argued that global population growth has been made possible by an exponential increase in the use of available energy sources and raw materials, derived from coal, oil, natural gas, biomass and nuclear power (Martin-Amoroux, 2012; Lescaroux, 2010). At present, the average energy consumption per capita is 1823 kg of oil equivalent. Compared to 1900, when consumption was estimated at 681 kg, there has been an almost 3-fold increase in consumption. These trends are illustrated in Figure 6.

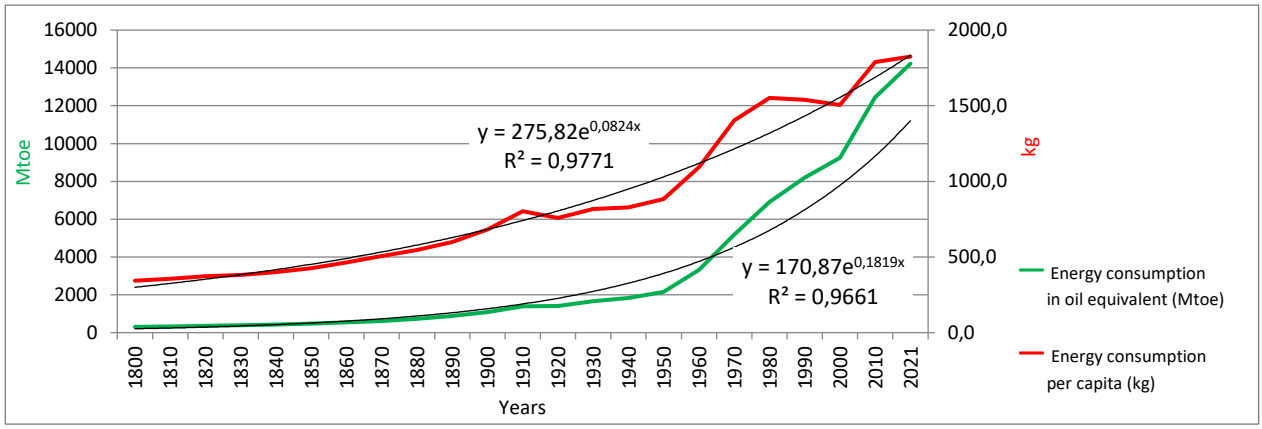

Figure 5. World energy consumption in oil equivalent in the years 1800-2021
Source: author's own studies based on Martin-Amoroux, 2012, World Energy & Climate Statistics – Yearbook 2022, worldometer.com.

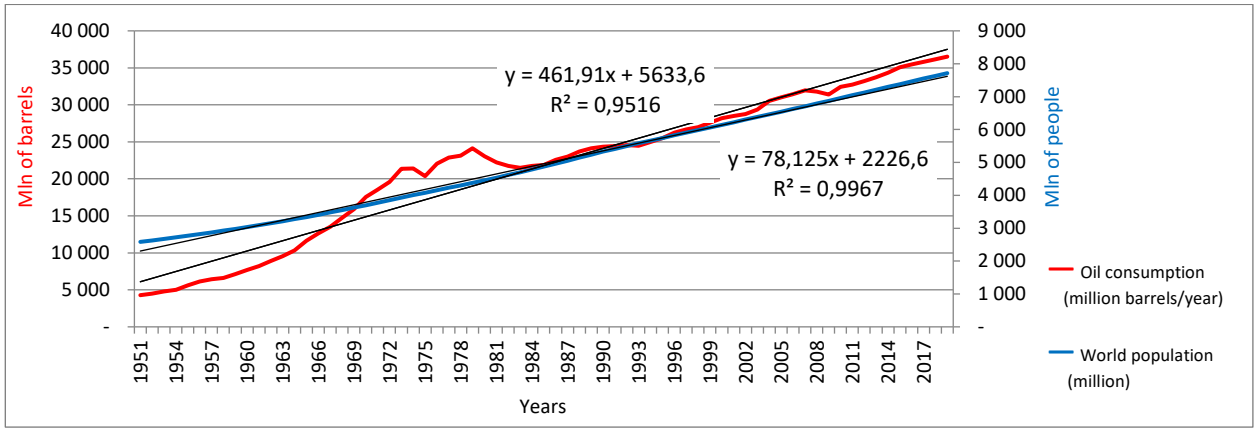

Figure 6. Oil consumption against world population growth 1951-2020
Source: author's own studies.

A high correlation was noted between population growth and oil consumption growth. After the crisis on the oil market in 1983, the correlation coefficient R2 was 0.995 (Table 1). This means an almost perfect match between these variables. It can be said with a high degree of certainty that the increase in oil production created favourable conditions for population growth.

Table 1. Relationship between population growth and global oil consumption (Pearson correlation coefficient)

Period	R^2
From 1950	0.965
From 1983	0.995

It is important to be aware that a greater proportion of the extracted oil and gas is consumed for chemical processing than for fuel production and heating. In the case of the Polish economy, fuel production accounts for only 20.3% of the value of the entire Chemical Industry. The industry consumes about 70% of the total volume of natural gas, much of which is used by chemical processing. Households consume only 30% of the total volume of natural gas.

The value of the global sales of Chemical Industry products was $5.7 trillion in 2022. This constitutes 5.6% of global GDP (Scruggs, 2019). It is estimated that in 2030 the sold value of the Chemical Industry will be €6.3 trillion.

The multi-year trend analysis reveals that the development of the chemical sector fits perfectly into the concept based on economic growth. From 1950 onwards, the average growth in chemical production has been 8.5% per year. This is primarily related to a steady increase in oil consumption, which amounted to 461.91 million barrels per year (Fig. 6).

3. The Chemical Industry in Poland

The Chemical Industry in Poland is made up of a network of around 13 thousand enterprises (Table 2). The branch employed 335 thousand people in 2021 and a steady increase in the number of employees has been observed. In 2005, there were 212 thousand people employed and in 2022 there were already 335 thousand, which means an increase of as much as 58%, with an increase in the number of employees of 3.4% per year.

The value of the Chemical Industry's sold production in Poland has increased steadily. In 2005, sales amounted to PLN 71.7 billion to reach PLN 341.3 billion in 2021. In nominal terms, this represents a 476% increase, with an average annual growth dynamics of as much as 28%.

The Chemical Industry is among the leaders of the economy as regards the amount of capital expenditure incurred. Between 2018 and 2021, an increase in capital expenditure of PLN 3.1 billion, or 24.1%, was observed.

Table 2. Basic indicators concerning the performance of the Chemical Industry in Poland

No.	Details	Years				
		2021	2020	2019	2018	2005
1.	Value of the production sold (billions of PLN)	341.3	245.4	266.3	264.8	71.7
2.	Number of employees (thousands of people)	335	323	327	315	212.2
3.	Number of enterprises			about 13,000		
4.	Capital expenditure (billions of PLN)	15.9	15.4	14.3	12.8	no data

Source: author's own studies based on: PIPC reports for the years 2005-2022.

Table 3. Structure of the sales of Chemical Industry products in Poland (PLN billion)

No.	Details	Years				
		2021	2020	2019	2018	2017
	According to PIPC classification					
1.	Production of bulk chemicals	54.2	37.45	41.74	39.9	no data
2.	Chemical processing	125.6	100.06	99.14	92.1	no data
3.	Refined oil products	69.2	69.2	91.5	80.3	no data
4.	Low-volume chemistry	27.7	27.05	24.72	27.1	no data
	According to GUS classification					
1.	Rubber and plastic products	105.7	84.7	84.8	83.1	78.3
2.	Manufacture of coke and refined oil products	107.2	74.9	99.7	98.9	88.1
3.	Manufacture of pharmaceutical products	12.0	11.4	10.9	10.5	13.5
4.	Manufacture of chemicals and chemical products	89.6	68.4	70.0	67.4	65.8

Source: author's own studies based on: 1) Manufacturing of industrial products in the years 2017-2021. The Central Statistical Office (GUS), Warszawa 2022; 2) PIPC reports for the years 2017-2022.

The analysis of the sales structure of Chemical Industry products between 2018 and 2021 shows that the share of the value of refined oil products such as fuels, oils and lubricants decreased in Poland (Fig. 7). The share of low-volume products in the sales structure also decreased. A significant growth was observed in the categories of chemical processing products and bulk chemicals.

In Figure 8, a trend can be seen that is important as regards the aim of this paper. Based on the example of the Chemical Industry in Poland, an opening of the scissors was observed between the share of fuel production in the sales structure and the total value of chemical processing production sold. This means that every year the economy uses more and more crude oil and natural gas for the production of non-fuel products. In this way the economy is becoming increasingly to OGPP products.

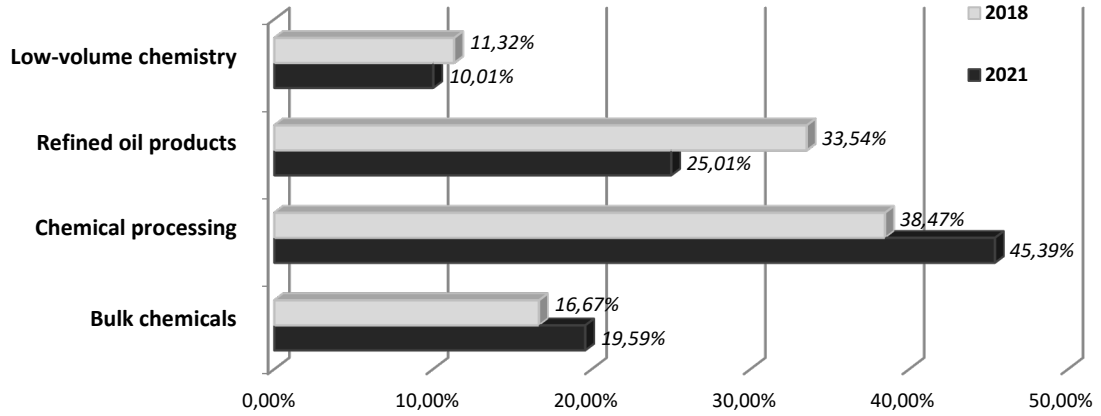

Figure 7. Structure of the sales of Chemical Industry products in Poland (PLN billion)
Source: author's own studies.

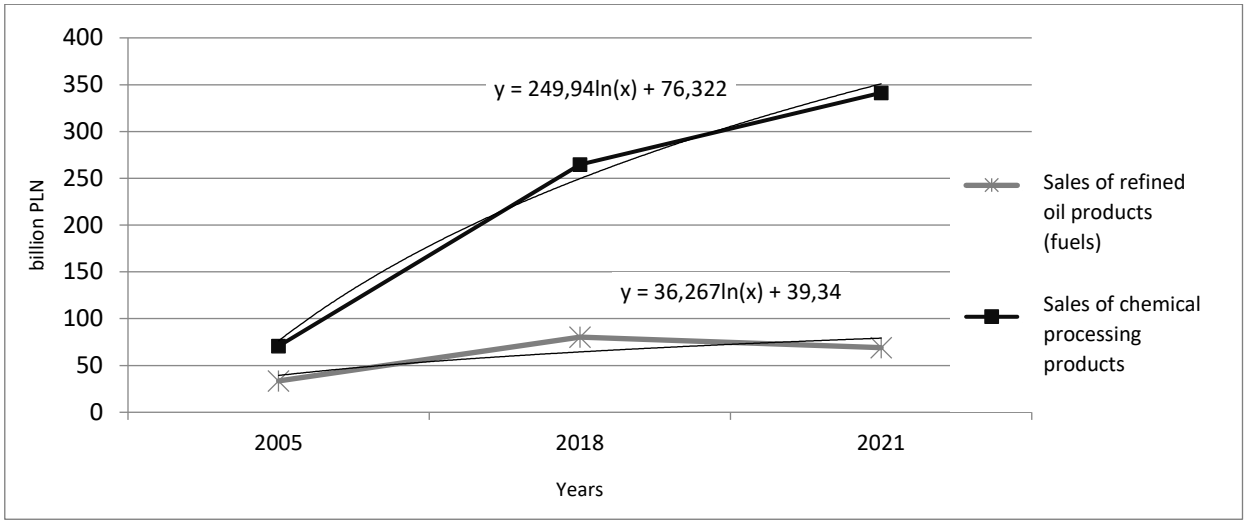

Figure 8. Sales of fuels and Chemical Industry products in Poland
Source: author's own studies.

Research findings – consequences of the lack of OGPP for the economy

Table 4 shows the main sectors of the economy involved in oil and gas processing, classified in PKD 2007 under numbers 20 and 22. This table shows the direct link between the products manufactured by the Chemical Processing Industry and the relevant economic sector. Indirect links are not shown, as in this case all sectors of the economy would have to be included.

Table 4. The basic products of the Chemical Industry, derived from the processing of oil and gas, according to the Polish Classification of Economic Activities (PKD) and their use by other sectors of the economy

Department no.	Name of Economy Sector	Direct links with other sectors of the economy
20	Manufacture of chemicals and chemical products	
20.1	Manufacture of basic chemicals, fertilisers and nitrogen compounds, plastics and synthetic rubber in primary forms	01, 02, 03, 05-09, 10,11,13,14, 17,18, 23, 26, 27, 29-33, 35, 36-39, 41-43, 45-47, 49-53, 55-56, 58, 59, 60-63, 75, 81, 82, 83, 85, 86, 87-88, 90, 91, 93, 95
20.2	Manufacture of pesticides and other agrochemical products	01, 02, 03, 10, 13, 56, 81
20.3	Manufacture of paints, varnishes and similar coatings, printing ink and mastics	01-03, 15-18, 25- 33, 41-43, 52, 58, 59, 72, 81, 82, 86, 88, 90,
20.4	Manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations	01-03, 05-09, 15, 17-23, 33, 36-39, 41-43, 45-47, 52, 55, 56, 75, 86-88, 93
20.5	Manufacture of other chemical products (explosives, glues, essential oils, other chemical products n.e.c.,	01-03, 05-09, 10-12, 15, 33, 41-43, 85, 86
20.6	Manufacture of man-made fibres	01-03, 05-09, 13, 14, 33, 41-43, 73, 86, 95
22	Manufacture of rubber and plastic products	
22.1	Manufacture of rubber products	01-95
22.2	Manufacture of plastics products- plastic plates, sheets, tubes and profiles, plastic packing goods, builders' ware of plastic, other plastic products	01-95

Source: author's own studies.

The semi-finished produced made from oil and natural gas, after further processing, are distributed to consumers as:

1. Agrochemicals,
2. Luggage,
3. Dyes,
4. Detergents,
5. Printing inks,
6. Paints,
7. Thermal insulation,
8. Adhesives,
9. Cosmetics,
10. Varnishes,
11. Medications,
12. Construction materials,
13. Insulation materials,
14. Explosives,
15. Furniture,
16. Mineral fertilisers,
17. Unbreakable glass,
18. Clothes,
19. Sport clothes,
20. Food packaging,
21. Tyres,
22. Fuel,
23. Paper,
24. Disposable diapers,
25. Coolants,
26. CDs,
27. Coatings,
28. Construction products,
29. Chemical synthesis products,
30. Automotive products,
31. Maritime Industry products,
32. Pharmaceutical products,
33. SCR,
34. Kitchen equipment, household appliances,
35. Medical equipment
36. Sport equipment
37. Artificial dyes,
38. Cleaning agents,
39. Pharmaceutical agents,
40. Textiles,
41. Inks,
42. Fibreglass materials,
43. Electronic equipment,
44. Electrical equipment,
45. Household equipment,
46. Food.

Table 5 shows the consequences that each of the economic sectors – ranked according to the Polish Classification of Economic Activities 2007 – would face if they were deprived of access to OGPP. The assumption made is that the sector could function without chemical processing products made from oil and gas: undisturbed, with minor problems, with major problems, could not function without these products.

A number of options are highlighted in relation to individual sectors. It is important to be aware that production varies greatly between individual sectors. Within each sector, there are branches that would do better without chemical processing products, but there are also branches that could not function at all without these same products.

Table 5. The ability of individual industry branches to produce goods and provide services in the absence of materials and raw materials derived from OGPP which are later used as raw materials or commodities in the production process in individual sectors

Department no.	Name of Economy Branch	Branch's ability to function			
		Possible	Impeded	Largely Impeded	Impossible
01	Crop and animal production, hunting and related service activities			X	X
02	Forestry and logging			X	X
03	Fishing and aquaculture			X	
05	Mining of coal and lignite			X	
06	Extraction of crude petroleum and natural gas			X	
07	Mining of metal ores			X	
08	Other mining and quarrying			X	
09	Mining support service activities			X	X
10	Manufacture of food products			X	X
11	Manufacture of beverages			X	X
12	Manufacture of tobacco products		X		
13	Manufacture of textiles			X	X
12	Manufacture of wearing apparel			X	X
15	Manufacture of leather and related products	X	X		
16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials		X		
17	Manufacture of paper and paper products			X	
18	Printing and reproduction of recorded media			X	X
19	Manufacture of coke and refined petroleum products			X	X
20	Manufacture of chemicals and chemical products				X
21	Manufacture of basic pharmaceutical products and pharmaceutical preparations			X	X
22	Manufacture of rubber and plastic products				X
23	Manufacture of other non-metallic mineral products			X	
24	Manufacture of basic metals		X		
25	Manufacture of fabricated metal products, except machinery and equipment	X	X		
26	Manufacture of computer, electronic and optical products			X	X
27	Manufacture of electrical equipment			X	X
28	Manufacture of machinery and equipment n.e.c.			X	X
29	Manufacture of motor vehicles, trailers and semi-trailers			X	X
20	Manufacture of other transport equipment			X	
31	Manufacture of furniture			X	X
33	Repair and installation of machinery and equipment			X	X
25	Electricity, gas, steam and air conditioning supply			X	
36	Water collection, treatment and supply			X	X
37	Sewerage			X	X
38	Waste collection, treatment and disposal activities; materials recovery			X	X
39	Remediation activities and other waste management services			X	X
41	Construction of buildings			X	X
42	Civil engineering			X	X
43	Specialised construction activities			X	X
35	Wholesale and retail trade and repair of motor vehicles and motorcycles			X	X
46	Wholesale trade, except of motor vehicles and motorcycles			X	X
47	Retail trade, except of motor vehicles and motorcycles			X	X
49	Land transport and transport via pipelines			X	X
50	Water transport			X	
51	Air transport			X	X
52	Warehousing and support activities for transportation			X	X
53	Postal and courier activities			X	X
55	Accommodation		X	X	
56	Food and beverage service activities		X	X	

58	Publishing activities			X	
59	Motion picture, video and television programme production, sound recording and music publishing activities			X	
60	Programming and broadcasting activities		X		
61	Telecommunications			X	
62	Computer programming, consultancy and related activities		X		
63	Information service activities			X	
64	Financial service activities, except insurance and pension funding			X	
65	Insurance, reinsurance and pension funding, except compulsory social security			X	
66	Activities auxiliary to financial services and insurance activities			X	
68	Real estate activities			X	
69	Legal and accounting activities			X	
70	Activities of head offices; management consultancy activities		x		
71	Architectural and engineering activities; technical testing and analysis			X	
72	Scientific research and development			X	
73	Advertising and market research			X	X
74	Other professional, scientific and technical activities			X	
75	Veterinary activities			X	X
77	Rental and leasing activities	X			
78	Employment activities	X			
79	Travel agency, tour operator reservation service and related activities			X	X
80	Security and investigation activities	X			
81	Services to buildings and landscape activities			X	
82	Office administrative, office support and other business support activities			X	
84	Public administration and defence; compulsory social security			X	
85	Education			X	
86	Human health activities			X	X
87	Residential care activities		X		
88	Social work activities without accommodation		X		
90	Creative, arts and entertainment activities		X	X	X
91	Libraries, archives, museums and other cultural activities	X	X		
92	Gambling and betting activities	X			
93	Sports activities and amusement and recreation activities			X	X
94	Activities of membership organisations	X			
95	Repair of computers and personal and household goods			X	X

Source: author's own studies.

Often a situation can be encountered where the absence of a small plastic component, worth a few tens of Polish groszy, leads to an immobilisation of the entire device. This shows how important OGPP are in the economy and in everyone's everyday life.

The effects of the lack of OGPP for selected economic sectors will be presented here (Table 5). The focus is on the most important sectors of the economy from the point of view of securing basic human needs. A description of all the consequences of the absence of OGPP is well beyond the scope of this article. Remedial action should be taken to offset the effects of the lack of OGPP on the global economy

The effect of cutting the economy off from the OGPP resulting in the greatest consequences, would see, in the first instance, a large drop in agricultural productivity (01 in Table 5). A shortage of the basic raw materials, urea and ammonium nitrate, would lead to a decline in the yields of all crops – cereals, root crops, fodder crops, industrial crops and crops used as animal feeds. It will be much more difficult, and often even impossible, to protect crops from diseases and pests. Most pesticides used in agriculture are OGPP. In this situation, there will be a decline in productivity and yields may fall to pre-World War II levels. In the case of Poland, the average wheat yield in 2022 was 4800 kg/ha and in 1938 – 1240 kg/ha (Preliminary estimate..., 2022, Small..., 1939). This represents an almost 4-fold decrease in yield. The consequence could be mass starvation around the world. Unfortunately, there are currently no substitutes for nitrogen fertilisers that can be produced on such a large scale to replace those

made from OGPP. However, one should not bury one's head in the sand without noticing the problem. Finding substitutes for nitrogenous fertilisers produced from OGPP is a priority task that science is facing to enable the survival of humanity.

The absence of the OGPP will be strongly felt by health care (86). Without sterile disposable gloves, test kits, syringes, drips, catheters, blood containers, ventilators, implants, valves, etc. used in huge quantities every day, there will be a breakdown in medical care in hospitals, intensive care units and rehabilitation facilities. Healthcare is one of the largest recipients of single-use OGPP.

In such a scenario there would be a breakdown in road transport (49), caused by a shortage of tyres for vehicles of all types: cars, trucks, agricultural machinery, construction equipment, bicycles, motorbikes and many, many more. Air transport will also be affected by the tyre shortage. Although rail and sea transport will be feasible, it will not be possible to distribute goods to transhipment points and to the end user, as only road transport is used for this purpose. Virtually all e-commerce will collapse, due to the inability to deliver products directly to the consumer. The efforts currently being made to replace hydrocarbon-powered vehicles with electric motors will be of little use if these vehicles do not have tyres to run on. In the absence of the ability to move goods and provide services, the entire global economy will collapse.

Another major consequence for all sectors of the economy would be the absence of insulation for electrical wires. These wires are the basis for the operation of all DC and AC electrical equipment without exception, such as electrical installations in buildings, road, water and air transport, electronic equipment, household appliances, workshop tools, mining machinery, space shuttles, health-related equipment and many others, too numerous to mention in this study. There is no sector of the economy that does not currently make direct or indirect use of insulated electrical wires.

Like the lack of insulation for electrical cables, most mechanical equipment will be immobilised due to the lack of gaskets, transmission belts, tubes and containers manufactured from OGPP. The consequences will be borne practically by the whole economy.

Crucial products made from OGPP are shoe soles. Their absence will virtually halt footwear production. One must be aware of the fact that, apart from the soles, other parts of modern footwear are also made from OGPP. The sports and rubber footwear market will be particularly affected by the collapse. It is possible to replace plastics with leather, but the amount is limited. It will be impossible to produce footwear on the scale that is currently done using OGPP.

A major implication for the food (10) and beverage production (11) sectors will be the lack of plastic packaging. These sectors have become dependent on plastics made from OGPP in recent years. The trade and distribution of food and drinks in their current form, based on small unit packages that are immediately discarded after opening and consumption, will collapse. For many consumers, the absence of Coca Cola and Pepsi may come as a shock. It is important to be aware that these two companies are the world's largest consumers of plastic bottles. The distribution of cosmetics and cleaning products (20) will collapse because it relies on plastic packaging. The largest consumer of these packages worldwide is Unilever (breakfreefromplastic…2023).

The Automotive, Aerospace, Rail and Transport Equipment, and Manufacturing industries would face collapse (29, 30). Today, the interiors of cars, planes and trains consist almost entirely of OGPP. This collapse would be exacerbated by the lack of electrical wires and tyres, preventing these sectors from functioning.

The Construction Industry would collapse (41, 42, 43), due to a shortage of adhesives, paints, window and door frames, polystyrene, silicone and the huge amount of other OGPP used in this sector of the economy.

The lack of OGPP would deeply affect the Textile and Clothing Industry (13, 14, 15). The lack of polyester fibres would lead to a collapse of the market of sportswear and sports equipment made from plastics (93).

The collapse of these sectors would subsequently cause the collapse of other branches of the economy. The toy market – blocks, dolls, mechanical toys – would virtually cease to exist. It will be impossible to buy tights, to get nail tips or false eyelashes. Disposable diapers will vanish and fireworks will become unavailable. There will be a clampdown on the production of weapons and explosives.

Cutting off these sectors of the economy from OGPP, which are the basis for their functioning, would represent the beginning of the collapse of the entire economic structure created over the last 250 years (Fig. 9A). Once the negative phenomena in the economy begins, a financial crisis will set in, which will worsen as the shortage of OGPP increases in more sections of the economy. Its scale will be unimaginable. Black

Thursday of 24 October 1929, the financial crisis of 2008, or the crisis caused by COVID 19 in 2020, could be considered as child's play in the face of this real economic tsunami. Whether it is called a plastic crisis, a plastic Armageddon, or some other name, it will not matter. One thing is certain – its scale will be unimaginable and the consequences for humanity very severe. If this is not remedied in time, the economy will regress in its development by 250 years, to the pre-industrial revolution period (Fig. 9B).

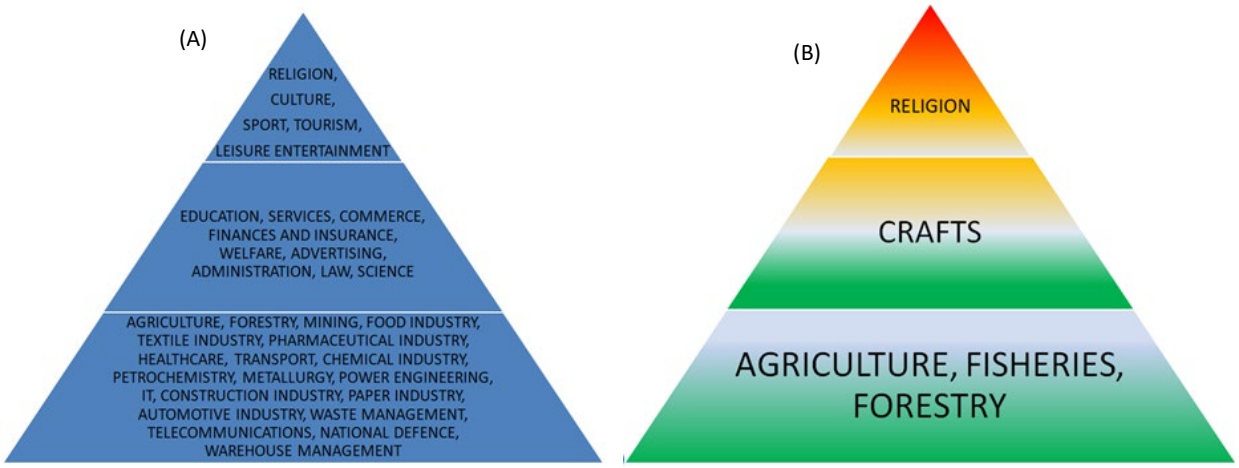

Figure 9. Structure of the economy before (A) and after (B) the peak plastic crisis
Source: author's own studies.

Summary and conclusions

The analysis of the material in this paper suggests the conclusion that virtually the entire economy has become more or less dependent on OGPP. The scale of this dependency is continually increasing, as the Chemical Industry offers consumers ever better and cheaper products, which end users are happy to use. On the basis of the analysis of the links between OGPP and various sectors of the economy, we can identify a group of products of strategic importance to the economy. These may include the following:

1) tyres, inner tubes
2) electrical wire insulation,
3) transmission belts, gaskets, sealants,
4) tubes and containers made of PVC.

The lack of these products, in addition to the nitrogen fertilisers and pesticides mentioned earlier, prevents the operation of all, without exception, electrical, electronic, combustion and mechanical equipment in all sectors of the economy. These products ought to be treated as strategic and their availability should be secured first. An analysis of the OGPP should therefore be carried out in terms of:

1) hierarchy of the production of individual goods for the economy and consumers,
2) their recyclability and the availability of substitutes,
3) replacement of these products by such that are not derived from the synthesis of oil and natural gas (essentialchemicalindustry, 2023).

That task cannot be delayed because, in the long term, it is not only a question of the functioning of the entire global economy, but a question of the survival of the human race. Appropriate actions taken now will help to offset the negative effects of the lack of OGPP.

This analysis also shows that the approach to OGPP needs to alter. OGPP are derived from non-renewable raw materials. At the current stage of economic development, given the volumes of their consumption, there is little possibility of replacing them with other products. Knowing the consequences of not having these products, we should respect all OGPP. Above all, their single use should be abandoned, and this should not be based on goodwill but rather on appropriate regulations. There should also be a worldwide campaign making people aware that the use of disposable OGPP is not only an environmental issue, but above all a question of the human race's survival. If we do not change our attitude within this scope, the annihilation may not take place in some unspecified future but may take place while we are still alive or in the lifetime of our children.

A large portion of the public is aware that the excessive use of plastics derived from OGPP is harmful to the environment. However, few people realise that the disposable use of these products and the lack of recycling is a simple path toward the annihilation of humanity. It is therefore necessary to introduce, along the lines of environmental regulations, selective collection of chemical processing waste and to develop methods for recycling the same. The manufacturing philosophy in the industry must also change. The production of perishable single-use goods for short-term profits should be abandoned in favour of the production of durable goods that can be used for many years and repaired without problems.

Observing today's economy and society's behaviour, one gets the impression that we are living in a drug-induced dream, unaware of the effects of the OGPP addiction. While the Chemical Industry is behaving like a drug dealer, making us more and more dependent on its products. Depriving the economy of OGPP will set back human development by 250 years. Oil and natural gas are non-renewable resources. It should therefore be considered extremely irresponsible to use a significant proportion of these products in a 'use it and throw it away' form. This is not only the case with plastic packaging and bottles, but also with other products in everyday life that are discarded as waste at the end of their usability period. There can be no doubt that our prosperity, well-being and wealth have been built primarily on OGPP. Humanity faces a huge challenge. It is not only a question of sustaining the current rate of development, but of achieving a level of development that does not lead to a collapse of the economy. Time is short and it is only to be hoped that there is enough of it so that peak plastic does not turn into peak people and ruin our world.

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