Eurasian Development Bank

Petrochemical Industry in Eurasia: Opportunities for Deeper Processing

Reports and Working Papers 24/4

Almaty — 2024

PETROCHEMICAL INDUSTRY IN EURASIA: OPPORTUNITIES FOR DEEPER PROCESSING

KEY FINDINGS

ANALYTICAL REPORT'24

PETROCHEMICAL INDUSTRY CONTRIBUTES SIGNIFICANT ECONOMIC BENEFITS

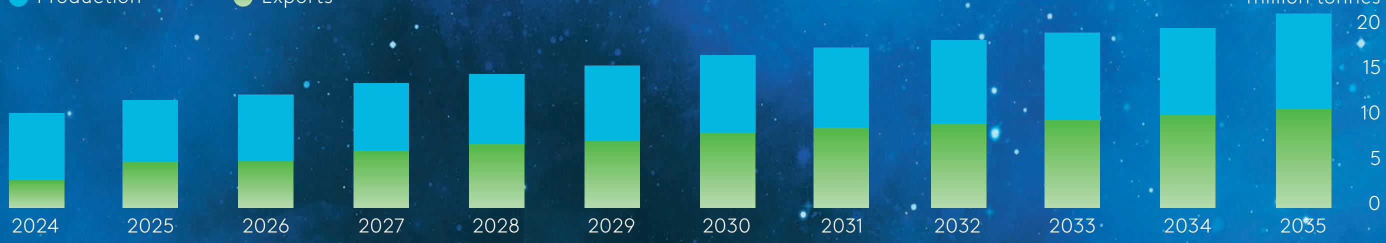
Cumulative GDP growth of **$153** billion in the region

3.2-fold increase in polymer exports

$12 billion annual growth in polymer production

5.8% annual industry growth

Target forecast for polymers in the region



PETROCHEMICAL INDUSTRY – ONE OF THE TOOLS TO OVERCOME THE INERTIAL DEVELOPMENT RUT

Promotes qualitative diversification

$2.62 increase in gross economic output per $1 of petrochemical production

Stimulates the creation of knowledge-intensive related industries

2–7 jobs in the economy for every 1 job in the petrochemical industry

Localisation of value added

20× price difference between feedstock and finished products

Finished product (PE pipes) $2.500–3.700 per tonne

Polyethylene (Stage III) $1.600–1.800 per tonne

Ethylene (Stage II) $600 per tonne

Ethane (Stage I) $80–90 per tonne

PRIORITY ACTIONS TO UNLOCK THE POTENTIAL OF THE EURASIAN PETROCHEMICAL INDUSTRY

- **Create modern petrochemical clusters** in natural centres of strong economic attraction **as the main development route**
- Focus project implementation on **innovative low-tonnage petrochemicals**
- Introduce **circular economy mechanisms**
- **Provide transport and logistics solutions** for export
- **Using the international status of MDBs** to attract investment capital to the industry

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Ahunbaev, A., Adakhayev, A., Chuyev, S., Ignatov, S., Prozorova, M. Pechenskaya-Polishchuk, M., Lukin, E., Polzikov, D. (2024). *Petrochemical Industry in Eurasia: Opportunities for Deeper Processing*. Reports and Working Papers 24/4. Almaty: Eurasian Development Bank.

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Abstract

The petrochemical industry is an important sector of the global economy. Today it is undergoing a major structural change. There is an ongoing energy transition that is closely linked to a deeper transformation of petrochemical products. Demand is shifting to developing countries, particularly the Asia-Pacific region and India. The Eurasian region's geographical proximity to the large emerging Asian markets offers great opportunities. If these opportunities are properly exploited, production and exports of commodity polymers could more than triple by 2035. However, our diagnostic has identified certain challenges and constraints. Addressing these will require an integrated approach. The main ways to unlock the potential of the petrochemical industry include the following: (1) creating petrochemical clusters in attractive centres; (2) focusing on innovative and low-tonnage production; (3) using circular economy mechanisms; (4) designing transport and logistics solutions to deliver polymer products to emerging markets; and (5) using the international status of multilateral development banks to attract investment capital to the industry. If the region's existing potential is fully harnessed, the petrochemical industry can become a powerful tool for breaking out of the inertial development rut.

Keywords: petrochemical industry, polymer products, Eurasian region, Central Asia, production potential, industrial co-operation, development of process stages, transition from raw materials to finished products, export potential.

JEL: F15, L65, N65, O14, Q32, Q35

The electronic version of the report is available at the Eurasian Development Bank website at https://eabr.org/analytics/special-reports/

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INTRODUCTORY REMARKS BY NIKOLAI PODGUZOV

Nikolai Podguzov,
Chairman of the Management Board,
Eurasian Development Bank

Are resource-dependent economies destined be resource-dependent forever? Can they overcome this path dependence and move up the ladder of added value? And, while doing so, can our member states move forward a greener industry? These are the questions our research team had in mind while working on this report.

The oil and gas sector is undergoing substantial structural transformations propelled by the global green energy transition. This shift is geared towards curbing hydrocarbons consumption while amplifying the non-energy applications of oil and gas, requiring deeper processing. As a result, the global petrochemical market is poised for substantial expansion in the coming decade, surpassing the overall growth rate of the global economy. Forecasts indicate that the petrochemical industry will stand behind approximately half of the anticipated global surge in crude oil demand.

These structural changes in the global economy could bring numerous benefits for our member states. The huge natural raw material potential of the region should be harnessed for long-term industrial growth. By capitalizing on this potential, the region can foster the development of knowledge-intensive industries, boost the production of high-value polymer products locally, diversify its economy, and carve out a robust position in global markets as an exporter of technologically sophisticated products.

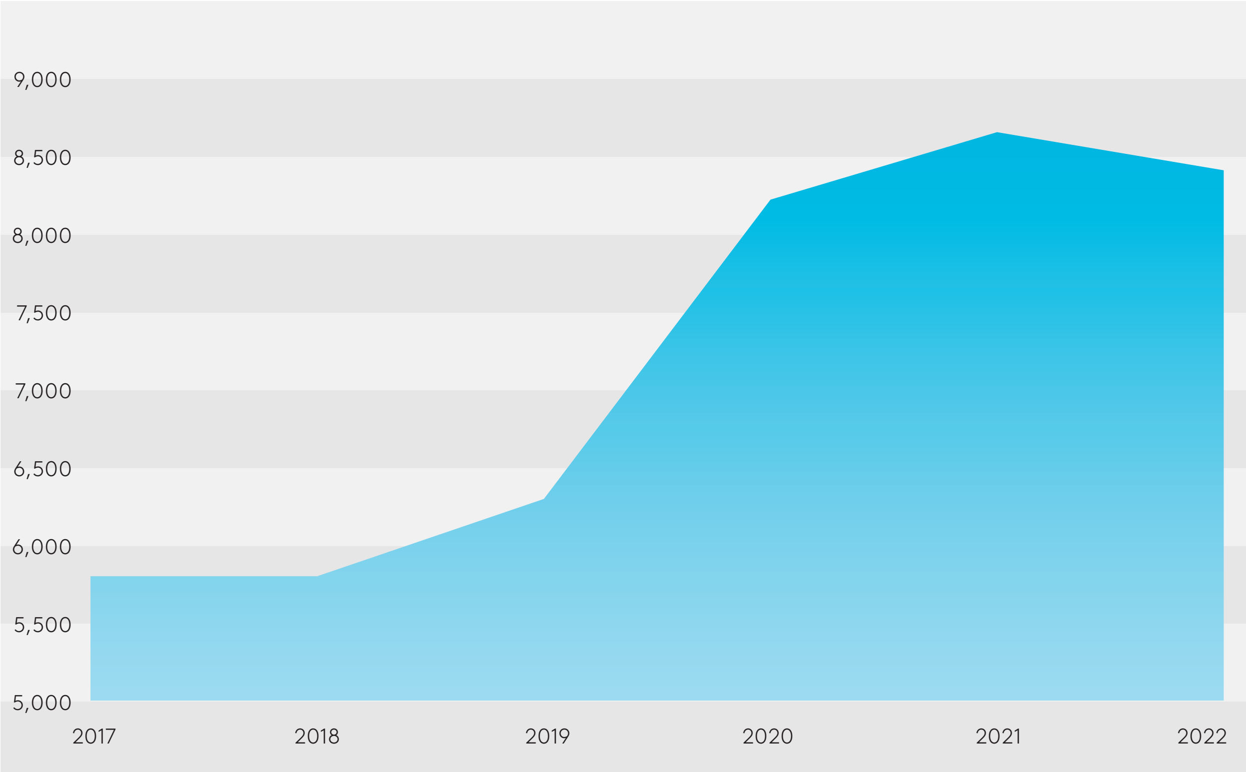
The development of new petrochemical projects poses intricate technological and economic hurdles. While these projects demand substantial capital investment, international practice indicates that Multilateral Development Banks also have a role to play alongside other investors. They actively participate in financing petrochemical ventures, having allocated approximately $7.5 billion to this sector from 2010 to 2020. The EDB has approximately 7% of its investment portfolio invested in this sector.

We advocate for the petrochemical sector to serve as a catalyst for the region's economic development. Petrochemicals will enable our member states to secure a more significant and attractive foothold in the global division of labor and break away from a reliance on commodity-based development models.

SUMMARY

The petrochemical industry in the Eurasian region (Armenia, Belarus, Kazakhstan, Kyrgyzstan, Russia, Tajikistan, Turkmenistan, Uzbekistan) is developing rapidly. Over the last six years, the total production of basic polymers (*polyethylene, polypropylene, polyvinyl chloride, polystyrene, polyethylene terephthalate, synthetic rubber*) has increased by a factor of 1.5, from 5.8 million tonnes in 2017 to 8.4 million tonnes in 2022. The production of polyethylene, polyethylene terephthalate and polypropylene in Russia is accelerating. There is one active player in the market — the national petrochemical company SIBUR — which has implemented a number of large-scale projects and is planning to expand its production capacity in the next few years (*Amur Gas Chemical Complex in the east of the country*). Kazakhstan is actively pursuing an industrial policy that includes rapid expansion of petrochemical production. A polypropylene production project has recently been completed in the Atyrau region (*KPI LLP*). Uzbekistan and Turkmenistan, together with their foreign partners, have commissioned the Ustyurt Gas Chemical Complex (*Uz-Kor Gas Chemical*) and the Kiyanly Gas Chemical Complex, respectively.

↓ **Figure A. Polymer Production in the Eurasian Region, KT**



Source: national statistical agencies.

Unlocking the petrochemical production and export potential can offer the Eurasian region significant economic benefits. Going forward, by 2035 the industry may secure:

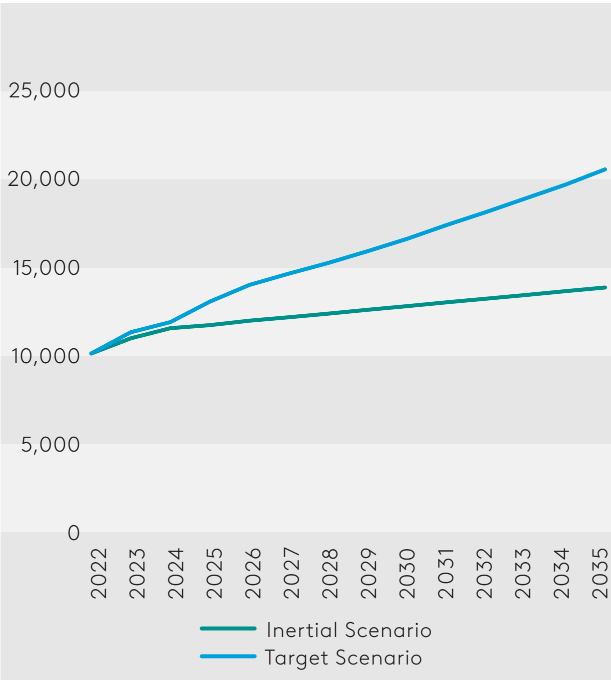
- **an annual increase in the output of base polymers and synthetic rubber of up to 5.8%.** In total, the volume of polymer production may increase by 10.8 MT (Figure B) to more than 20 MT, with the current output more than doubling. The total value of supplementary output in the manufacturing industry may be as high as $138.1 billion;

- **an annual increase in the Eurasian region's GDP of up to 0.44 pp** (*ratio of the average annual total investment and output growth effect on GDP to GDP volume in 2022*). The indicator for the Russian Federation is 0.32 p.p., and for the Republic of Kazakhstan — 1.38 p.p. In total, by 2035, the region's GDP may receive an additional $153.5 billion;

- **a 3.2-fold increase in petrochemical exports** (*by 7.2 MT to 10.4 MT*) (Figure C). There are several base polymers that have significant export potential. By 2035, net exports may increase to 4.7 MT (*annual average growth in 2017–2022: 536.9 KT*).

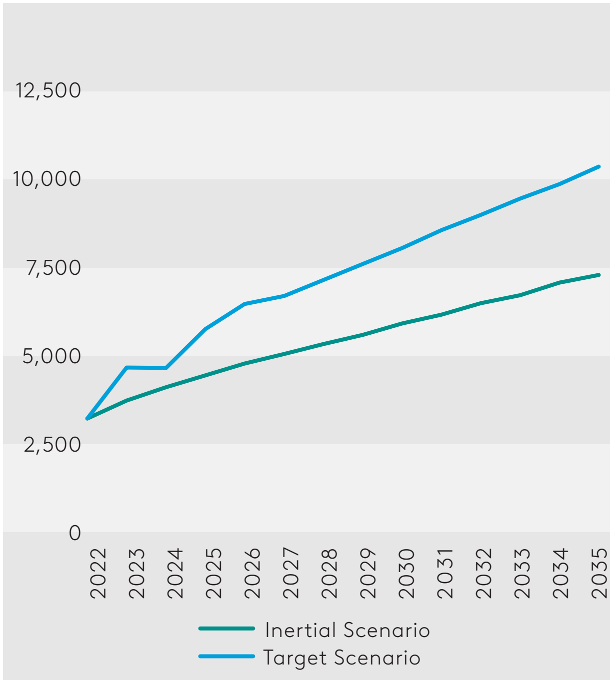
The petrochemical industry has a **high multiplier effect, and is capable of supporting a transition from the commodity-based to the innovative economic development model** (*the multiplier effect is estimated at $2.62 per $1 of industry output*). It is capital-intensive, and has the highest capital-expenditure-per-worker ratio among the manufacturing industries, generating the second-highest added value after the pharmaceutical industry (Oil and Capital, 2023). Moreover, the UNIDO classifies the petrochemical industry as a high-tech industry alongside the manufacture of computers, mechanical engineering, and the pharmaceutical industry. Each job in the petrochemical industry creates 2–7 new high-productivity jobs in related sectors of the economy (Braginsky, 2015).

↓ Figure B. Projected Petrochemical Output in the Eurasian Region, KT



Source: authors' calculations.

↓ Figure C. Projected Petrochemical Exports from the Eurasian Region, KT

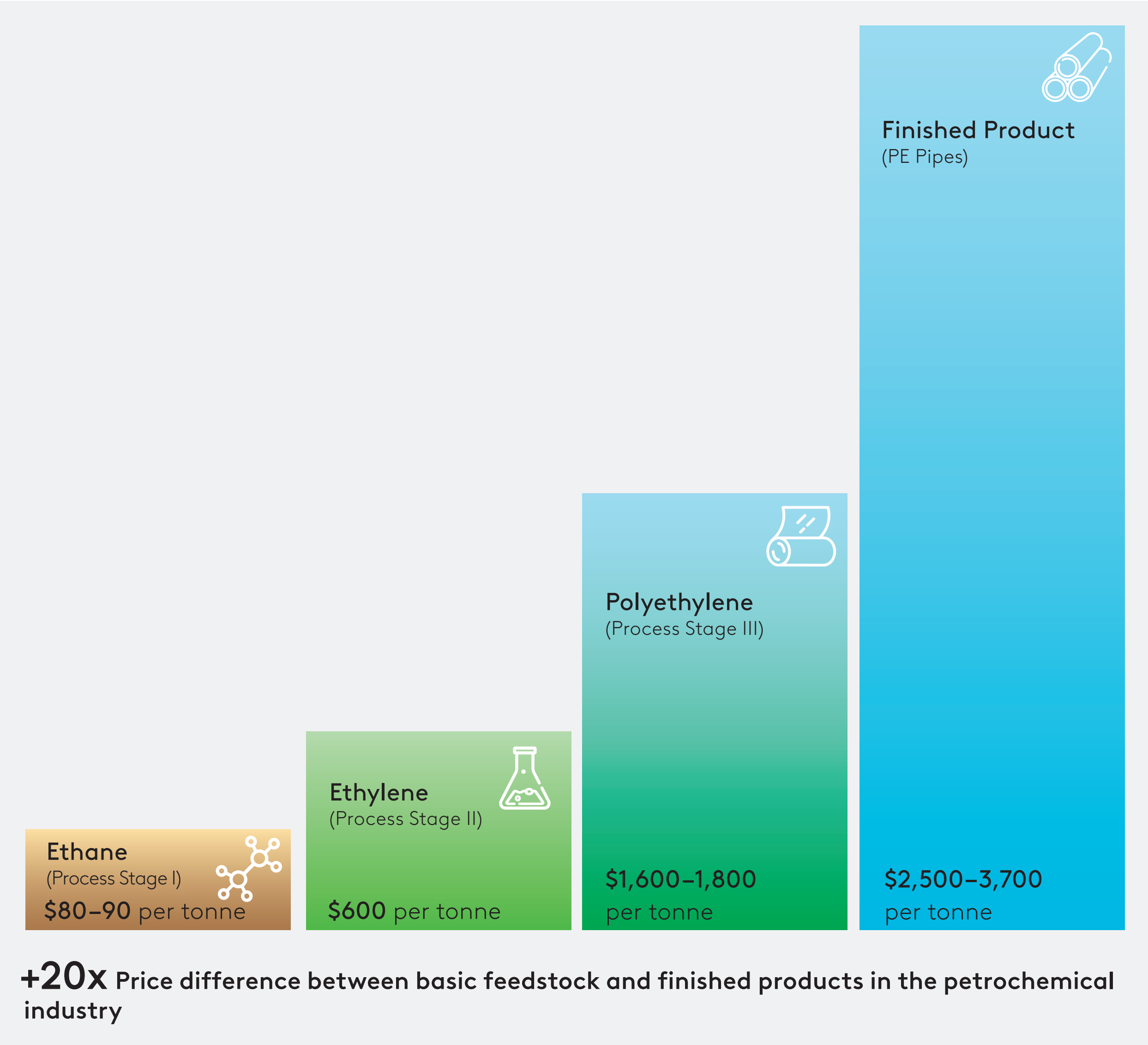


Source: authors' calculations.

The industry is characterised by a rapid added value increase along the process chain (Figure D). As production moves along from one process stage to another, newly — generated added value grows exponentially. The prices for base raw materials and final polymer products may differ more than 20-fold (Ivanov, 2016). Both mining and processing companies are attracted to deep hydrocarbon conversion process stages, not only because they are highly profitable, but also because they make their business more resilient.

On the other hand, development of the petrochemical industry in the Eurasian region creates **not only economic benefits, but also an additional environmental load.** In particular, continued growth of industrial output will be accompanied by an increase in greenhouse gas emissions (*annual average: 6.7–17.8 mln t*CO_2*e*) and polymer waste (*annual average: 1.4–2.2 MT*). However, that impact needs to be viewed in the context of the possible benefits associated with using plastics as opposed to other materials (*use case: significant advantages of using plastic pipes vs cast-iron pipes in the Housing and Utilities sector*).

↓ **Figure D. Product Value per Tonne at Different Process Stages from Raw Materials to Finished Products**



Source: Ivanov, 2016.

Further strengthening of the petrochemical industry is a natural economic policy priority for the countries of the Eurasian region. All conditions for that are in place:

- The region has a **huge resource potential**. Total proven oil reserves (*as of 2022*) are 115 MMbbl (*more than 7% of world reserves*), while total proven gas reserves are 62.8 TCM (*about 30% of world reserves*). The region is one of the world's largest producers and exporters of raw hydrocarbons, which aligns its petrochemical industry development goals with those of the other oil and gas exporting countries.

- Just like industrially developed countries, the region has a **long-standing tradition of petrochemical industry development**, including both production *per se* and creation of the related scientific and technological basis (*for example, Russia is one of the world's leaders in the invention and commercialisation of ground-breaking synthetic rubber production technologies*), and a successful track record of implementation of large-scale chemicalisation programmes.

- The countries of the region are already proactively pursuing **government policies aimed at advancement of petrochemical projects**. There are more than 20 ongoing large-scale petrochemical projects with a total value of more than $200 billion.

- The **region is geographically close** to the emerging Asian markets. By 2035, the Asia-Pacific Region (APAC) and India will account for more than 40% of the global petrochemical market. Their immense growth potential can be attributed to their relatively modest current per capita polymer consumption levels relative to developed economies. The Eurasian region is putting considerable effort into maintaining **logistical connectivity with those markets**.

The structural transformation of the global petrochemical industry is creating long-term advantages for the countries of the Eurasian region. The global economy is going through a new energy transition, which is closely linked to deeper conversion of petrochemical products. A qualitative technological breakthrough requires polymer raw materials (*for example, ethylene is used in the production of photovoltaic elements for solar power stations*). The global petrochemical market will be growing at a compound annual growth rate (CAGR) of **3–6% until 2035** (IEA, 2022). By 2050, 50% of incremental global demand for crude oil will be generated by the evolving petrochemical industry. Accordingly, petrochemical regions with a substantial resource potential will be playing an increasingly important role.

The Eurasian region can potentially improve its position in the global division of labour. It currently accounts for merely 2.1% of total global petrochemical output, and positions itself as a supplier of primary products (*particularly oil and gas*). However, everything is in place for the region to transform itself into the world's largest polymer production centre. Taking into consideration the technological intensity of the petrochemical industry and the considerable multiplier effect it produces, it may be instrumental in escaping from the "rut" of previous development (overcoming "path dependence").

Box A. Successful Escape from the "Rut" of Previous Development: South Korea

It took South Korea only a few decades to turn from one of the world's poorest agrarian countries into an industrially developed country with a high per capita income. In the beginning of the transformation journey, the government of South Korea created important points of economic attraction in the country's agrarian economy by pursuing a selective industrialisation policy that prioritised heavy and chemical industries (Jwa, 2023). It also set out to develop shipbuilding and mechanical engineering, two industries that were virtually non-existent in the country's economy. Emergence of capital-intensive industries triggered a new "economic miracle" process that encompassed development not only of production capacity, but also of all collateral sectors of the economy, including education, science, engineering, logistics, and services. Today South Korea's export product basket is extremely diversified. The country has a strong competitive position in trade in electronic, mechanical engineering, and chemical products. These, in turn, have a strong "connection" to the traded products that can be described as "contiguous" in terms of complexity. According to Harvard Growth Lab, the "cost of switching" to such contiguous products necessitated by industrial production expansion exigencies is rather low. The more such connections, the more opportunities for the diversification of the economy.

The petrochemical industry may become a point of economic attraction for the Eurasian region. It has already scored some successes in building up its scientific potential and creating engineering and manufacturing complexes with their own R&D. The region has sufficient scientific potential to expand domestic production of polymers needed by local companies. For example, there are several ongoing polymer import substitution R&D projects, including the testing of cold catalysis technologies for plastic waste processing (TNK company), work on polyarylates, polysulfones, and polyethersulfones ("Digital Materials Engineering: New Materials and Substances" National Technical Initiative, Bauman Moscow State Technical University), launch of seven proprietary polyethylene brands, development of 28 new polymer materials, 18 new low-tonnage localisation projects and 10 catalyst development projects (Polylab Research Centre, Skolkovo, Sibur company), pilot testing at a Voronezhsintezkauchuk facility of the new reagent Macromer SP-9 to replace the adhesion-reducing powders Sokalan AC CP 9 (BASF company) and Geropon T/36-DF (Solvay company) previously used for rubber production, and others.

In many successful countries, the state plays a critical role in developing the petrochemical industry. In the Eurasian region, comprehensive government support could be structured so as to ensure coordinated decision-making by the key industry players, forge stable research–production and production–demand links, enhance human resources, and create specialised infrastructure facilities. The following three principles should be observed: an emphasis on locally procured raw materials and local talent; a commitment to promoting innovation, creating high-tech production facilities at initial process stages, and making end products with high added value; and a focus on boosting the investment appeal of the petrochemical industry.

Based on our review of an extensive body of international best practices, we have identified **five blocks of priority measures** designed to unlock the existing production and export potential:

1. **Creation and accelerated development of modern petrochemical clusters in natural centres of attraction** within the Eurasian region close to major sources of hydrocarbon materials (oil and gas). A cluster is defined as the full value chain from developing proprietary production technologies and manufacturing of required equipment to production of ready-to-use end products. Special attention should be paid to creating deep-conversion value chains that yield end products with high added value, and establishing close links between petrochemical facilities and consumers, both within such clusters and at their "exit points". This needs to be done, primarily in industrial clusters, to achieve economies of scale, facilitate comprehensive utilisation of hydrocarbon materials, pipelines, and infrastructure facilities, and create technoparks and technopolises for the implementation of relatively small high-tech and innovative production projects. Global clustering success stories include petrochemical clusters at Jurong Lake (*Singapore*), in the cities of Al Jubail and Yanbu (*Saudi Arabia*), and at the Texas Petrochemical Cluster (*USA*).

2. **Innovative and low-tonnage petrochemical production** is likely to be the most promising growth area in the Eurasian region. The segment is facing very tough import substitution challenges. Accordingly, there is a significant market potential for expanding domestic production. It also concentrates the bulk of added value in the process chain. For that reason, the share of low-tonnage facilities in total chemical production is 40% in developed countries, and only 15% in developing countries. The segment accounts for 70% of total end-product value in the petrochemical industry. Low-tonnage petrochemistry is the cornerstone of knowledge-intensive, waste-free production, and it may become one of the pillars of transition to a new technological paradigm. Importantly, the cost of potential projects is much lower than capital-intensive, large-scale projects. Notably, it is low-tonnage chemical production that is the key driver of large-tonnage chemical production.

3. Subject to the environmental aspects of evolution of the petrochemical industry in the Eurasian region, it is **advisable to take into consideration global circular production and rational consumption trends**, primarily in connection with the deployment of circular

economy mechanisms. To do that, it is necessary to support recycling of by-products of oil and gas extraction (especially plastics); use polymer waste in chemical recycling processes; minimise release of plastic particles into the environment; procure and deploy the best available petrochemical technologies which minimise emissions and streamline the use of natural resources. Recycling can be rather profitable in terms of utilisation of resources. It requires merely 10% of the energy consumed during primary polymer production, but yields a product with almost identical physical properties and quality parameters.

4. It is necessary to **come up with transport and logistical solutions to enable effective delivery of polymer products to the emerging markets** in the Middle East and the Asia-Pacific region. The countries of the Eurasian region can easily increase domestic and export freight traffic of polymer products using the **Eurasian transport corridors**. Development of alternative logistical corridors and export routes should reduce the adverse impact of the existing constraints on freight traffic. In the new geopolitical reality, the new transport channel — the International North–South Transport Corridor (INSTC) — has become particularly significant. Its development will open new routes for business co-operation with India, Iran, Pakistan, and the countries of the Middle East. The Northern Sea Route, a potentially stable logistical option, also warrants attention due to the importance of maritime routes to Southeast Asia.

5. **Using the international status of multilateral development banks (MDBs) to attract investment capital to the industry.** To carry out the steps listed above, it will be necessary to secure long-term investments from a consortium of oil, gas, and petrochemical companies, states, and diverse financial institutions. Over the last ten years, the MDBs have invested about $7.5 billion in the petrochemical industry. Those financial institutions offer the same financial instruments as bilateral development banks in developing countries. However, the MDBs are less prone to the influence of national political or industrial stakeholders. They can structure financing programmes, enrol private capitalists in loan syndications, attract investment resources from other MDBs and commercial banks, issue bonds, acquire equity stakes, etc. MDBs can also offer umbrella programmes for international investment partners, use their access to international financial markets, and facilitate development of the petrochemical industry by employing a broad range of financial instruments (*including trade finance support, funded participation, and soft export loans*).

TERMS AND DEFINITIONS

Multiplier effect — change in the value of the indicator under review (gross output, GDP, gross output in the manufacturing industry) resulting from an initial impact and its propagation under the influence of forward and backward links in the economy (the effect is shaped by intersectoral interactions, as well as by redistribution of income and its transformation into additional consumption).

Direct effect — initial change in the indicator under review triggered by the initial impact, in most cases in the form of additional final demand (including household and government consumption, capital expenditures, and exports), causing an output change in one or several sectors.

Indirect multiplier effect — additional change in the indicator under review due to an output change in sectors which directly or indirectly (through a chain of intersectoral links) supply resources for current industrial consumption to sectors affected by the output change triggered by the direct effect.

Induced multiplier effect — additional change in the indicator under review caused by an output increase in various sectors of the economy related to induced final demand on the part of the population, the state, and the business community, caused by spending of the income received in the form of wages and salaries, taxes, and profit in the sectors involved in realisation of direct and indirect effects.

Multiplier — ratio of the multiplier effect to initial impact.

Sectoral production multiplier of output in sector *i* for sector *j* — final output change in sector *i* (expressed in US dollars) per 1 dollar of the initial output increase in sector *j*.

Sectoral production multiplier of gross output (for sector *j*) — final gross output change (expressed in US dollars) per 1 dollar of the initial output increase in the selected sector (sector *j*).

Sectoral production multiplier of output in the manufacturing industry (for sector *j*) — final output change in the manufacturing industry (expressed in US dollars) per 1 dollar of the initial output increase in the selected sector (sector *j*).

Sectoral production multiplier of the GDP (for sector *j*) — final GDP change (expressed in US dollars) per 1 dollar of the initial output increase in the selected sector (sector *j*).

INTRODUCTION

The petrochemical industry is an integral part of global industry, and one of the fundamental economic components of modern society. Petrochemical products are not only used to manufacture goods playing a critical role in our day-to-day life, but they also represent absolutely indispensable elements of modern energy infrastructure, including solar cell batteries, wind-driven turbines, electric batteries, heat insulators, and e-vehicle parts.

Demand for polymer products, the most widespread of petrochemical products, has exceeded demand for all other industrial materials (steel, aluminium, cement, etc.), having almost doubled since the beginning of the 21st century. The US, European countries, and other economically developed countries are now using 20 times more plastics and 10 times more fertilisers per capita than developing countries, which only proves the existence of a huge growth potential in the world. The petrochemical industry accounts for approximately 13% of global demand for oil (*or 13 MMbbl per day*) and 8% of global demand for gas (*or 300 BCM per day*).

The post-COVID-19 changes are of a structural nature, especially considering the ongoing reformatting of the global oil and gas market against the backdrop of the transformation of the world order. While previous economic slowdowns were predominantly cyclical, today petrochemical companies are experiencing fundamental shifts in demand and supply. Because of these profound changes, it is likely that in the next decade the industry will evolve into something completely different.

The Eurasian region, with its substantial oil and gas reserves, is integrated into the global petrochemical industry production chains mostly as a supplier of feedstock.

The aim of this report is to measure the region's potential for boosting its petrochemical production. This is how this aim is achieved:

- **Chapter 1** presents an analysis of the global trends that will affect the evolution of the petrochemical industry over the long term, and offers forecasts on the future of global petrochemical markets.

- **Chapter 2** describes the state of the petrochemical industry in the countries of the Eurasian region, its competitive advantages, the barriers hindering its development, and its projected production potential.

- **Chapter 3** provides an in-depth review of the ways in which the countries of the Eurasian region can increase petrochemical exports to their historical sales markets, and to the markets emerging in the developing regions of the world, and offers an assessment of their future export potential subject to the production potential identified in Chapter 2.

- **Chapter 4** features an assessment of the macroeconomic and associated environmental impact on the Eurasian markets, subject to the production and export potential of the petrochemical industry of the countries of the region.

- **Chapter 5** lists the key barriers, and offers practical recommendations that will make it possible to unlock the substantial production and export potential of the petrochemical industry of the Eurasian region.

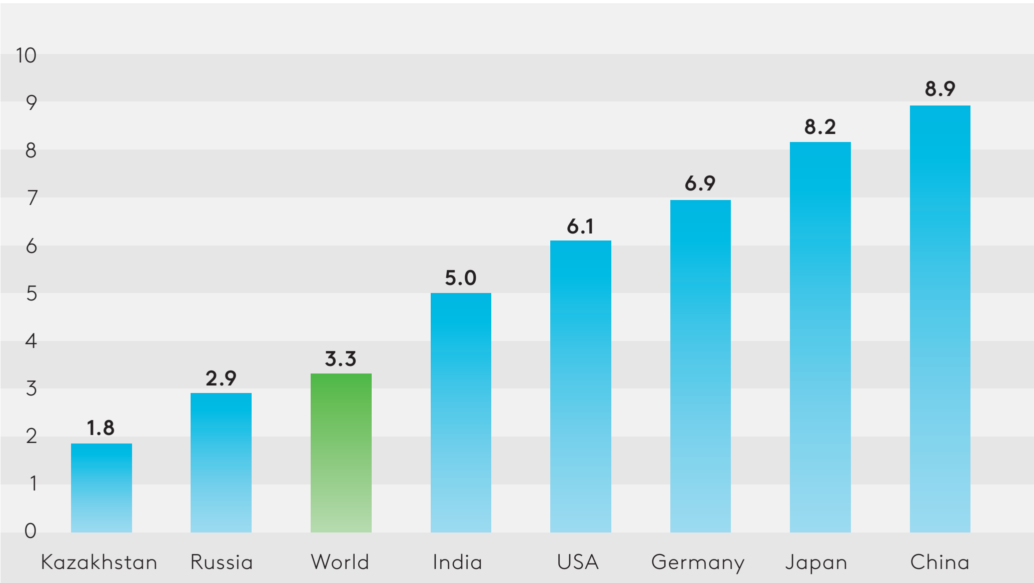
1. GLOBAL PETROCHEMICAL TECHNOLOGY TRENDS, WORLD MARKET STRUCTURE, AND LONG-TERM PROSPECTS

1.1. Global Role of the Petrochemical Industry

The petrochemical industry is one of the key branches of the world economy, and an integral part of the chemical industry. It specialises in processing oil, gas condensate, and associated petroleum and natural gas, forming a link between the oil and gas complex and manufacturing industries. Oil and gas feedstock can be used to generate heat and electricity, and processed to manufacture various petrochemical products.

The petrochemical industry produces four out of every five items habitually used by people in their day-to-day life (*polyethylene bags, equipment frames and parts, car tyres, plastic windows, waterproof footwear, dropped ceilings, food packaging — the list goes on and on*) (Sokolov-Mitrich, 2022).

The petrochemical industry accounts for approximately 3.3% of global GDP, and for 8.9% of GDP in China, 8.2% in Japan, 6.9% in Germany, 6.1% in the USA, 5% in India, 2.9% in Russia, and 1.8% in Kazakhstan (Figure 1).



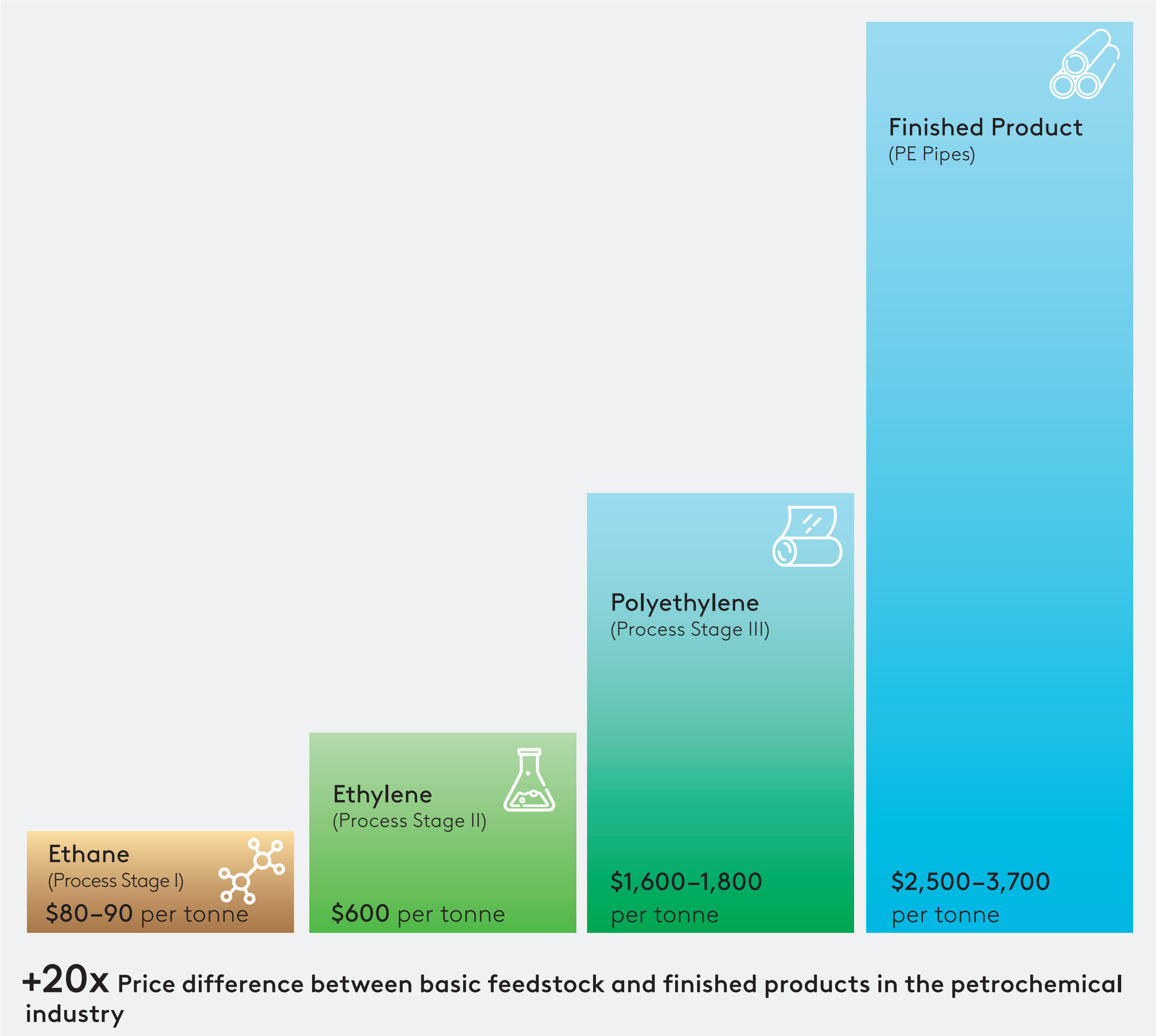
← **Figure 1. Share of the Petrochemical Complex in the GDP of Various Countries, %**

Source: Statista, Federal State Statistics Service of the Russian Federation (Rosstat), National Statistical Bureau under the Strategic Planning and Development Agency of the Republic of Kazakhstan, "Energy Policy".

The petrochemical industry is characterised by significantly higher resilience and growth rates than most other sectors of the economy. It has the highest capital-expenditure-per-worker ratio among the manufacturing industries, generating the second-highest added value after the pharmaceutical industry (Oil and Capital, 2023).

The industry ensures the highest added value growth rate in the process chain. The prices for feedstock and high-tech products may differ by more than 20 times. Deep processing of gas increases the value of the finished product at each process stage: natural gas → ethane (*$80–90 per tonne*) → ethylene (*$600 per tonne*) → polyethylene (*$1,600–1,800 per tonne*) → finished polyethylene products (*for example, polyethylene pipes*) (*$2,500–3,700 per tonne*).

↓ **Figure 2. Product Value per Tonne at Different Process Stages from Raw Materials to Finished Products**



Source: EDB.

According to the UNIDO classification[1] (2010), the petrochemical industry is assigned to the group of high-tech manufacturing industries capable of resisting external shocks and withstanding turbulent periods (Figure 3). Because of its technological intensity and complexity, the industry has a strong multiplier effect on the national economy.

Manufacturing of high-value-added products makes petrochemical projects 20–25% more profitable than mining projects. Both mining and processing companies are attracted to deep hydrocarbon conversion process stages not only because they are highly profitable, but also because they make their business more resilient. Petrochemical corporations specialising in deep processing of feedstock receive more stable profits than extracting corporations even during periods of fluctuation of gas and oil prices. The industry demonstrates superior growth rates — 4.4% vs global GDP CAGR of 3%, while in 2020–2022 the oil and gas companies Sinopec and PetroChina (China) reported revenue growth rates of 58–69% (Sinopec, 2023).

[1] The UNIDO classification arranges manufacturing sectors by R&D intensity relative to output and gross added value.

↓ Figure 3. Technological Complexity of Manufacturing Industries

LOW-TECH	MID-TECH	HIGH-TECH
Food Products	Fabricated Rubber Products	Chemical and Petrochemical Industry
Beverages	Construction Materials	Pharmaceutical Industry
Tobacco Products	Ferrous and Non-Ferrous Metallurgy	Computers and Electronics
Light Industry	Repair and Installation of Machines and Equipment	Electrical Equipment
Wood Processing and Pulp Products	Manufacture of Toys	Heavy Machinery
Oil Refining and Fuel Production	Manufacture of Jewellery	Automotive Industry
Metalware Production	Sports Equipment and Apparel	Railway Equipment and Transport
Furniture Production		

Source: stat.unido.org.

Each dollar invested in the petrochemical industry yields a return of 2–3 dollars, and each new high-productivity job creates 2–7 jobs in related sectors of the economy (Braginsky, 2015).

Development of the petrochemical industry also facilitates achievement of the UN Sustainable Development Goals. Low-waste and no-waste technologies are used to manufacture certain types of petrochemical products (SDG 12) (*for example, glycerine production waste is used to make epoxy resins*); some types of petrochemical products are widely applied for purification of air, water, and other elements of the environment (SDGs 6, 13, 14, 15), while development of petrochemical production generally creates a steady foundation for long-term quality economic growth (SDGs 8, 9).

1.2. Classification of Petrochemical Products

Almost ¾ of production chains in the petrochemical industry end with polymer materials. Petrochemical products are classified mostly by production scale and technological intensity (Figure 4). Low-tonnage chemistry represents the most knowledge-intensive, competitive, and virtually waste-free production. Expansion of low-tonnage production is a significant national economy growth driver. Its absence, in turn, restrains development of large-tonnage and medium-tonnage production. In developed countries, the share of the low-tonnage segment exceeds 40% of total output; in developing countries it is up to 15%.

↓ Figure 4. Classification of Chemical Products by Production Scale

Base Large-Tonnage Chemicals (150+ KT)	Medium-Tonnage Chemicals (50–150 KT)	Low-Tonnage and Special Chemicals (1–15 KT)	Finished Products (1 kg–200 KT)
large-tonnage plastics	engineering plastics	chemical fibres and threads	plastic items
synthetic rubbers	urethanes	plasticisers	car tyres
mineral fertilisers	acrylates	surfactants	fabricated rubber products
methanol	polymer resins	catalysts	geosynthetics
base chemicals (HDPE, LDPE, LLDPE, PS, EPS, GPPS + HIPS, ABS, PVC, PET)	organosilicon and organochlorine compounds	paints and varnishes, crop protection chemicals	nonwoven materials
	pigments, dyes, adhesives		household chemicals
			cosmetics

Source: EDB.

Petrochemical production using oil and gas feedstock is divided into four process stages (Table 1). Moving **up** along the chain guarantees increased complexity of the economy, and ensures its diversification and strong inflow of high added value.

Polymers have been known since the 1840s, and their commercial application started in the 20th century. Polymer products are obtained by polymerisation (*polystyrene, chloroprene and butadiene rubber, Teflon, polypropylene, polyethylene, etc.*) and polycondensation (*polyethylene terephthalate* (*Lavsan*), *polypeptides, phenol formaldehyde resins, etc.*). Base polymers are aggregated into several large groups (Table 2): polyolefin (polyethylene, polypropylene, polybutylene, and their copolymers), polystyrene, polyvinyl chloride, and polyethylene terephthalate.

↓ Table 1. Classification of the Petrochemical Industry by Process Stage

Value Chain Link (Process Stage)	Products	Cost per Unit	Ratio to Feedstock Cost
Extraction of petroleum and natural gas (feedstock)	Crude oil, associated and natural gas	Oil: \$60–90 per 1 bbl (\$0.44–0.66 per 1 kg) Gas: \$100–200 per 1,000 m^3	1x
▼			
Production of petrochemical feedstock (Process Stage I)	Naphtha, natural gas liquids (NGL), liquefied hydrocarbon gases (LHG), ethane, propane, butanes, etc.	\$0.6–1 per 1 kg	1.5x

Value Chain Link (Process Stage)	Products	Cost per Unit	Ratio to Feedstock Cost
▼			
Production of basic intermediate products, large-tonnage polymers, and petrochemicals (Process Stage II) Basic Products	Ethylene, propylene, butadiene, benzene, toluene, methanol, isoprene, and other intermediate products; polyolefin (polyethylene, polypropylene, polybutylene, and their copolymers), polystyrene, polyvinyl chloride, polyethylene terephthalate, spirits, aldehydes, anhydrides, oxides, ketones, glycols, etc.	\$1.6–4.8 per 1 kg	2.9–6.5x
▼			
Production of deep-conversion petrochemical products (polymer products) (Process Stage III) Performance Products	Functional polymers, composites, engineering plastics, specialty rubber, etc.	\$5–6 per 1 kg	8–10x
▼			
Production of high-tech products and innovative functional materials Market-Driven Products	Biopolymers, nanomaterials, biotechnological materials. Biosensors, polymer heat- and fire-resistant coatings, anticorrosive materials, crystalline materials for thermoelectric energy converters, etc.	\$6+ per 1 kg	12–20x

Source: EDB.

↓ **Table 2. Structure and Composition of Base Polymers**

Polymer	Types
Polyethylene (PE)	High-pressure low-density polyethylene, <0.94 g/cm^3 (LDPE); low-pressure high-density polyethylene, >0.94 g/cm^3 (HDPE); linear low-density polyethylene, <0.94 g/cm^3 (LLDPE); ultra-high-molecular-weight polyethylene (UHMWPE) Ultra-low-density polyethylene (ULDPE); metallocene linear low-density polyethylene (mLLDPE), etc.; ethylene copolymers and modified polyethylene
Polypropylene (PP)	Homopolymers (PP-H); block copolymers of propylene and ethylene (PP-B); polypropylene random copolymers (PP-R); polyisobutylene
Polystyrene (PS)	General-purpose polystyrene (GPPS); high-impact polystyrene (HIPS); expanding polystyrene (EPS); acrylonitrile butadiene styrene plastics (ABS); styrene acrylonitrile plastics (SAN)
Polyvinyl Chloride (PVC)	Suspension PVC (PVC-S); emulsion PVC (PVC-E); rigid compounds; soft plastic compounds; pastes based on emulsion PVC and additives
Polyethylene Terephthalate (PET)	High-viscosity PET-granulate; membranous PET; fibrous PET

Source: EDB.

1.3. Strategic Focus on Polymer Products

Polymer products stimulate expansion of production in allied industries (*medicine, aircraft building, construction, space industry, production of electronic and communication equipment, the agroindustrial complex, packaging industry, production of goods for sports, tourism, and leisure, and production of household goods*), and are an important component of the transition to high-tech production. Polymer production has a high multiplier effect. To compare, the sale of 4.5 BCM of gas and 360 KT of condensate in the form of raw materials yields $350–400 million per year, while processing of that feedstock and its sale in the form of propane/butane mix, methane and ethane fractions brings in $500–600 million per year, and its conversion and sale of the resultant polymers — $2 billion per year (Ivanov, 2016).

Polymer products often have properties better for the consumer than various traditional materials. For example, PVC plastic windows have the same quality and durability as wooden windows, but their cost is, on the average, 50% lower, and their operation is simpler, as external coating of wood needs to be regularly refreshed. Plastic pipes have a longer service life than iron pipes (*up to 50 years vs 20 years*); they do not rupture at freezing temperatures; they are not prone to decay, rust, and limescale deposits, are resistant to corrosion, easy to install, lighter (*a PE pipe with a diameter of 16 cm weighs 3.7 kg, a steel pipe 17.5 kg, and a cast-iron pipe 28 kg*), and 3–5 times cheaper than steel and cast-iron pipes.

Development of polymer production opens up new possibilities for restructuring and quality growth of the economy, as manufacturing of polymers is knowledge-intensive, generates high added value, and requires qualified personnel and expensive equipment. That creates a demand and supply ecosystem, from raw materials and finance to human resources.

Formation of a self-reliant, export-oriented petrochemical industry on the basis of export of polymers and products manufactured at subsequent process stages improves the country's prospects, and serves as a valid economic success criterion.

Experience of many countries clearly demonstrates that shifting the focus to polymer production is the right decision. For example, in 1994–2023, Malaysia cut its oil production by 23% from 650 KBPD to 500 KBPD, and redirected part of its oil to the production of polymers (*vulcanised rubber, fertilisers, paints, varnishes*) (Exchange Portal No. 1, 2023). Other countries (*Saudi Arabia, Qatar, Norway*) also overcame their commodity dependence and organised high-tech polymer production (Semyagin, 2023; Markelova, 2022; Daily Finance, 2018).

1.4. Current State of the World Petrochemical Industry

The world petrochemical market is demonstrating steady growth. In 2020, its total value was estimated at $461 billion, increasing to $672 billion in 2022. It is projected that by 2027 it will be as high as $800 billion, following the launch of new projects in the polypropylene segment (*128 projects*), the polyethylene segment (*121 projects*), and the propylene segment (*101 projects*) (Orekhova, 2023).

The key drivers of the rapidly growing global petrochemical industry are the countries of the Asia-Pacific Region (APAC), and expansion of production capacity in the basic chemical industry, packaging industry, construction, and mechanical engineering. The petrochemical industry was also affected by the rapid growth of consumption of durable goods (*household appliances, motor vehicles, etc.*), household items (*plastic food wraps, containers, etc.*), and construction materials (*plastic windows, linoleum, etc.*). For example, in 1997–2022, global production of motor vehicles increased by 60% to 85 million, with China demonstrating a 17-fold growth (to 27 million motor vehicles). In 1990–2019, global production of packaging materials increased 3.6 times to 143 MT, while the use of plastics in construction and transport was up 3.5 times (to 77 MT) and 3.7 times (to 54 MT), respectively.

The global petrochemical market was dominated by countries with high-tech production paradigms, or countries with a substantial technological edge and extensive resource base (Table 3). Countries with the catch-up economic growth model have few, if any, large petrochemical facilities.

↓ **Table 3. Key Players by Petrochemical Process Stage**

	Value Chain Link	Country	Company	2022 Revenue ($ billions)
1	Extraction of petroleum and natural gas (feedstock)	Russia	Gazprom	172.7
			Lukoil	139.7*
			Rosneft	133.8
		USA	ExxonMobil	398.7
			Chevron Corporation	155.6
		Saudi Arabia	Saudi Aramco	604.3
2	Production of petrochemical feedstock (Process Stage I)	China	Sinopec	493.7
			PetroChina	469.7
		United Kingdom	Shell	381.0
			British Petroleum	248.9
		France	TotalEnergies	281.0
		USA	Marathon Petroleum	177.0
			Valero Energy	176.4
3	Production of basic intermediate products, large-tonnage polymers, and petrochemicals (Process Stage II)	Japan	Mitsubishi Chemical	141.5
		China	Rongsheng Petrochemical	43.0
		Russia	SIBUR	12.2
4	Production of deep-conversion petrochemical products (polymer products) (Process Stage III)	China	Hengli Petrochemical	33.1
			Wangua Chemical Group	24.6
		Brazil	Braskem	18.3
		Japan	Asahi Kasei	21.9
			Shinetsu Chemical	20.6
5	Production of high-tech products and innovative functional materials	Germany	BASF	92.0
		United Kingdom	Ineos	79.6*
		China	Sinochem	12.9
		Taiwan	Formosa Plastics Group	8.5
		USA	Dow Inc.	56.9
			ExxonMobil Chemicals	36.8*
		Saudi Arabia	SABIC	52.9
		Republic of Korea	LG Chem	40.1

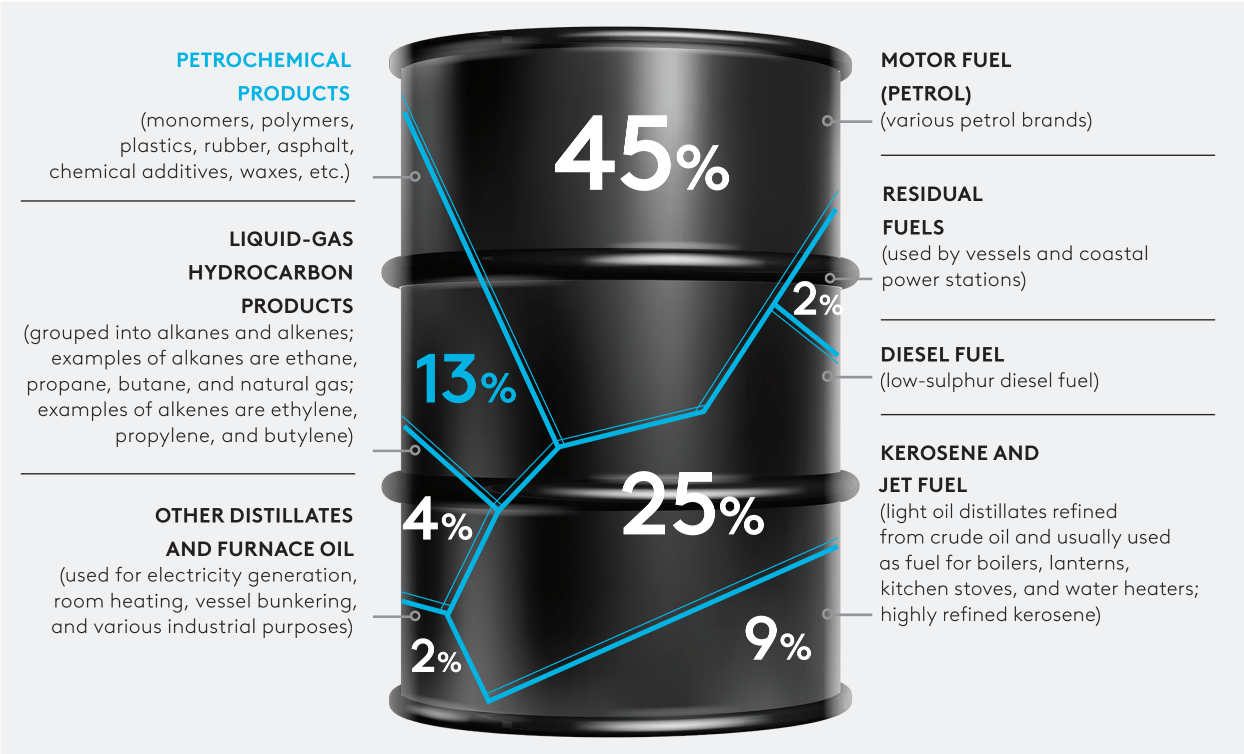
*2021
Source: financial statements of oil and gas companies.

APAC countries account for more than 50% of global output of high-value chemical substances (olefins and aromatic substances), methanol, and ammonia. China is the largest producer. The petrochemical industry in that country is growing at a rate 1.5 times higher than its national GDP, and Chinese products account for more than ¼ of the global petrochemical market.

The bulk of the feedstock is made up of naphtha in Asia and Europe, ethane in North America, coal in the APAC countries, and naphtha, natural gas, and ethane in the Middle East.

Almost ¾ of production chains in the petrochemical industry end with polymer materials. Base polymers are aggregated into several large groups: polyolefins (*polyethylene, polypropylene, polybutylene, and their copolymers*), polystyrene, polyvinyl chloride, and polyethylene terephthalate. Extraction of petroleum and natural gas remains an important starting point in the production chain. Manufacture of petrochemical products and their derivatives uses about 13% of total global oil production (*~13 MMbbl per day*) (Figure 5), and 8% of total global gas production (*~300 BCM [per day]*).

↓ **Figure 5. Current Structure of Utilisation of One Barrel of Oil by Product Type**

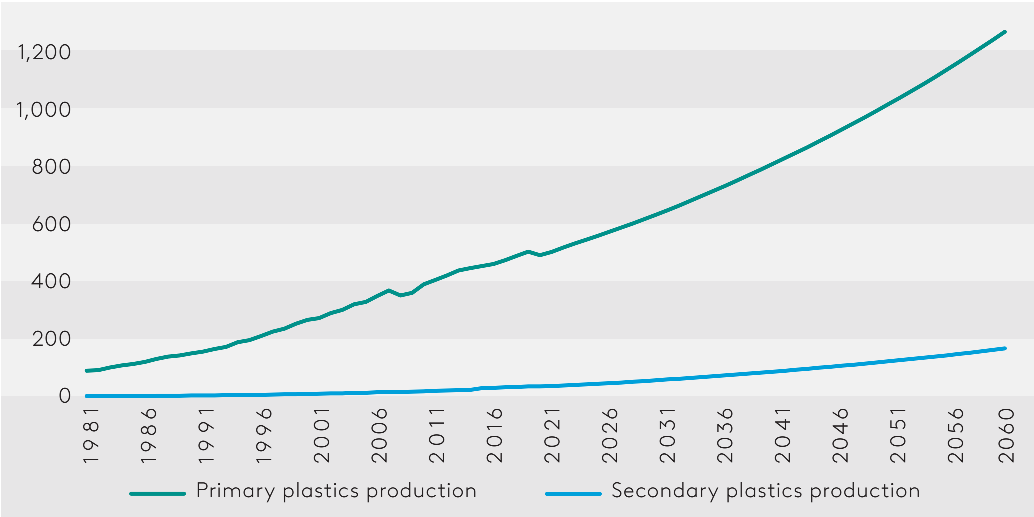


Source: EIA, 2022

Polymers in the World

Over the last 40 years, global output of polymers increased more than sixfold (to 475.4 MT in 2022). The average annual growth rate from 1982 to 2022 was 4.6%. In comparison, during the same period, power generation increased by 2.6%, natural gas production by 2.5%, coal production by 1.5%, and oil production by 1%. Over the last 40 years, polymer production growth exceeded that of global GDP (*3.8-fold*) and global output of such widely used materials as cement (*5.8-fold*), aluminium (*4.1-fold*), ammonia (*2.9-fold*), and steel (*2.6-fold*).

According to the baseline OECD forecast until 2060, the volume of global polymer production will be rising both in primary and secondary plastic segments (OECD, 2022), with output of secondary plastics growing faster than output of primary plastics. The share of secondary plastics (*a key economic cyclicality indicator*) will double from 6% to 12% by 2060. Their utilisation can be increased in two ways. In particular, it may be possible to (1) increase recycling volumes, which may increase availability of scrap for secondary plastic production, and (2) boost demand for plastics, and increase investments for primary plastic production.



← **Figure 6. Production of Primary and Secondary Plastics in 1981–2019, and Forecast until 2060, MT**

Source: oecd-library.org.

A regional breakdown of polymer production points to the leading role (*~52% of total global output*) of Asian countries (*China, Japan, India, South Korea*), with China manufacturing 32% of all polymers in the world. Other major polymer production regions are North America (*20%*) and Europe (*16%*). The share of the Eurasian region in global polymer production is close to 3%.

Box 1. Petrochemical Industry Development Models

USA. Reliance on local shale feedstock. Large domestic market for petrochemical products, proximity to the growing Latin America market. Advanced infrastructure (95% of olefin manufacturing facilities are connected by product pipelines).

Europe. Limited domestic resource base. Low competitiveness of pyrolysis plants due to their considerable age and low capacity. Specialisation on high value-added products. Technologically sophisticated petrochemical facilities, low product delivery costs. Extensive domestic market.

Middle East (Saudi Arabia, Iran, Qatar, Kuwait). Availability of new large (annual output: 1+ MT) cost-effective pyrolysis plants. Reliance on locally sourced feedstock. Government regulation of hydrocarbon prices. Government programmes for the construction of infrastructure facilities (including product pipelines). High price competitiveness of products. Partnership with international businesses as a source of required technologies. Proximity to the large APAC market.

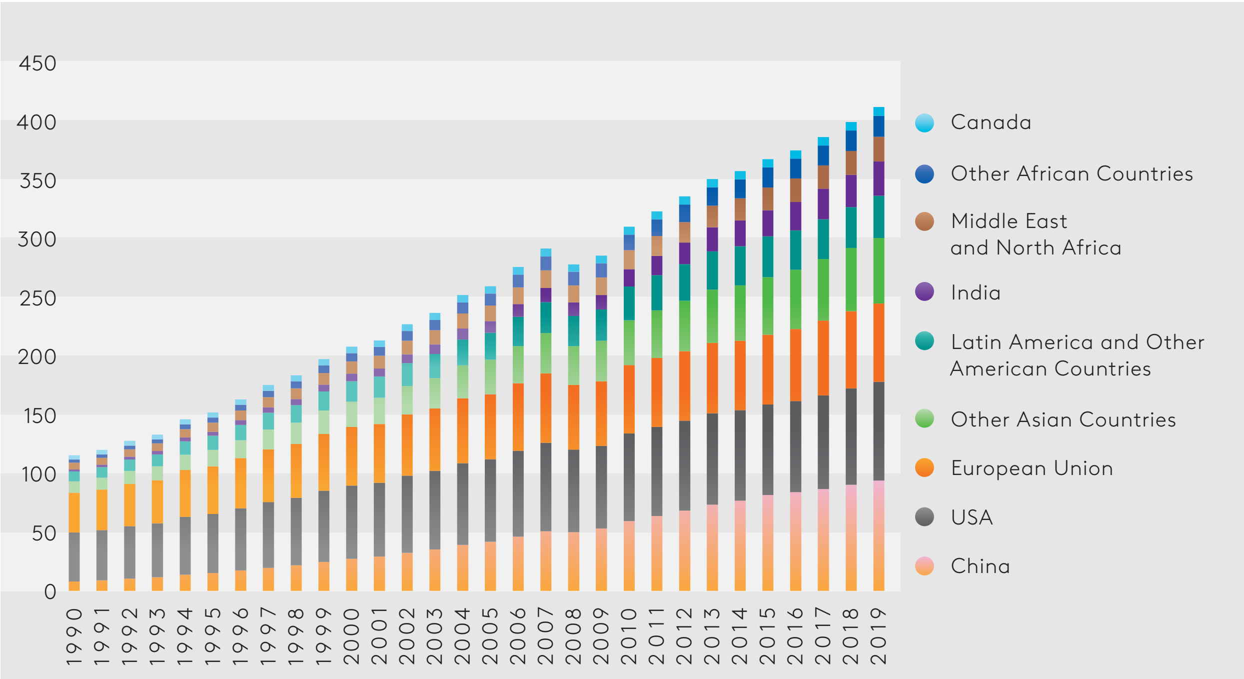
APAC countries (China, India). Regular buildup of large-scale pyrolysis production facilities. Reliance on imported feedstock. Governments have plans for petrochemical industry development. Low initial capital expenditures for new projects. Interaction with foreign technology partners. Large and expanding domestic market.

Eurasian region (Armenia, Belarus, Kazakhstan, Kyrgyzstan, Russia, Tajikistan, Turkmenistan, Uzbekistan). Availability of huge oil and gas reserves. Rather small domestic market for petrochemical (polymer) products. Proximity to the rapidly growing markets of the Asia-Pacific region, India, and the Middle East. Extremely uneven territorial distribution of petrochemical facilities depending on the country. Availability of government development programmes and strategies aimed at building up domestic petrochemical industries and creating new processing facilities.

Global annual consumption of polymers is increasing by 7% for polyethylene terephthalate, by 4% for polyolefin, and by 3% for polyvinyl chloride. In the base polymer group, stagnation is reported only for polystyrene due to the imposition of restrictions on its use in a number of countries (*66 countries have banned the use of polystyrene products, including India, 26 EU countries, and 11 US states*) due to its potentially deleterious effect on human health and the environment, with polystyrene being gradually replaced by polypropylene and polyethylene terephthalate. The European Union is considering a ban on plastic bags and polystyrene packaging.

About 2/3 of global plastics consumption is concentrated in North America, Europe, and the APAC. China is the world's largest plastics consumer with 94 MT (*22.8% of total global consumption*). In 1990–2019, plastics consumption in the PRC increased 12-fold. The USA comes in second with 84.3 MT (*20.4% of total global consumption*). Over the last 30 years, consumption has merely doubled. The third position is held by the EU countries (*OECD member states*) with 63.7 MT (*16.2%*), a 1.9-fold consumption increase.

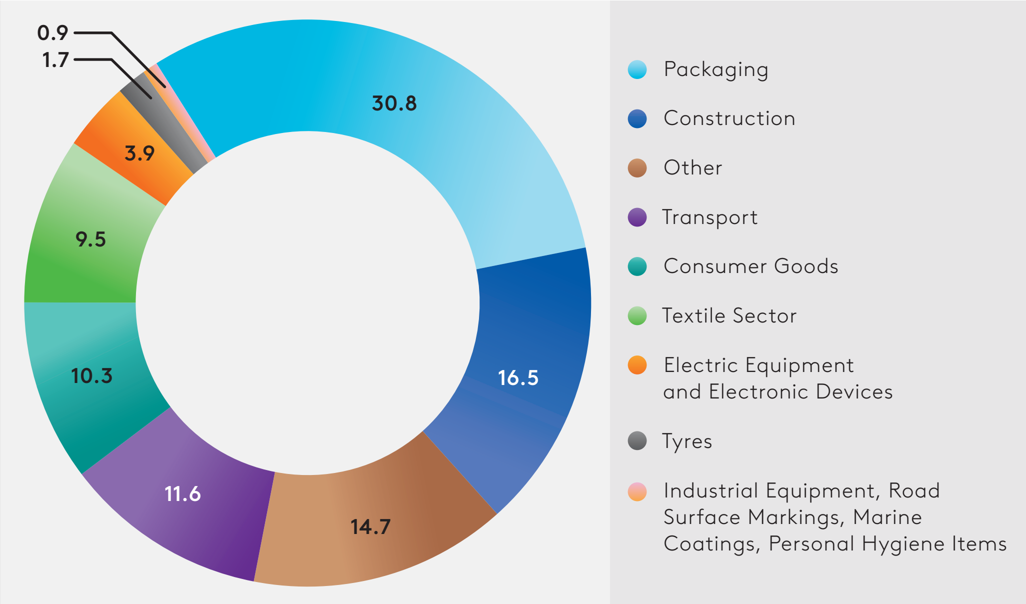
↓ Figure 7. Use of Plastics by Country and Macro-Region in 1990–2019, MT



Source: stats.oecd.org.

The fastest increase in polymer consumption was in developing countries. For example, consumption in India increased 15.5-fold to 29.3 million tonnes (*7.1%*), and there was a 10.6-fold increase in non-OECD Asian countries, a 4.2-fold increase in Latin America, and a 3.8-fold increase in the Middle East and North Africa.

The main application of plastics is in manufacturing of packaging materials (Figure 8). During the period under review, consumption for those purposes amounted to 142.6 MT, or 31% of total consumption. The volume of plastics used to manufacture packaging materials in 1990–2019 increased by a factor of 3.6. Construction comes in second with 76.9 MT (*16.5%*), a 3.5-fold increase. The use of plastics to manufacture consumer products increased by a factor of 3.4 to 46.7 MT (*10.3%*). Information on the use of base polymers in various sectors of the economy is presented in Annex 1.



← **Figure 8. Structure of Plastics Use by Application Area, 1990–2019 averages, %**

Source: stats.oecd.org.

1.5. Key Petrochemical Industry Trends at the Global Level

Geographical Trends

Over the last 20–30 years, the footprint of the global petrochemical industry has changed quite substantially. In the APAC and the Middle East, there was a rapid buildup of production capacity, with a shift in demand for petrochemical products. It is projected that by 2025 annual ethylene production capacity in China will increase to 53 MT, making the country the world's largest manufacturer of that polymer. Singapore will remain a critically important oil and petroleum product blending hub. India will have the world's highest energy consumption growth rate. In the EU, Japan, and South Korea, the petrochemical industry will demonstrate signs of oversaturation and stagnation. The USA is likely to gain fresh momentum as its domestic market forms a surplus of cheap gas used by petrochemical facilities as feedstock.

On the other hand, Europe, having lost access to cheap gas supplies from Russia in 2022, may suffer from a significant slump in petrochemical production. The cost of gas in Europe is five times higher than in the USA and, as a result, high electricity costs make it more profitable to import ready-to-use ethylene (one of the base petrochemical raw materials) than to produce it locally. In 2023, European consumption of naphtha, another cornerstone of the petrochemical industry, dropped to a 50-year low, and is currently 18.5% below pre-COVID levels and 40% below the peak values recorded 20 years ago. This makes domestic petrochemical production in Europe economically unviable, forcing companies to move their production facilities to other regions. Over the last 15 years, investments by European companies in new projects in Asia increased by 50%. These momentous changes open up excellent opportunities for further expansion of petrochemical production in the Eurasian region, by increasing market share and attracting investors to new projects.

Economic Trends

The National Research University of the Higher School of Economics (NRU HSE, 2020) forecasts an increase in the use of large-tonnage polymers by associated production facilities. Demand for ethylene, polyolefin, and PVC will be growing at an annual rate of 3.5%, 4%, and 3%, respectively. Since 2020, there has been a COVID-driven spike of demand for polyethylene due to its intensive use in the manufacture of consumer products (*food packaging, disposable products, HDPE/LDPE/LLDPE films, etc.*). The APAC accounts for more than 65% of global demand for PVC, with China, the USA, Germany, Japan, and France remaining the world's largest producers. Demand for polyethylene terephthalate is growing as textile production is expanding (*replacement of natural fibre with polyether fibre*), and easy packaging is becoming more and more widespread. It encourages commissioning of new production facilities, with China reaching an annual capacity of 10 MT.

There is an increase in global demand for specialty polymers (*engineering thermoplastics, polymer mixes, structural plastics, elastomers, composites, etc.*). Mordor Intelligence (2023) projects that in 2023–2038, the world market for specialty polymers will be growing at an average annual rate of more than 7%. The APAC will become the world's largest and most rapidly growing market in this segment, as China, India, and Japan are upgrading their facilities. For example, many companies are restructuring polystyrene production: in 2022, demand for high-impact polystyrene (55%) exceeded demand for general-purpose polystyrene. In line with this trend, several global manufacturers (*such as INEOS and Versalis*) have already repurposed their facilities to manufacture ABS plastics instead of polystyrene.

R&D costs have increased substantially. During the period from 2011 to 2021, they grew from €6 billion to €15 billion in China, from €7 billion to €10 billion in the EU, from €1 billion to €2 billion in India, from €1 billion to €3 billion in South Korea, and from €7 billion to €8 billion in the US (CEFIC, 2023). In 2020–2022, total global R&D costs in the petrochemical industry stood at approximately $41 billion per year (*2011: $30 billion per year*). For example, in 2022 the amount of funding allocated by the German chemical concern BASF to finance R&D projects was €2.3 billion (*2020: €2.1 billion*) (Engineering Chemical Technology Centre, 2023).

Energy Trends

The structural transformation of the global petrochemical industry is creating long-term advantages for the countries of the Eurasian region. The global economy is going through a new energy transition, which is closely linked to deeper conversion of petrochemical products. A qualitative technological breakthrough requires polymer raw materials (*for example, ethylene is used in the production of photovoltaic elements for solar power stations*). The global petrochemical market will be growing at a compound annual growth rate (CAGR) of **3–6% until 2035** (IEA, 2022). It is projected that global demand for oil by the petrochemical industry will increase by approximately 6 MBPD to 18 MBPD in 2050 vs 2017 (IEA, 2018), which accounts for almost half of total increase in demand for oil. Accordingly, petrochemical regions with substantial resource potential will be playing an increasingly important role.

Global demand for gas will continue to increase until at least 2035 according to EIA projections (until 2050 according to BP scenarios). It is expected that oil and gas consumption peaks will occur in the 2030s and 2040s, respectively, despite the growing demand for renewable sources of energy to minimise the anticipated carbon border tax on exports (BP, 2022).

The projected structure of global energy consumption until 2040 shows a gradual equalisation of the shares of fossil fuels (*oil: 27%, gas: 25%, coal: 25%*) and non-fossil fuels (*all fuels: 23%*), which testifies to the emergence of inter-fuel competition and the increasing stability of power supply (Table 4). Petrochemical projects are acting as energy transition drivers. For example, polymethyl methacrylate is required for LCD screens, high-density polyethylene for automotive components, and ethylene for photovoltaic elements used by solar power plants.

↓ **Table 4. Global Fuel and Energy Balance Structure, %**

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2025	2030	2035	2040
Oil	33.0	33.4	33.5	33.4	32.9	32.7	30.9	31.0	31.6	30.3	30.0	28.8	27.8
Natural Gas	22.5	22.8	23.0	23.2	23.7	23.9	24.5	24.4	23.5	21.3	23.1	24.1	25.0
Coal	29.9	28.9	28.2	27.8	27.4	26.8	26.8	26.9	26.7	25.8	25.0	23.5	25.0
Nuclear Power Generation	4.4	4.4	4.3	4.3	4.2	4.3	4.3	4.3	4.0	6.5	7.5	5.9	5.6
Hydro Power Generation	7.0	6.9	7.0	6.9	6.8	6.9	7.3	6.8	6.7	3.2	1.9	2.9	4.4
RES	3.2	3.6	4.0	4.5	4.9	5.3	6.2	6.7	7.5	12.9	12.5	14.7	12.2

Source: BP Statistical Review of World Energy; Energy Research Institute of the Russian Academy of Sciences.

Technological Trends

The manufacturing of high-value-added products is growing around the world. By the end of 2022, the share of low-tonnage petrochemical products in total output increased (*relative to 2015*) from 28% to 40% in the EU countries, and from 5–7% to 10–15% in developing countries. Production of low-tonnage, knowledge-intensive and expensive goods has become a priority for large petrochemical companies in the USA, Canada, Japan, EU member states, and other developed countries. In that connection, many companies tend to separate and repurpose some of their facilities to manufacture specialty products so as to meet the needs of specific customers and segments of finished product markets. That increases the aggregate added value, and moves high-margin products closer to the end of the process chain (*for example, at BASF, DOW, Henkel, AkzoNobel, DuPont, Huntsman, Hexion, etc.*). The trend is also becoming more pronounced in a number of developing countries, as focus on high-value-added products improves productivity and makes businesses more resistant to crises and adverse changes in market conditions. For example, Guangdong Petrochemical became China's first integrated oil refinery and chemical plant capable of carrying out deep processing of low-grade heavy oil.

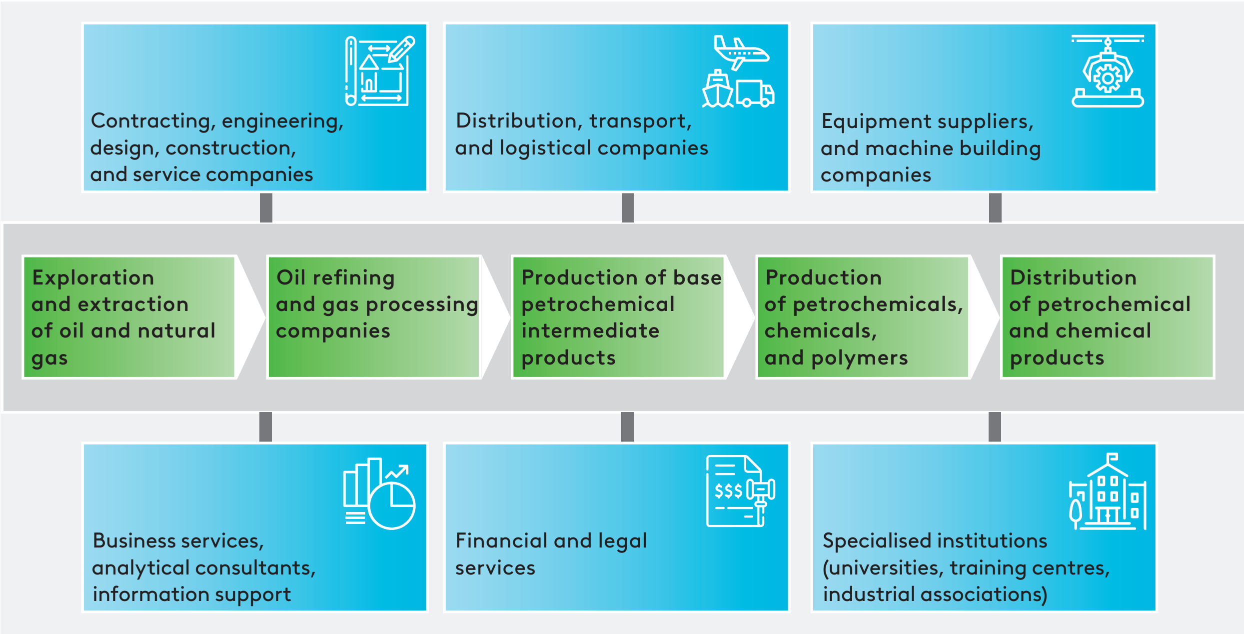
Petrochemical companies are implementing large-scale IT programmes envisaging deployment of innovative technologies, including sensors, predictive analytics, UAVs (drones), cognitive computing, advanced geological data interpretation, robotics, and additive technologies. The mining sector (*exploration and production*) is still spearheading that work with smart wells, digital fields, etc. Digitisation of the petrochemical industry is aimed at increasing oil production at depleted fields, streamlining oil and gas exploration, and accelerating implementation of new oil extraction technologies to enable development of hard-to-recover reserves. Integrated application of information technologies will make it possible to increase the oil recovery rate by 2–7 pp, and cut operating costs by 25%. According to BP estimates, technological advances may increase recoverable reserves by 35%, and reduce production costs by 25%.

Co-operation Trends

Transformation of the global energy space and increasingly fierce competition in the global energy market are forcing participants to seek new competitive advantages, such as economic integration. Integration processes have spread across almost all continents, giving rise to numerous trade and economic alliances.

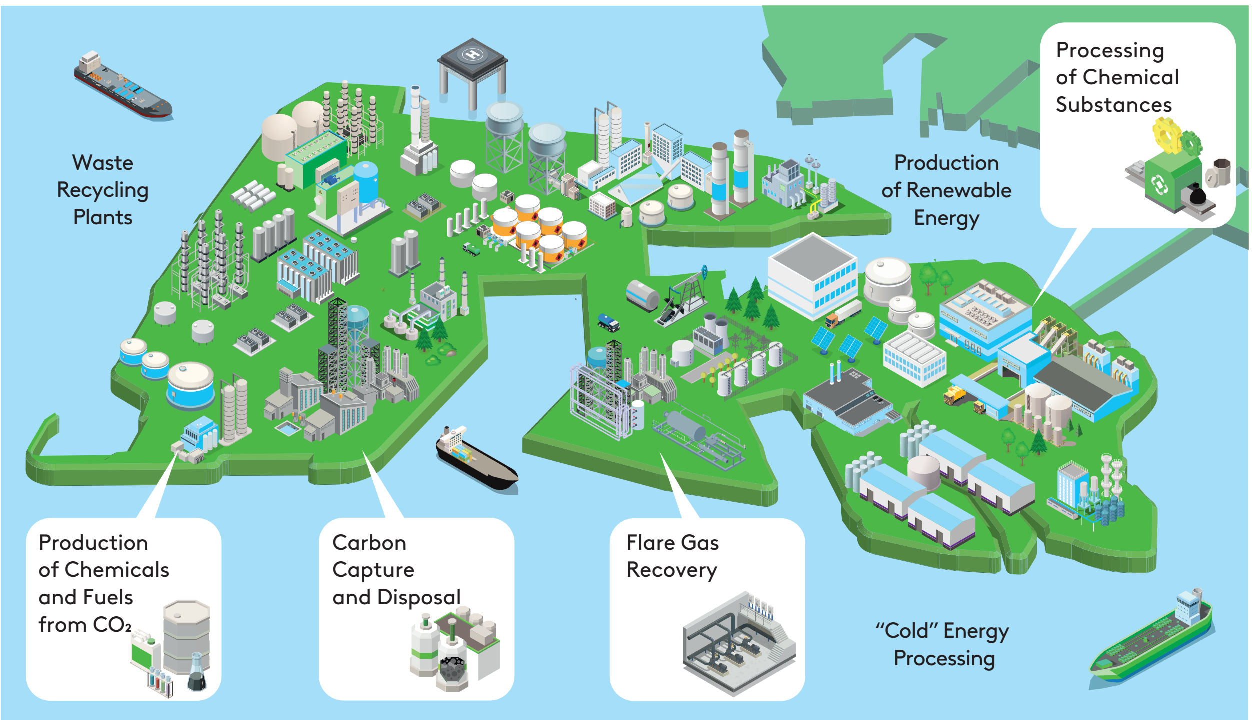
The ongoing global intersectoral co-operation relies on the strengthening of integration between the petrochemical industry and allied industries. Petrochemical companies are building plants to manufacture polymers with an active membrane function designed to screen and sort molecules, materials capable of self-diagnostics and self-adaptation, amorphous materials that regenerate damaged coatings, and new chemical and pharmaceutical substances. For example, BASF (Germany) acquired the pharmaceutical company Ciba, and Dow Chemical (USA) purchased Rohm and Haas, a company specialising in fine organic synthesis products. The American companies Dow Chemical and DuPont completed a $69 billion merger of chemical and petrochemical companies. The German concern Bayer took over the biotech company Monsanto, while the Chinese company ChemChina merged with the Swiss pharmaceutical company Syngenta.

↓ **Figure 9. Structure of Petrochemical Clusters**



Source: EDB.

↓ **Figure 10. Petrochemical Cluster in the Island of Jurong, Singapore**



Source: EDB based on JTC data.

Vertical integration is also proceeding at a fast pace, including through development of industrial clusters. Combination of basic large-scale mass-consumption polymer production facilities with low-tonnage high value-added product manufacturers gives rise to new integration opportunities. This is done primarily in industrial clusters (Figure 9), to achieve economies of scale, facilitate comprehensive utilisation of hydrocarbon materials, pipelines, and infrastructure facilities, and create technoparks and technopolises for relatively small high-tech and innovative production projects (Annex 2).

Key petrochemical cluster examples include the Island of Jurong (*Singapore*) (Figure 10), the petrochemical cluster in Texas (*USA*), and the petrochemical clusters in the cities of Al Jubail and Yanbu (*Saudi Arabia*).

Environmental Trends

The "green agenda", in particular decarbonisation of production, is gaining momentum in the petrochemical industry, which, according to McKinsey (2019), is responsible for 9% of total global anthropogenic greenhouse gas (GHG) emissions. The industry is also producing fuel which accounts for 33% of global emissions. Modern society pays increasingly more attention to environmental safety, which prompts international organisations to launch initiatives (*Paris Climate Agreement, UN Sustainable Development Goals, Recommendations of the Task Force on Climate-Related Financial Disclosures*) incentivising various decarbonisation strategies.

Petrochemical companies are stepping up their decarbonisation efforts by using carbon credits to offset emissions, or by working to ensure compliance with the SDGs to preserve their investment appeal. According to McKinsey estimates, over the last 15 years, the Total Return to Shareholders (TRS) of a medium-sized petrochemical company has been 7 pp below the S&P 500 Index, while global capital investments in the industry exceeded $10 trillion. Decarbonisation technologies are actively used by ExxonMobil (USA), Chevron (USA), Occidental Petroleum (USA), BP (Great Britain), Equinor (Norway), Total (France), Shell (Great Britain), Saudi Aramco (Saudi Arabia), and ADNOC (UAE). In 2021, the World Economic Forum launched the Net Zero Transition initiative aimed at reducing emissions by the plants comprising industrial clusters. The companies which joined the initiative cut their CO_2 emissions to 451 MT/year, which is comparable to total annual emissions by Turkey (WEF, 2023).

According to AMI Plastics (2020), the amount of waste generated in 2019 in the course of production of 368 MT of plastics reached 215 MT (58.4%). To deal with massive waste produced by the polymer industry, stakeholders around the world are developing circular production models. The highest rate of growth of demand for secondary (*recycled*) polymers is in the EU and the USA. Some countries (*EU member states, Thailand, India, and others*) are already taking steps to stop uncontrolled use of disposable plastic items in daily life. In combination with certain other factors (*environmentally friendly technologies, renewable materials, bio-based products*), this encourages companies to focus on recycling plastics and using renewable feedstock.

According to McKinsey & Company, the share of recycled plastics could increase from 6% in 2017 to 10–15% in 2030. Sibur Holding PJSC forecasts that by 2039, the annual rate of growth of demand for secondary polymers may reach 0.3% (*primary polymers: 3.5%*). According to IEA forecasts, development of plastics recycling will result in demand for oil as feedstock for the petrochemical industry dropping by up to 6% by 2030.

It is expected that higher demand for petrochemical products (*average annual growth rate: 1.5%*) will increase consumption of natural resources (*water: x2*) and pollutant emissions (*CO_2: by 30%*). According to WEF (2020), annual losses sustained by the global economy as a result of environmental pollution stand at about $44 trillion. The OECD maintains that soil degradation alone inflicts annual losses of $6–11 trillion.

According to the IEA base technology study, by 2050 CO_2 emissions in the chemical sector will have increased by more than 30% (*relative to 2017*), with 2/3 of that increase occurring before 2030, while in 2030–2050 emissions will continue to grow at a slower rate of slightly below 2 Gt CO_2 per year. The increase in emissions will be caused by a substantial growth of demand for primary chemicals (by 32% by 2030, and by 56% by 2050).

Inasmuch as chemical processes use massive amounts of coal, oil, and natural gas, in 2017–2050 global freshwater intake for use in primary chemical production will triple to 12 BCM due to higher indirect water intake. Water consumption will increase from 2 BCM in 2017 to almost 5 BCM by 2050.

1.6. Key Barriers to Global Petrochemical Industry Development

Trade Barriers

The uncertainty of the global geopolitical situation is leading to shifts in the macro-regional structure of petrochemical imports/exports, affecting logistics and production costs. The ban imposed by the USA, Great Britain, and Australia on Russian oil imports, and the EU price embargo on maritime shipping of Russian oil resulted in a redistribution of the global petrochemical market. Many countries redirected their exports to China, India, Turkey, and the countries of the Middle East and North Africa. At the same time, China is rapidly reducing polymer imports in line with its technological independence and import substitution policies.

There is a long-standing division of polymer production among the key global players (*China, Japan, India, USA, Canada, and others*), which makes it difficult for new players to enter the petrochemical market for the following reasons:

1. high capital expenditures (*capital construction, acquisition of equipment and expensive feedstock, etc.*);

2. continuous cost increases due to the rise in energy and transport prices;

3. restricted access to primary feedstock for the production of polyethylene, namely, ethylene and its co-monomers;

4. the need to find equipment suppliers (alternative: in-house development and deployment);

5. problems with customs clearance of polymers;

6. challenges related to finding new markets because of long-established ties in transport, logistics, and communications.

The lack of adequate petrochemical infrastructure in developing countries hinders expansion of export/import operations. The petrochemical industry needs an extensive infrastructure, which assumes availability of well-coordinated warehousing and logistical systems, a ramified transport network, modern pipeline systems in petrochemical clusters, and sufficient areas to accommodate service companies.

Production Barriers

There is surplus petrochemical capacity in some regions of the world. Although petroleum products were supplied by developed countries, developing countries (*especially China and the countries of the Middle East*) created their own large petrochemical facilities. Increasingly strict carbon dioxide emissions regulations will further reduce available capacity. The Eurasian region has substantial oil and gas reserves which can be extracted at a relatively low cost. Reasonable and effective utilisation of domestic resources and exportation of petrochemical products to target markets at low prices may give the countries of the Eurasian region a major competitive advantage.

Global petrochemical facilities commissioned at the middle and end of the 20th century have deteriorated and become obsolescent. Some of the most frequent signs of wear and tear in basic production assets include breaches, dents, loss of containment by fuel tanks, failure of cocks, valves, or faucets, and rusting. The factors causing or accelerating wear and tear include natural hazard events (*severe frosts, hurricanes, earthquakes*), insufficient funding, poor maintenance, lack of experience and neglect on the part of operators. To improve the state of repair of petrochemical assets, it is necessary to apply systemic measures, including timely replacement of old equipment and installation of new equipment, use of modern technologies to detect oil and gas leaks, and continuous monitoring of oil pipelines and gas transmission networks.

Depth of oil conversion is one of the most important drivers of petrochemical industry competitiveness. However, at the end of 2014, global average depth of oil conversion was estimated at 87%: 94% in North America, 89% in Asia, 86% in Europe, 76% in Central and South America, 73% in the Middle East and Africa, and 71% in Russia (PRONPZ, 2019). In 2019, it reached 90–95% in the USA, 85% in the OPEC member states, and 85–90% in Europe (Business Profile, 2020). In 2020, depth of conversion in Russia rose to 83%. However, it varies from refinery to refinery: at some facilities (*for example, Omsk and Volgograd refineries*) it stands at 92%, while others fail to achieve the levels that prevailed in the middle of the 20th century (60%) (Chebotova and Udanov, 2021). In 2019, LUKOIL (Russia) extracted more than 80 MT of oil, but produced less than 2 MT of petrochemical products.

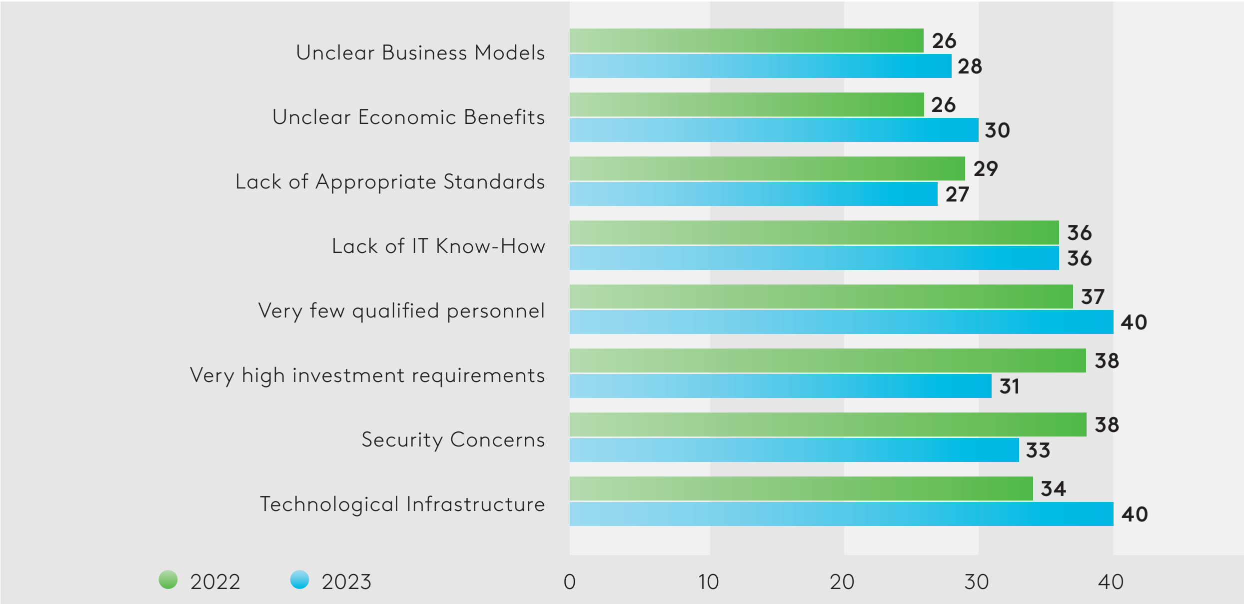
The petrochemical industry is energy-intensive, with the share of fuel at 42%. Only 23–26% of total energy consumed by refineries was utilised efficiently, while 74–77% was lost (*flue gases: 14–16%; cooling water and air: 48–52%; emissions: 8–12%*) (Glagoleva and Piskunov, 2021). Process plants consume the most energy. For example, the aggregate capacity of drilling rigs used for the construction of deep operating and prospecting wells is an impressive 3–5 MW. According to the IEA baseline study, total energy-intensity of primary chemical production will decrease by 3.4% by 2030, and by another 2.6% by 2050 (*relative to 2017*).

Technological Barriers

Petrochemical plants in developing countries are actively procuring licensed equipment, as the R&D stage may last for up to 10 years. The share of imported equipment and technologies in the industry is rather high, ranging from 80% to 95%. The degree of import dependence is proportional to the complexity of the technological process: the share of imports in equipment whose manufacturing involves more metal-working and less complex engineering operations (*reactors, columns, tanks, reservoirs*) is about 20%. For example, six licensors (*Chemtex, Scientific Design, Grace Catalysts and Technologies, Sinopec, Topsoe, and Versalis*) are involved in the construction of an MTO gas chemical complex in Uzbekistan, with estimated construction costs at $3.1 billion (MTO Gas Chemical Complex, 2023). It is critical that equipment repair and maintenance requirements formulated by the foreign licensors be strictly observed, which limits the licensees' freedom of action.

The extent of technological advancement and digitisation in the world remains insufficient when it comes to manufacturing high value-added petrochemical products. Meanwhile, the IEA estimates that application of digital technologies can cut petrochemical production costs and boost performance of petrochemical corporations by 12–20% (Raunholt et al, 2017). According to the EY DigiChem SurvEY (Figure 11), 40% of respondents believe that the main barrier to digitisation at their plant is lack of qualified personnel; 38% maintain it is massive initial capital expenditures; 38% cite digital security challenges, and 36% mention the absence of requisite know-how.

↓ **Figure 11. Main Barriers to Digitisation According to Petrochemical Company Managers (more than 2,000 respondents from 51 countries)**



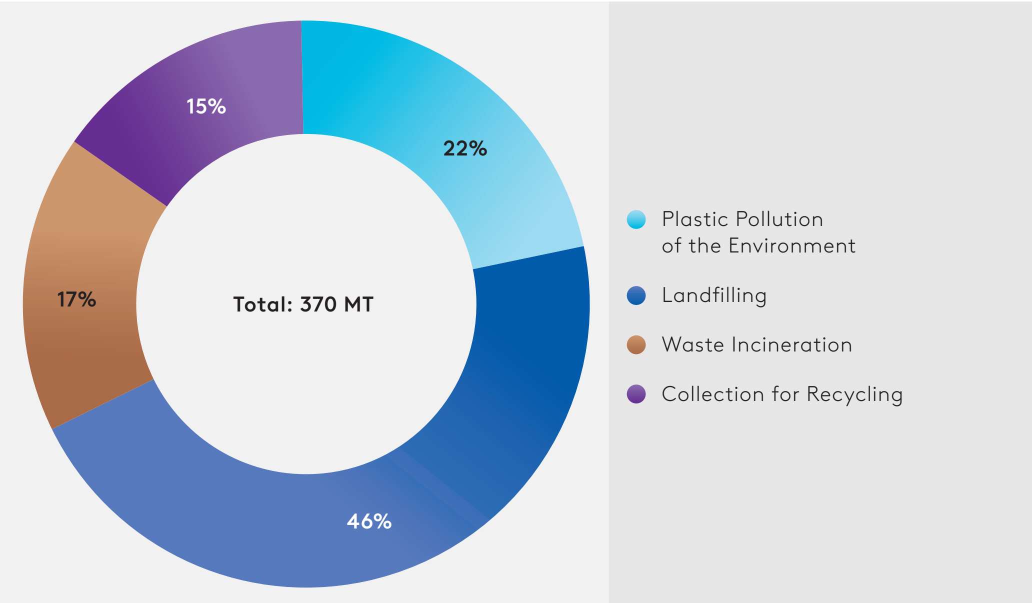
Source: EY DigiChem SurvEY.

With the increasing complexity of exploration of oil fields and extraction of new oil and gas, regulations governing R&D support of those activities are becoming more and more rigorous, which is creating a pressing need for cutting-edge equipment that can be used to discover and develop hard-to-recover oil and gas reserves. For example, the overall level of technical sophistication of production facilities in China is not sufficient to support oil and gas exploration and development to the extent required to build up reserves in line with current needs (Jiaxin and Popova, 2014).

Environmental Barriers

The current trend toward a circular economy is intended to maintain environmental safety. One of the key environmental agenda items is to discontinue uncontrolled daily use of disposable plastic items (*polyethylene bags, straws, disposable tableware, etc.*) which are mostly made of polyethylene and polypropylene (Covestro, 2023). With more than 35 countries (*EU member states, Thailand, India, and others*) joining this initiative, it is likely to reduce global demand for plastic and petrochemical feedstock. However, despite the trend to substitute plastic packaging with environmentally friendly materials, a ban on disposable plastic items in many countries was postponed with the onset of the COVID-19 pandemic. Consumers, retailers, and food producers favoured disposable bags and tableware over reusable items (*for both sanitary/hygienic and economic reasons — plastic is cheaper*).

Because of the complexity of polymers, their production and practical utilisation are often accompanied by discharge of harmful low-molecular substances. The carbon dioxide emission intensity rate during the production of plastic, glass, and aluminium is 0.2, 0.7, and 8.1 tonnes per 1 tonne of finished product, respectively. Most petrochemical products, especially polymers (*for example, packaging polymers*), have short life cycles. On the average, polymer packaging material is used for a maximum of 30 days. Then it is classified as waste, and disposal of 85% of such waste on a global scale is inefficient and/or unsafe (Figure 12). The average decomposition time for plastic items is 400–700 years, for polyethylene bags 100–200 years, for aluminium 500 years, and for glass more than 1,000 years. In the absence of effective recycling solutions, environmental factors will hinder intensive development of the petrochemical industry.



← **Figure 12. Treatment of Plastic Waste in 2019**

Source: OECD Global Plastics Outlook Database.

1.7. Global Petrochemical industry: Long-Term Development Drivers

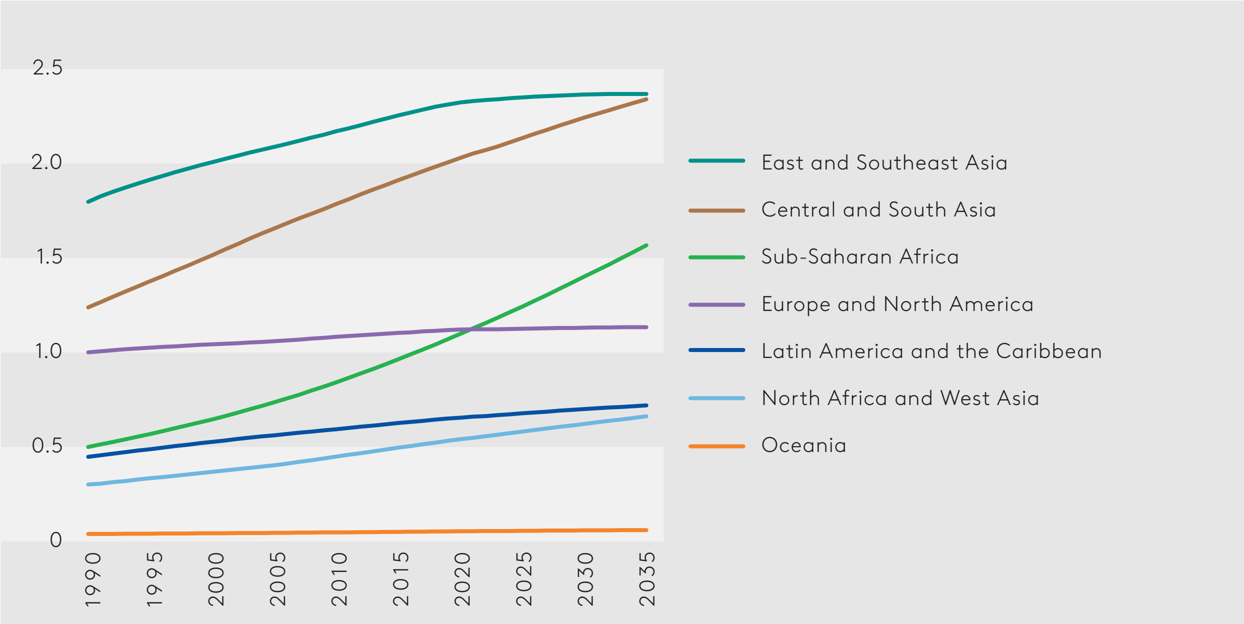
Despite the current situation in the petrochemical industry, we expect substantial market growth going forward. The global petrochemical industry has good long-term development prospects that will be generally defined by demand volume and structural trends, availability of raw materials and energy, introduction of new technologies, and plans for the deployment of new, more competitive production capacity.

Demand-Side Trends

Consumption of many types of petrochemical products (*especially packaging and construction materials, and mechanical engineering composites*) will be directly affected by population growth. The UN projects that in 2023–2035, the world's population will increase by 10% from 8 billion to 8.8 billion people (UN, 2022). Most of that growth will occur in Africa and Asia, which will be home to more than 78% of the world's population by 2035 (Figure 13).

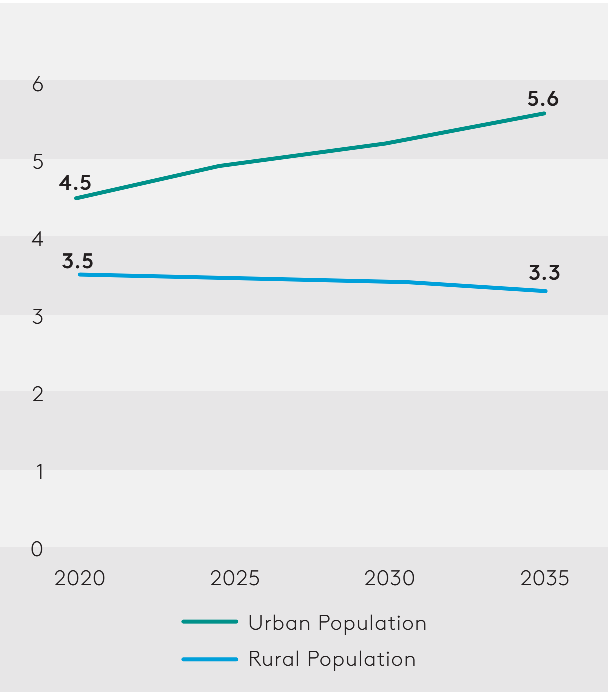
Another long-term trend is global urbanisation (Figure 14), accompanied by increased consumption of polymer packaging (*40% of total demand of polymers*). According to the Institute for Economics & Peace (2022), by 2035 the world's urban population will increase by more than 20%, with the number of people living in rural areas declining to some extent. The share of urban residents will grow from 55% to 63%. The countries of Africa and Asia with a low level of development will account for the largest increase in urban population (Figure 15).

↓ Figure 13. Population of the World in 1990–2035, billion people

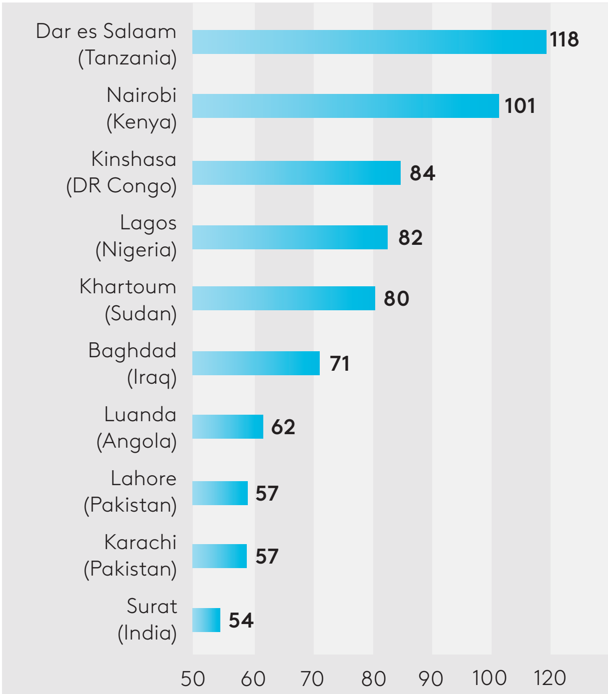


Source: UN (World Population Prospects, 2022).

↓ Figure 14. Urban and Rural Population of the World in 2020–2035, billion people



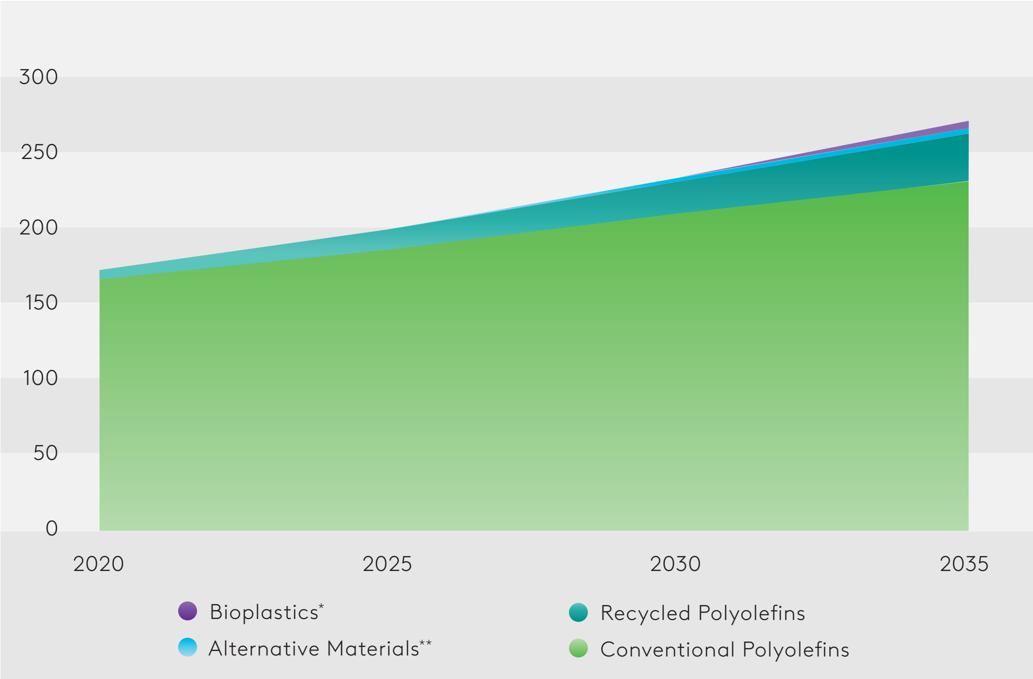
↓ Figure 15. Top 10 Megalopolises of the World by Population Growth Rate by 2025, % relative to 2022



Source: Institute for Economics & Peace (Ecological Threat Report, 2022).

Another driver of growth of demand for petrochemical products is the ongoing expansion of the global economy. A substantial part of petrochemical goods and services goes to meet intermediate demand. According to calculations performed on the basis of the World Input-Output Database, more than 80% of chemical products, rubber, and plastic items manufactured in the world is used as semi-finished products in other sectors.

Global demand for polymers will surpass polymer waste-recycling volumes until 2035 (Figure 16), because most of that demand will be generated in Asia and Africa, while polymer waste-recycling growth will be occurring in developed economies (*where demand for polymers will be increasing at a slower rate*). Developing countries will have to face the challenges related to recycling polymer waste and secondary plastics at a later stage.



← **Figure 16. Projected Global Demand for Polyolefin until 2035, MT**

Note: * Bio-polymers, polylactic acid, polyhydroxy acid. ** Polyethylene terephthalate, glass, etc., and new polymers (super plastics).
Source: Kostin, 2021.

Technological Drivers

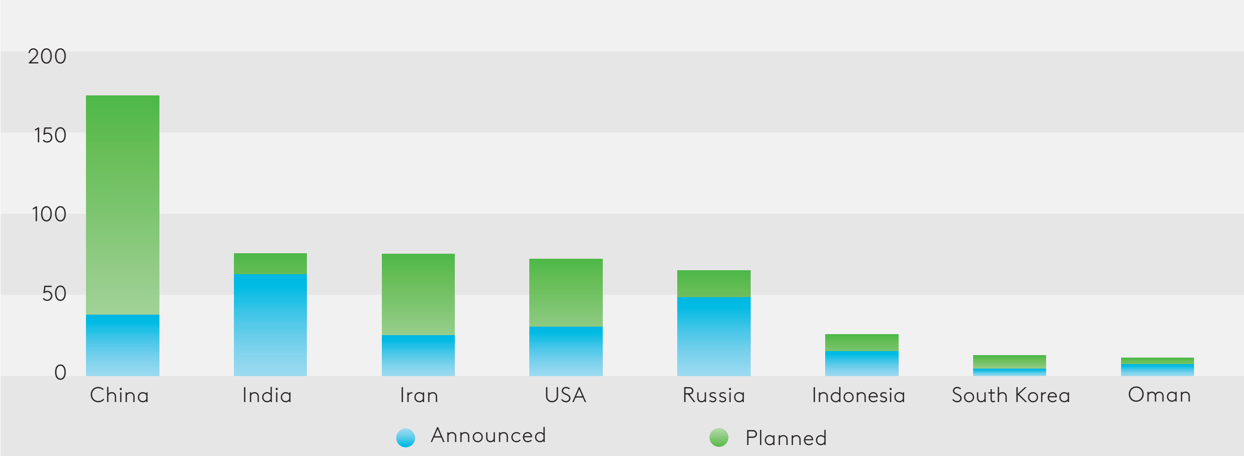
The number of technologies implemented in the petrochemical industry will also have a considerable impact on its development. According to the WIPO, more than 22,000 macromolecular chemistry and polymer patents were registered in 2018–2022, with an average annual growth rate of 2.3%, and the share of such patents in the total number of all patents registered during the same period was 1.7%. In the foreseeable future, emergence of new energy-efficient petrochemical processes will facilitate active transition of the industry to a sustainable development path (WIPO, 2023).

Those technologies have a substantial development potential, and their application in conventional industries is expanding, which makes it possible to manufacture end products that are less expensive or have better consumer properties. In the future, both of those options will boost final consumption and, consequently, increase the volume of petrochemical products, including high-value-added products (high-tech polymers) used in the economy.

Deployment of New Production Capacity

In the future, global annual petrochemical production capacity should increase substantially from 2,397.1 MT in 2022 to 3,233.8 MT in 2030 (Business Wire, 2023). GlobalData experts anticipate that the largest number of newly commissioned petrochemical facilities will be deployed after the APAC, in the Middle East (Figure 17). An analysis of the regional breakdown of petrochemical projects shows that large-tonnage petrochemical capacity will continue to concentrate primarily in developing countries. In this respect, the Eurasian region has a substantial potential to expand its petrochemical capacity, but the petrochemical race will be won by whoever is the first to offer enough polymers at affordable prices.

↓ **Figure 17. Announced and Planned Petrochemical Capacity* by Country in 2019–2030, MT**



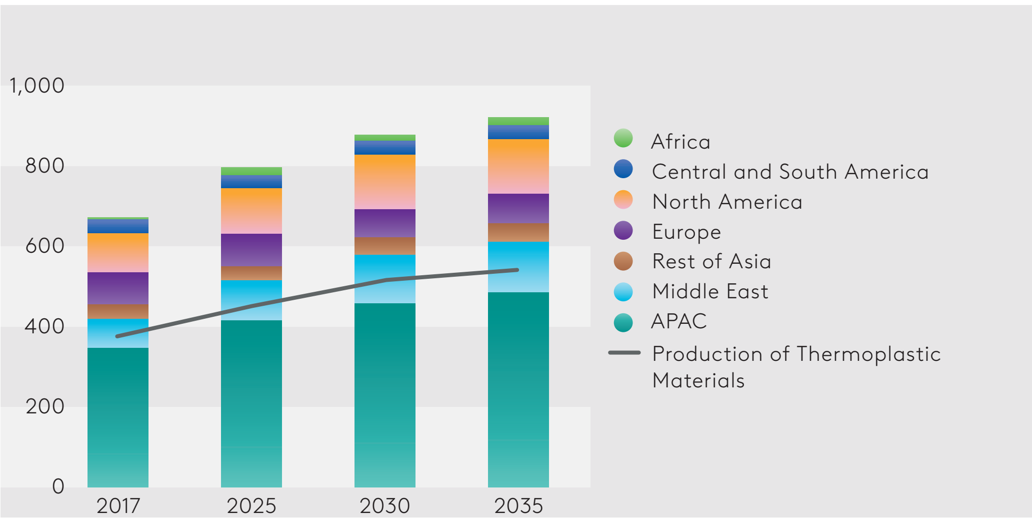
Source: Statista, 2020.
* Petrochemical capacity includes all process stages starting with feedstock processing.

It is projected (NexantECA, 2022) that, in the near future, the available supply of basic petrochemical products will no longer be sufficient to cover the ever-increasing demand. Prompt implementation of large-scale petrochemical projects based on the processing of cheap Eurasian feedstock will be the proper response to the constantly growing global demand for polymers, enabling manufacturers from the Eurasian region to maintain a strong position in the global market over the long term.

Active development of the petrochemical industry requires significant investments, and the state should assume the role of the main growth accelerator, failing which there may soon emerge a shortage of production capacity, causing a structural imbalance strongly biased in favour of demand, and making petrochemical products more expensive. However, the Eurasian region can offer a solution based on its competitive advantages (see the following sections).

Global Long-Term Development Prospects

An analysis of the combined impact produced by multiple factors leads us to the conclusion that, under the baseline scenario (*assuming that the current economic and political trends remain unchanged*), the global petrochemical industry will be growing at a relatively fast pace. We project that, over the long term, global production and consumption of petrochemical products, including polymers, will increase, primarily in developing countries (Figure 18).



← **Figure 18. Projected Global Production of Primary Chemical Substances and Thermoplastic Materials until 2035, MT**

Source: EDB estimates.

The predominant trend in the global chemical industry is fragmentation of production capacity, with an increase in the number of companies engaged in low-tonnage production of customer-specific specialty items. As a result, the locus of creation of added value in the chemical industry is shifting from large-tonnage production (petrochemical industry) to the medium- and low-tonnage segment.

In that connection, we forecast continued rapid growth of polymer consumption, and further "plastification" of the world economy without any significant limitations. In developed countries, the rate of increase of consumption remains pegged to the growth of per capita GDP (with some lag, in line with a long-standing trend), while developing countries will experience an accelerated "plastification", a remake of what happened in the world economy in the 1980s and 1990s.

It is expected that the global petrochemical market will be growing at an aggregate annual rate of 3–6% until 2035, as the petrochemical industry is a priority development segment, and the market for its products is expanding faster than the market for conventional materials. Therefore, in the next 3–5 years the industry will be attractive for investors. We also project surplus demand for petrochemical products in the markets of developing countries, particularly China and India. At the same time, supply growth rates will gradually exceed demand growth rates, and development of the petrochemical industry will slow down.

According to IEA projections (2018), by 2035 global production of primary chemical substances and thermoplastic materials (base polymers) will increase by more than 20% and more than 25%, respectively. The APAC and the Middle East will account for the bulk of that increase. To a large extent, it will be supported by growth of per capita plastics consumption and growth of population — the two key factors generating demand for polymers. Accordingly, feedstock flows (oil, natural gas) will be gradually redirected to those regions. It is projected that North America will follow the APAC with an average annual growth rate of 6%, while in Europe that indicator will be 4%.

1.8. International Experience in Financing of Petrochemical Projects

Over the last decade, the global chemical industry has attracted a significant amount of investments. According to expert estimates (Bauer et al., 2023), in 2010–2020, more than $238 billion was invested in 56 large petrochemical projects (projects with capital expenditures of $1+ billion). Of that amount, $205 billion was provided by private institutions, and $33 billion by public institutions ($165 billion, or 70%, was invested in polymer production). The two forms of financing are closely linked. State involvement in the financing of large capital-intensive projects guarantees a certain level of trust, and triggers inflow of private capital. Besides, companies with state equity participation are often classified as private. In fact, the boundaries between public and private companies in the industry are often blurred.

The list of public financing sources features both national and international institutions, including the following:

1. *National development banks* are established mostly in countries with emerging markets and in developing countries to support domestic industrial development by providing guarantees for loans, credits, and fixed-income instruments.

2. *State-owned companies* operating in the gas and oil industry or in the petrochemical industry. Such companies provide equity for the development of petrochemical infrastructure both domestically and abroad.

3. *National welfare funds* are particularly widely represented in oil- and gas-producing countries. They also invest both at home and abroad.

4. *Central banks* in industrially developed countries and countries with emerging markets provide financing by purchasing bonds issued by petrochemical companies. For example, during the qualitative easement period, the European Central Bank acquired petrochemical bonds for €14–15 billion.

5. *Export credit agencies* (*ECAs*) provide support in the form of guarantees, credits, or fixed-income instruments to finance procurement in foreign countries of goods and services in situations where they cannot be purchased domestically on market terms, for example, because of excessive risks or high costs. The total value of direct financing of petrochemical projects and credit guarantees provided by ECAs in 2000–2021 is estimated at $31 billion and $23 billion, respectively.

6. *Bilateral development banks* provide grants, credits (often on soft terms), and guarantees, and (in rare instances) acquire equity participations in petrochemical projects, or offer direct budget support.

7. *Multilateral development banks* (*MDBs*) are also actively involved in the financing of petrochemical projects. In 2010–2020, they provided financing of about $7.5 billion. The MDBs offer the same financial instruments as bilateral development banks in developing countries, but are less exposed to the influence of national political or commercial interests.

Box 2. Financing of the Project for the Construction of the Ustyurt Gas Chemical Complex (UGCC, Uz-Kor Gas Chemical) in Surgil Field (Uzbekistan)

The value of the project is $4 billion.

The plant can annually process 4.5 BCM of natural gas, and produce 3.7 BCM of commercial gas, 387 KT of polyethylene, 83 KT of polypropylene, and other valuable petrochemical products.

UGCC's $1.4 billion capital is divided among four companies: (1) STX, South Korea (5%); (2) Lotte Chemical Corporation, South Korea (17.5%); (3) Korea Gas Corporation, South Korea (17.5%); (4) Uzbekneftegazprom, Uzbekistan (50%).

The tender for the arrangement of external financing was announced in 2009; the Asian Development Bank signed the contract in January 2012, and project financing was completed at the end of 2013.

In addition to the shareholders' equity, 52% of total project financing was provided by private financial institutions (mostly from the Asia-Pacific Region), while the remaining 34% came in the form of debt financing offered by state-owned ECAs. The final project financing arrangements were approved in May 2012. The list of financing providers also included multilateral and national development banks.

South Korean private financial institutions took the lead in terms of both direct financing and provision of credit guarantees, which is hardly surprising considering that three of the four UGCC owners are Korean companies: Korea Gas Corporation, Lotte Chemical Corporation, and STX Energy.

Source: Bauer et al., 2023

Banks, companies specialising in extraction of fossil fuels (primarily oil and gas) and petrochemical companies are the most important sources of financing. While banks usually extend credits and participate in the issue and acquisition of bonds, petrochemical and gas companies mostly provide equity. It is important to understand that petrochemical companies and mining companies are closely linked. The latter often own large blocks of shares in the former, or the former are subsidiaries of the latter. Of the 52 large petrochemical companies, many are also engaged in extraction and processing of fossil fuels.

The global bond market is one of the key sources of financing for new large investment projects. The global petrochemical industry frequently uses bonds to finance investment activities and other operations. An analysis of Bloomberg global bond market data shows that at the end of 2021 there were more than 2,300 outstanding bond issues originated by chemical companies with a total value of $135 billion, which illustrates the massive scale of investments in the petrochemical industry.

2. SCENARIO-BASED FORECASTS FOR PETROCHEMICAL PRODUCTION DEVELOPMENT POTENTIAL OF THE EURASIAN REGION UNTIL 2035

2.1. Significance of the Eurasian Region for the Global Petrochemical Market

The petrochemical sector of the Eurasian region is relatively weak. For example, in Russia (where it is the strongest among the countries of the region) it accounts for merely 2.9% of total generated added value. Armenia, Tajikistan, and Kyrgyzstan do not manufacture petrochemical products, and oil and gas consumption is represented by manufacture of petroleum products and the energy sector.

The share of the Eurasian region's petrochemical industry in the global market is modest (Table 5), with output at merely 2.1% of the total. However, regional consumption exceeds production and, accordingly, imports exceeds exports.

↓ **Table 5. Shares of the Countries of the Eurasian Region in the Global Petrochemical Market, 2021, % of total**

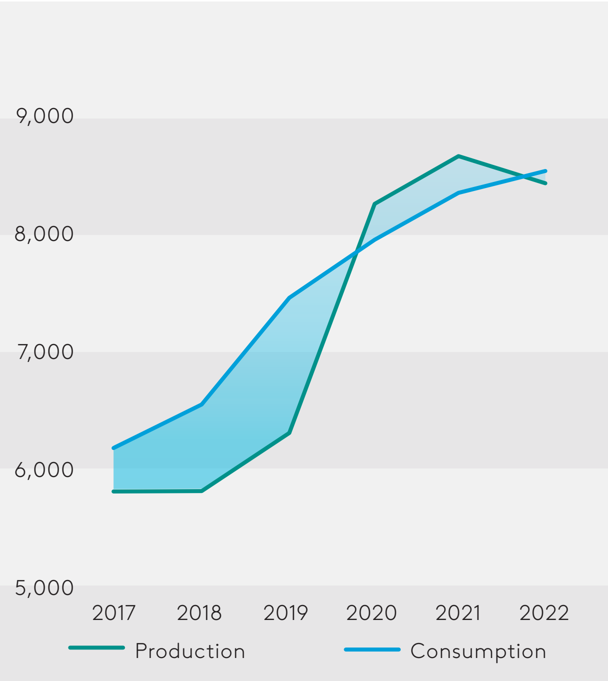
Country	Production	Consumption	Export	Import
Armenia	0	0.01	0.01	0.03
Belarus	0.09	0.1	0.13	0.21
Kazakhstan	0.01	0.1	0.02	0.22
Kyrgyzstan	0	0.04	0.01	0.03
Russia	1.93	1.62	0.8	1.64
Tajikistan	0	0.05	0	0.01
Turkmenistan	0.05	0.02	0.02	0.02
Uzbekistan	0.01	0.18	0.05	0.12
Eurasian Region	**2.08**	**2.12**	**1.04**	**2.27**

Source: national statistical agencies, Cisstat, TradeMap.

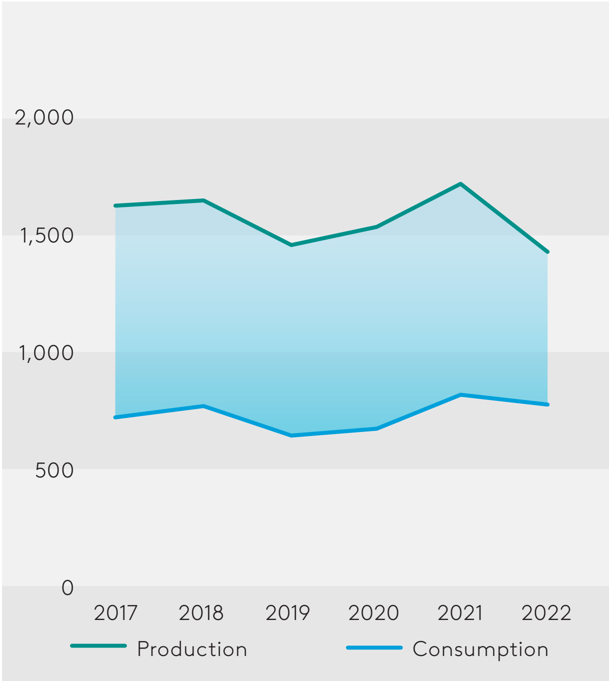
The absence of domestic petrochemical facilities in Armenia, Tajikistan, and Kyrgyzstan forces them to consume imported products. Belarus has polyethylene and polyethylene terephthalate production facilities; Kazakhstan manufactures polystyrenes, polyethylene, and polypropylene; Uzbekistan and Turkmenistan — polyethylene and polypropylene. In addition, Uzbekistan manufactures polyvinyl chloride, and Turkmenistan manufactures polyethylene terephthalate. Russia produces the full range of base polymers and synthetic rubber. Development of the petrochemical complex facilitated satisfaction of demand for polymers in the Eurasian region. Over the last several years, production of base polymers and synthetic rubber exceeded their consumption (Figures 19 and 20).

For reference: *In Russia base polymers account for about 85% of total polymer production.*

↓ **Figure 19. Production and Consumption of Polymers in the Eurasian Region, KT**



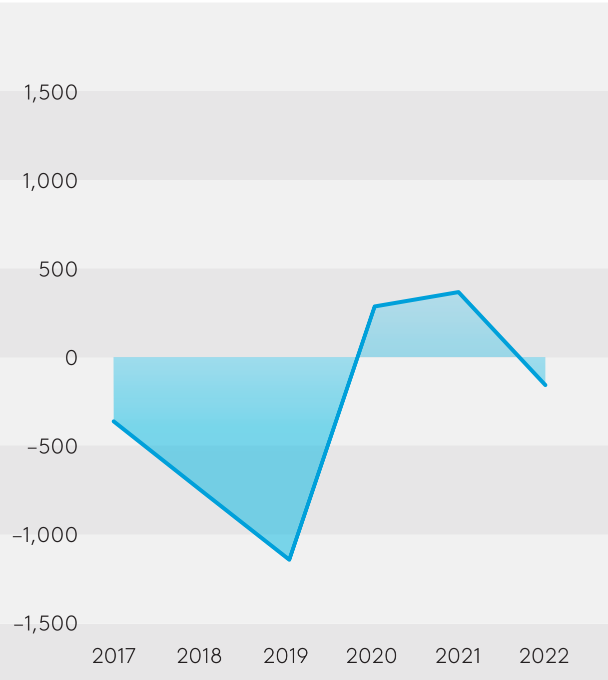
↓ **Figure 20. Production and Consumption of Synthetic Rubber in the Eurasian Region, KT**



Source: national statistical agencies, TradeMap.

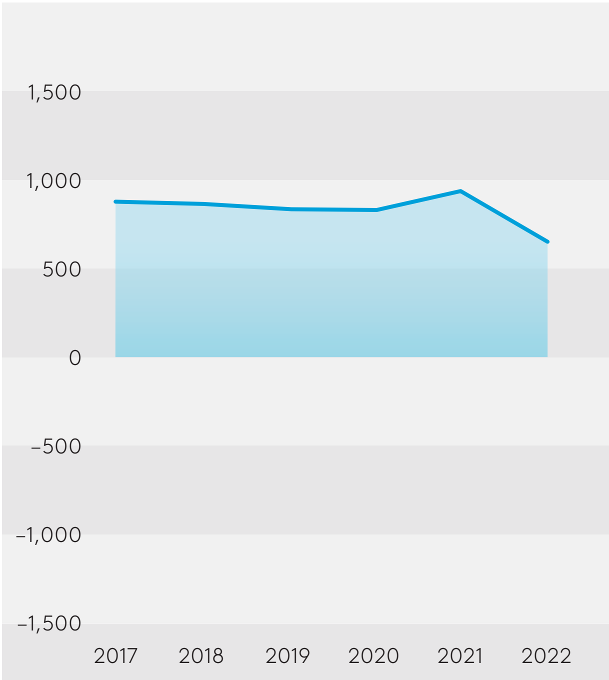
As a result, the countries of the Eurasian region have achieved a positive balance of foreign trade in base polymers (Figure 21). The positive balance of foreign trade in synthetic rubber decreased, but remained positive (with the exception of 2022, Figure 22).

↓ **Figure 21. Net Export of Base Polymers from the Eurasian Region, KT**



Source: TradeMap.

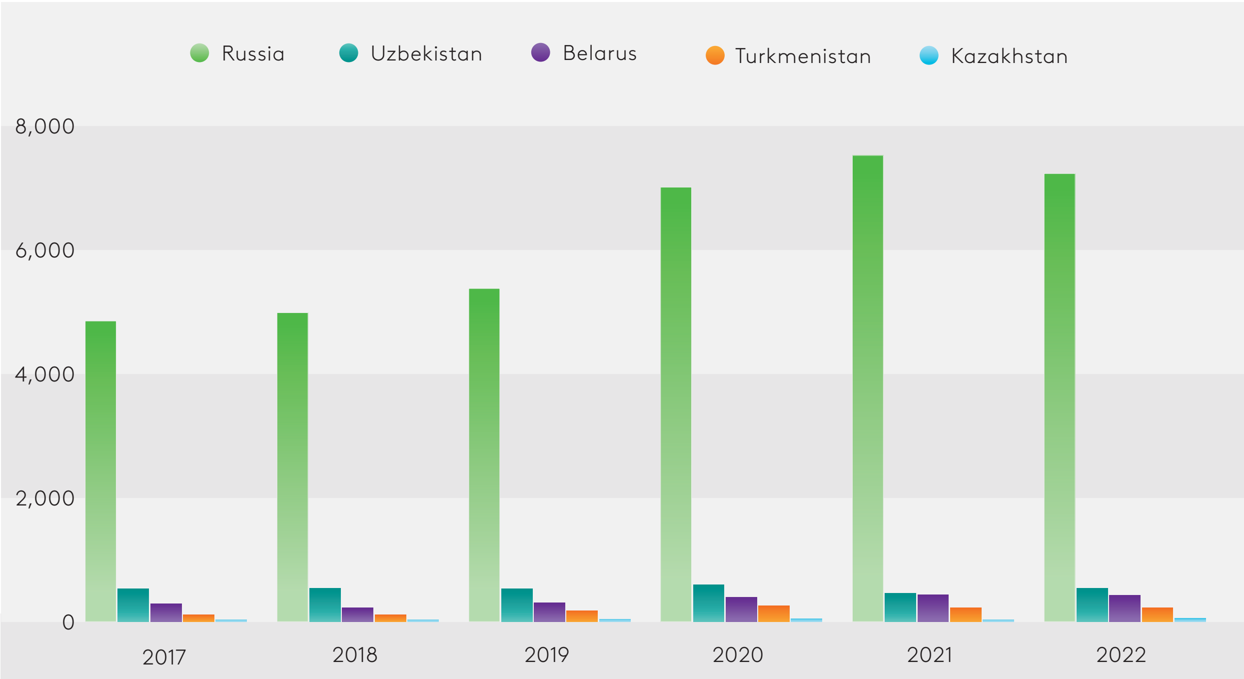
↓ **Figure 22. Net Export of Synthetic Rubber from the Eurasian Region, KT**



Source: TradeMap.

Eurasian petrochemical market trends are largely shaped by changes in production and consumption of petrochemical products in Russia. In 2022, Russia manufactured 86% of base polymers in the region (Figure 23). The shares of Uzbekistan and Belarus were 6% and 5%, respectively, while Turkmenistan, Tajikistan, Kyrgyzstan, and Kazakhstan together accounted for 3% of total production. Armenia does not have any significant petrochemical facilities.

↓ Figure 23. Production of Base Polymers in the Eurasian Region, KT



Source: national statistical agencies.

The share of Russia in total regional production of polyethylene is 80.9%, polypropylene 94.6%, polyvinyl chloride 94.3%, and polystyrene 99.5%. Over the last several years, the Russian market has been characterised by the following trends: production of polyethylene doubled; production of polyethylene terephthalate and polypropylene increased significantly; and production of synthetic rubber declined. An increase in polymer output was also observed in Belarus, Kyrgyzstan, and Tajikistan.

Production of practically all types of base polymers covers most consumption, whereas dynamics in the balance of foreign trade in polymers has certain differences (Figure 24). For example, expansion of production of polyethylene and polypropylene reduced their share in total imports, while exports of those polymers increased.

Production of polyvinyl chloride and polystyrene demonstrated no positive dynamics; domestic consumption of polyethylene terephthalate almost doubled, while its production increased by only 22%. Output of synthetic rubber (the most export-oriented petrochemical products) declined, presumably due to a slump in external demand.

An analysis of the balance of production, consumption, and foreign trade in petrochemical products in the Eurasian region shows that several countries tend to specialise in certain products, mostly due to availability of feedstock and historically established production facilities. The needs of many countries for certain products remain unsatisfied. In that connection, it is advisable for the countries of the Eurasian region to expand co-operation so as to fully meet demand for petrochemical products.

↓ Figure 24. Production, Exports, Imports, and Apparent Consumption of Key Large-Tonnage Petrochemical Product Groups in the Eurasian Region in 2017–2022, KT

Source: national statistical agencies, TradeMap.

The main competitive advantages of the Eurasian region in the petrochemical market include the following:

- cost-competitive and growing resource base in traditional and new extraction regions, low petrochemical feedstock prices;
- well-developed oil and gas transport infrastructure, significant railway and maritime transport logistical capacity;

- growth of domestic and foreign sales markets: active expansion of the Asian markets and increase in production costs in the European markets give an additional competitive edge to Eurasian producers;

- portfolio of Eurasian investment projects assuring larger volumes and higher productivity in 2023–2038 (see Section 2.4).

On the other hand, the Eurasian petrochemical industry is facing a number of challenges:

- uneven development of national economies in the region and, consequently, of their petrochemical capacity, and uneven consumption of petrochemical products;

- slow modernisation of production facilities, slow deployment of new production capacity, and insufficient R&D investments, which reduces product competitiveness;

- high logistical costs due to the region's geographic position;

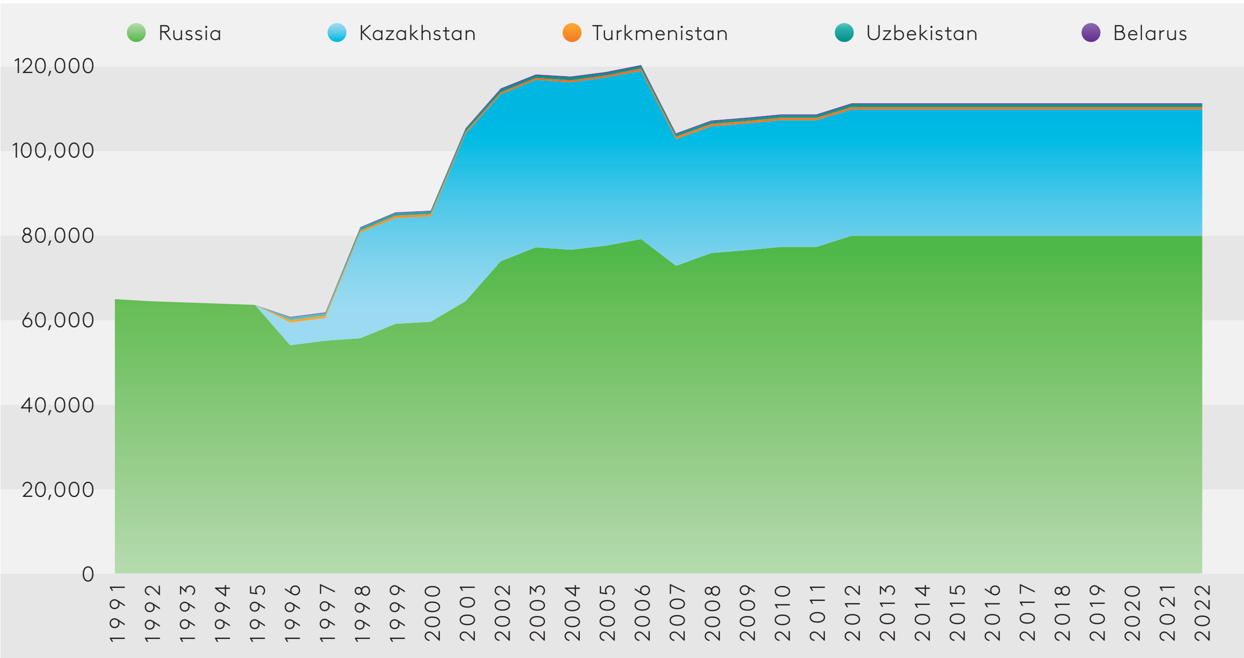
- inadequate development of human capital potential, and insufficient number of high-productivity jobs.

The main factors determining the development of the petrochemical industry in the Eurasian region will remain the scope of newly deployed capacity and, consequently, of investment in petrochemical production, domestic consumer demand, intermediate consumption of polymer products by conventional sectors of the economy ("plastic-intensity" of the economy), export potential, and technological import substitution.

2.2. Robust Resource Base of the Eurasian Region

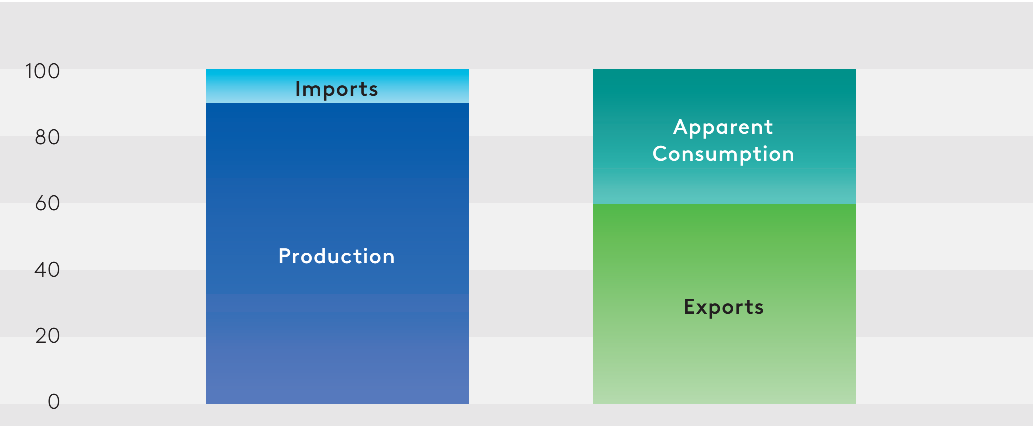
In 2022, proven oil reserves of the Eurasian region were estimated at more than 115 Gbbl (Figure 25). **Russia** has the largest oil reserves (*70.5% of total volume, 7th place in the world*).

↓ **Figure 25. Proven Oil Reserves in the Eurasian Region, MMbbl**



Note: Oil reserves in Armenia, Kyrgyzstan, and Tajikistan are absent or insignificant.
Source: OPEC, 2023. Annual Statistics Bulletin.

More than half of all oil extracted in the Eurasian region is exported (Figure 26), which gives rise to a significant deep-conversion development potential, including with regard to petrochemical production. The bulk of apparent consumption is related to generation of energy and production of fuel for motor vehicles. Thus, according to the Fuel and Energy Balance of the Russian Federation for 2021, 88.4% of consumed oil is converted into other types of fuel, while **the share of petrochemical production in oil consumption is merely 9.4%**.



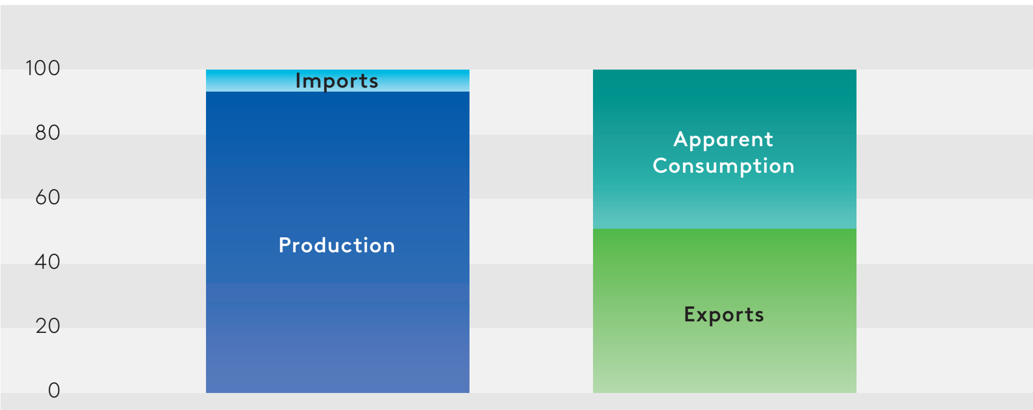
← **Figure 26. Balance of Oil Production and Consumption in the Eurasian Region in 2021, % of total**

Source: EDB calculations based on data provided by statistical agencies of the countries of the region.

It should be noted that proven oil reserves are sufficient to maintain extraction at its current level; in the context of energy transition, this gives the Eurasian petrochemical industry a major competitive advantage, as decline in global demand for oil-sourced energy makes oil (and petrochemical products) less expensive.

Proven gas reserves stand at about 62.8 TCM, or about 30% of total global reserves. The situation with the balance of production and consumption of natural gas is completely different from that of oil with regard to consumption: most gas is consumed within the Eurasian region, as generation of energy from gas is more environmentally friendly, and gas is extensively used as feedstock for the production of mineral fertilisers in the Russian Federation and Belarus (Figure 27).

Global consumption of gas will continue to grow, especially in the Asian markets, which creates favourable conditions for boosting eastward export from the Eurasian region. This process has already started because of the trade restrictions imposed by the European Union, previously the largest consumer of Russian gas. However, the use of natural gas as a feedstock for petrochemical production is rather limited (*9.1% of total consumption in the Russian Federation*). This points to an untapped petrochemical production potential, which gives the Eurasian region a significant competitive edge.



← **Figure 27. Balance of Gas Production and Consumption in the Eurasian Region in 2021, % of total**

Source: EDB calculations based on data provided by statistical agencies of the countries of the region.

2.3. Participants in Production and Distribution Chains in the Eurasian Region

Petrochemical plants manufacturing base monomers (*ethylene, propylene, aromatic hydrocarbons, etc.*) and their derivatives (*polyethylene, polypropylene, rubber, plastics, etc.*) occupy an intermediate position in the petrochemical production chain between producers of hydrocarbon feedstock (*naphtha, NGL, LHG, ethane, and others extracted from oil and natural gas, and from the light hydrocarbons contained in oil and natural gas*) and chemical plants producing a broad range of products used both by production facilities in other segments and industries (*primarily mechanical engineering and construction*), and by people in their daily life.

As shown above, the Eurasian region possesses a significant resource potential that can be used to build up petrochemical production chains. In 2022, total proven oil reserves were 115 MMbbl (*more than 7% of world reserves*), while total proven gas reserves were 62.8 TCM (*almost 30% of world reserves*). Under the Soviet centralised planning and management system, large petrochemical combines were created in industrial centres in various parts of the former USSR (in the European part of the country, Western and Eastern Siberia, Belarus, and Kazakhstan), with production scale and product range determined by "economies of scale". The main petrochemical production centres were concentrated in the Volga-Ural region (*primarily in Tatarstan and Bashkortostan*), and in Siberia (*in Omsk, Angarsk, and later Tomsk*). With time, extraction of hydrocarbons invariably shifted to the east of the country (*primarily to Western Siberia*).

Today the main participants of the petrochemical production chain in the Eurasian region are large vertically integrated oil and gas companies and the leading sectoral holdings operating in Russia, Uzbekistan, Belarus, and Kazakhstan combining all key petrochemical production process stages (Annexes 3 and 4).

2.3.1. Manufacturers of Monomers and Intermediate Commodities

Light Olefins (Ethylene and Propylene)

There are 15 ethylene manufacturers which have pyrolysis plants in the Eurasian region. Their aggregate annual production capacity exceeds 5.6 MT. Russia owns more than 87% of that capacity (*PJSC SIBUR Holding with six plants* (63%), *PJSC Rosneft Oil Company, PJSC Lukoil Oil Company, PJSC Gazprom, and Titan Group*), Uzbekistan about 10% (*Ustyurt and Shurtan Gas Chemical Complexes*), and Belarus almost 3% (*Polymir*).

There was a substantial increase in total capacity at the end of 2020 following the launch in Tobolsk of the ZapSibNeftekhim Combine, whose pyrolysis plant with an annual capacity of 1.5 MT of ethylene, is one of the five largest in the world.

Propylene is manufactured by 18 plants in the Eurasian region. Their total annual production capacity is 4 MT. About 84% of that capacity is concentrated in Russia (*of which 54% is represented by PJSC SIBUR Holding plants, 12% by PJSC Lukoil Oil Company, and the rest by PJSC Rosneft Oil Company, PJSC Gazprom, and Titan Group*). Kazakhstan accounts for 12% of total propylene manufacturing capacity (*Kazakhstan Petrochemical Industries Inc.*), with the remaining 4% situated in Belarus (*Polymir*) and Uzbekistan (*Ustyurt Gas Chemical Complex*).

Base Aromatic Hydrocarbons (Benzene, Toluene, Xylenes)

Manufacturers of aromatic hydrocarbons in the Eurasian region have a total annual production capacity of more than 4 MT, and are situated in Russia (73%), Kazakhstan (19%), and Belarus (*8%*). Total annual benzene, toluene, and xylene production capacity is estimated at almost 2.2 MT, almost 0.5 MT, and almost 1.4 MT, respectively.

Benzene is manufactured by more than 10 Russian plants, which account for more than 83% of total production capacity installed in the Eurasian region (*with the largest plants operated by Nizhnekamskneftekhim, SIBUR-Khimprom, SIBUR-Kstovo, Gazprom neftekhim Salavat, and Stavrolen*), the Novopolotsk Oil Refinery (OJSC Naftan) and the Mozyr Oil Refinery in Belarus (*11% of total production capacity*), and the Atyrau Oil Refinery (KazMunayGas) in Kazakhstan (*6% of benzene production capacity*).

Toluene is manufactured by five Russian companies, namely, Gazpromneft-ONPZ (*18% of total production capacity*), Gazprom neftekhim Salavat (*9%*), Ufaorgsintez (*12%*), LUKOIL-Permnefteorgsintez (*12%*), and KINEF (*8%*), and by the Atyrau Refinery (KazMunayGas) in Kazakhstan (*28%*).

Xylene is manufactured by four plants in Russia (*56% of total production capacity: Gazpromneft-ONPZ, Bashneft-Ufaneftekhim, KINEF, and Nizhnekamskneftekhim*), and by several facilities in Belarus (*7%; OJSC Naftan*) and Kazakhstan. The Atyrau Oil Refinery (KazMunayGas) in Kazakhstan has the region's largest annual xylene production capacity (*almost 500 KT, or 36% of the total capacity*).

Butadiene (Main C4 Fraction Product)

The total annual butadiene production capacity in the Eurasian region is 669 KT. All plants are in Russia, and operated by four companies: Nizhnekamskneftekhim, ZapSibNeftekhim (both owned by PJSC SIBUR Holding), Gazprom neftekhim Salavat (PJSC Gazprom), and Togliattikauchuk (PJSC Tatneft).

Styrene (Key Benzene Chain Product)

Styrene (*total estimated annual production capacity: 778 KT*) is manufactured only in Russia, with 58% of the total capacity operated by Nizhnekamskneftekhim and SIBUR-Khimprom (both owned by PJSC SIBUR-Holding), 28% by Gazprom neftekhim Salavat (PJSC Gazprom), and the rest by the Angarsk Polymer Plant (PJSC Rosneft Oil Company) and JSC Plastic.

2.3.2. Manufacturers of Plastics and Synthetic Rubber

Polyethylene

Total annual ethylene polymer production capacity in the Eurasian region is almost 5 MT. Most of that capacity (*79%*) is in Russia, with production plants operated primarily by PJSC SIBUR Holding, including ZapSibNeftekhim (*30%*), Kazanorgsintez (*almost 16%*), Tomskneftekhim (*6%*), and Nizhnekamskneftekhim (*almost 5%*). Other large plants are owned by Stavrolen (*6%; PJSC Lukoil Oil Company*) and Gazprom neftekhim Salavat (*3%*).

Other countries of the Eurasian region that have polyethylene production plants are Uzbekistan, Turkmenistan, and Belarus. The aggregate annual capacity of the Ustyurt GCC and the Shurtan GCC exceeds 0.5 MT (*10% of the total*). The Kiyanly Gas Chemical Complex (Turkmengaz) in Turkmenistan accounts for 8% of the region's total capacity, and Polymir (OJSC Naftan) (Belarus) for 3%.

Polypropylene

Propylene is manufactured in Russia (*74% of total Eurasian region capacity*), Kazakhstan (*18%*), Turkmenistan (*6%*), and Uzbekistan (*3%*). The aggregate annual production capacity in those countries is more than 3 MT. In Russia, the largest propylene polymer plants are owned by PJSC SIBUR Holding (*ZapSibNeftekhim* (*almost 34% of total capacity*), *Nizhnekamskneftekhim* (6%), *and Tomskneftekhim* (5.5%)), while PJSC Gazprom neft operates two modern plants (*Polyom* (7%), *and Neftekhimia Research and Production Plant* (5%)). The Russian Ufaorgsintez (PJSC Rosneft Oil Company) and Stavrolen (PJSC Lukoil Oil Company) each account for 4% of total capacity.

Following the commissioning in 2022 of the integrated gas chemical complex Kazakhstan Petrochemical Industries Inc., Kazakhstan's annual polypropylene production capacity increased by 0.5 MT. Neftekhim Ltd. manufactures another 70 KT of propylene per year. In Turkmenistan, polypropylene production plants are operated by the Kiyanly Gas Chemical Complex (Turkmengaz), and the Türkmenbasy Refinery Combine, in Uzbekistan by the Ustyurt Gas Chemical Complex.

Polyvinyl Chloride

The total annual polyvinyl chloride production capacity in the Eurasian region is 1,226 KT, with 92% of that capacity situated in Russia, and the rest in Uzbekistan.

In Russia, the bulk of polyvinyl chloride is manufactured by six plants: RusVinyl (*27% of the total capacity; joint venture established by PJSC SIBUR Holding and SolVin*), Sayanskkhimplast (*24%*), Bashkir Soda Company (*almost 22%*), JSC Caustic (*8%*), Polygran (*4%*), and Biokhimplast (*2%*). In Uzbekistan, a polyvinyl chloride production plant is operated by Navoiyazot.

Polystyrene

Total annual polystyrene production capacity is 663 KT. Almost all polystyrene in the Eurasian region is manufactured in Russia. The largest production plants are operated by Nizhnekamskneftekhim and SIBUR-Khimprom (*36% and 15% of total capacity, respectively; both owned by PJSC SIBUR Holding*), Gazprom neftekhim Salavat (*10%*), and Penoplex SPb (*almost 8%*).

Polyethylene Terephthalate

Polyethylene terephthalate is manufactured in Russia (*77%*) and Belarus (*23%*). Total annual production capacity is estimated at almost 1 MT. The largest manufacturers are four Russian plants: Polyef and Sibur-PETF (*23% and 8% of total capacity, respectively; both owned by PJSC SIBUR Holding*), Ecopet (*25%*), and SENEGE New Polymers Plant (*10%*).

Synthetic Rubber

Total annual synthetic rubber production capacity of the Eurasian region is more than 2.3 MT. All plants are in Russia. The largest synthetic rubber manufacturers are Nizhnekamskneftekhim, Voronezhsintezkauchuk, and the Krasnoyarsk Synthetic Rubber Plant (*35%, 15%, and 2% of the total capacity, respectively; all owned by PJSC SIBUR Holding*), Togliattikauchuk (*10%; Tatneft*), Sintez-Kauchuk (*6%*), Omsk Kauchuk (Titan Group), and the Sterlitamak Petrochemical Plant (*3%*).

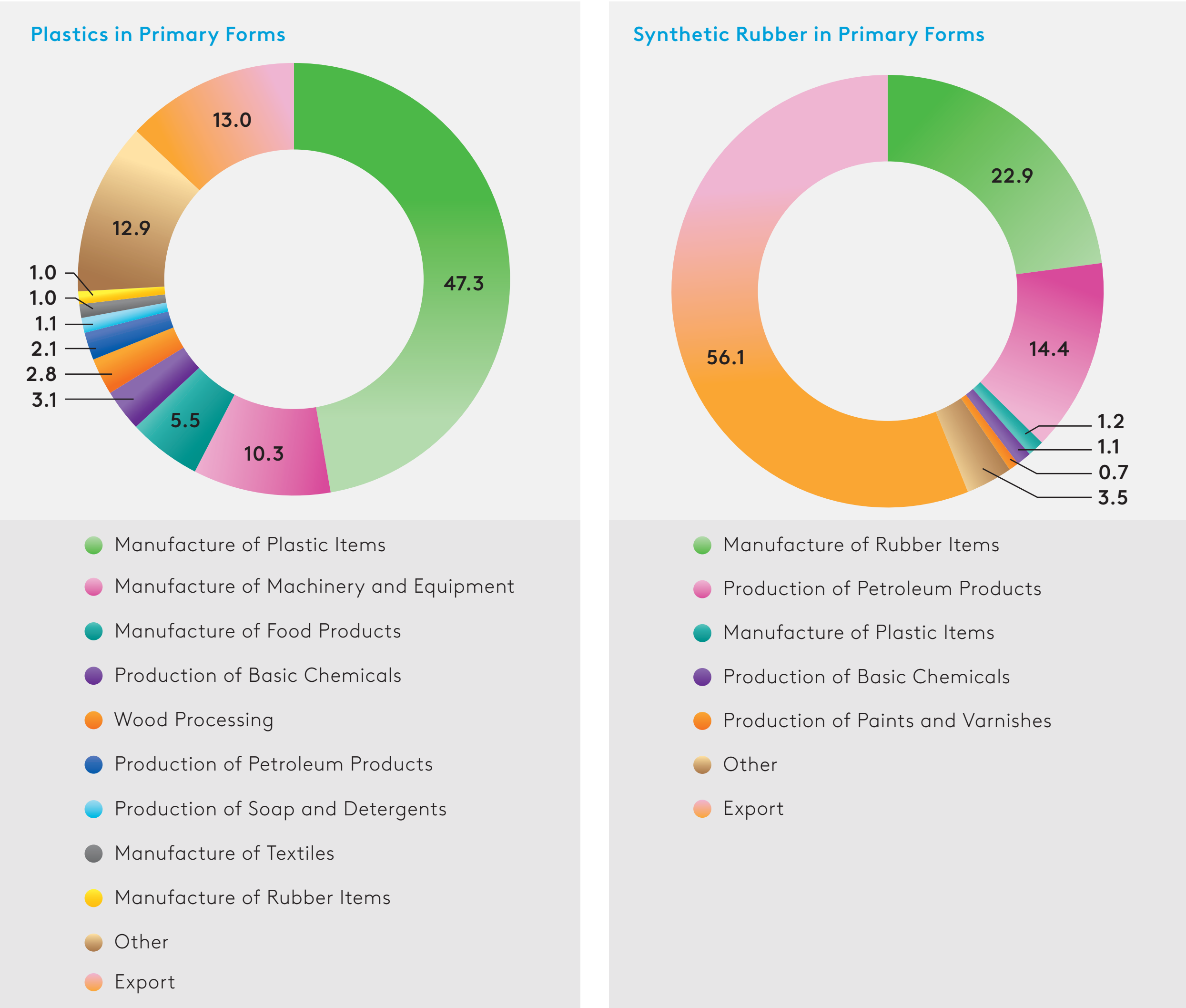
2.3.3. Consumers of Petrochemical Products

Petrochemical products are used in many areas, including production of packaging and construction materials, motor vehicles, electronic devices, medical devices, household chemicals, etc.

According to the latest available "input–output" tables published by Rosstat in 2016 (Figure 28), plastics in primary forms are used in Russia for the production of plastic goods

(*47% of the total*), various mechanical engineering products (*10%*), and food products (*more than 5%*), and are exported to other countries (*13%*). Most synthetic rubber in primary forms (*56% of the total*) are also exported. Domestic consumers of rubber include manufacturers of rubber goods (*almost 23%*) and petroleum products (*14%*).

↓ Figure 28. Structure of Utilisation of Petrochemical Products in Russia in 2016, % of total



Source: Rosstat "input-output" tables.

Consumption of petrochemical products in a country usually grows as the well-being of its population increases. According to expert estimates (Statinvestor, 2017; OSPAR, 2021; UN, 2021), annual per capita consumption of plastics in developing countries and developed countries is 15–40 kg and 80–90 kg, respectively; per capita consumption of rubber is 0.1–2 kg and 5.7 kg, respectively. We estimate that average annual per capita consumption of polymers and synthetic rubber in the Eurasian region is 36 kg and 3.1 kg, respectively, which is less than in developed countries by a factor of 2.2–2.5 and 1.8, respectively. This means that domestic consumption of polymer products has a significant growth potential, and that the plastic intensity (*ratio of consumption of petrochemical products to GDP*) of the Eurasian economies may substantially increase over the long term.

2.3.4. Optimal Development Path for Petrochemical Production and Distribution Chains in the Eurasian Region

Petrochemical production in various countries evolves in line with different models, each with a set of distinctive features:

- In the "old" industrially developed countries, the petrochemical industry came into existence and harmoniously evolved within the structure of national economies under the influence of scientific and technical progress, emergence and growth of demand for various chemical and polymer products, while its current development trends are linked primarily to its knowledge-intensive segments.

- The "new" industrial countries (*primarily in the APAC*) are rapidly expanding their petrochemical industry as one of the most important export branches, relying mostly on imported feedstock and energy.

- For the leading oil- and gas-producing countries with their commodity-based economies, the petrochemical industry became an important tool for "monetisation" of their hydrocarbon resources and economic diversification intended to weaken their commodity dependence (Kryukov and Shmat, 2023).

International experience shows that to be able to succeed in the competition for global markets and satisfy the need of the modern consumer for personalised end products, it is necessary to combine resources and technologies controlled by multiple economic agents. The growing shortage of resources and the increasingly prominent role of innovations and technologies force market players to pool their resources. Business models, organisational structures, and approaches to creating added value are constantly changing. Effective and mutually beneficial partnerships are the key to survival in the modern world, a world that competes by forging efficient co-operative ties (Kotov and Kachalkina, 2018).

In the course of its evolution, the petrochemical industry in the Eurasian region combined the features inherent in several models to reflect the diversity of objectives and conditions of its development, and their transformation with time.

On the one hand, as in the industrially developed countries, the region has a long-standing tradition of petrochemical industry development, including both production *per se* and creation of the related scientific and technological basis (*for example, Russia is one of the world's leaders in invention and commercialisation of ground-breaking synthetic rubber production technologies*), and a successful track record of implementation of large-scale chemicalisation programmes.

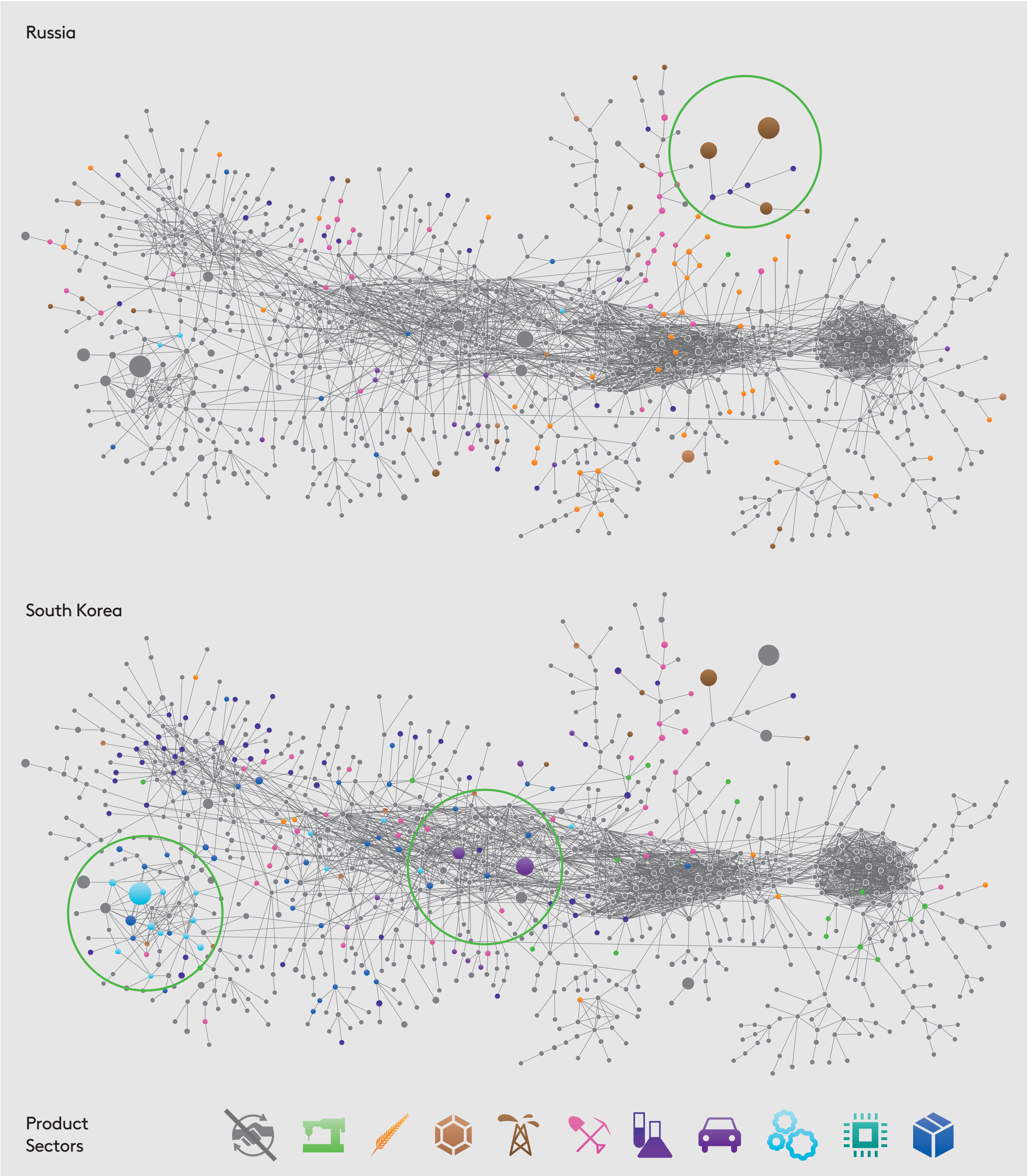
On the other hand, the region is one of the world's largest producers and exporters of raw hydrocarbons, which aligns its petrochemical industry development goals with those of the other oil- and gas-exporting countries. The current format of participation of the Eurasian region in global trade in chemicals is largely reduced to exporting the least valuable products (*such as mineral fertilisers*), and importing technologically sophisticated products (*"fine" chemicals, pharmaceutical products, etc.*).

The present oil and gas orientation of the Eurasian economies does not curtail their ability to "monetise" hydrocarbon resources and proceed with economic diversification to reduce their commodity dependence. Several countries are known to have successfully gotten out of the "rut" in their preceding development path. For example, it took South Korea only a few decades to turn from one of the world's poorest agrarian countries into an industrially developed country with a high per capita income.

At the beginning of its transformation journey, the government of South Korea created important points of economic attraction in the country's agrarian economy by pursuing a selective industrialisation policy which prioritised heavy and chemical industries (Jwa, 2023). This launched a new "economic miracle" process that encompassed development not only of production capacity, but also of all collateral sectors of the economy, including education, science, engineering, logistics, and services.

Today South Korea's export basket is strongly diversified, with priority given to high-tech products (Figure 29). The chart shows that, compared to Russia's current export basket, South Korea has a strong competitive advantage in electronic, engineering, and chemical products which, in turn, are closely connected to contiguous traded products. According to Harvard Growth Lab, the "cost of switching" to such contiguous products necessitated by industrial production expansion exigencies is rather low. The more such connections, the more opportunities for diversification of the economy.

↓ Figure 29. Export Product Baskets of Russia and South Korea, 2021



Source: Harvard Growth Lab

Repositioning of Eurasian companies in global petrochemical value chains and expansion of medium- and low-tonnage chemical production and polymer processing are constrained by many factors, including technological inferiority, dependence on component imports, complex logistics, narrowness of domestic markets, low efficiency of new projects, limited financial resources, and insufficient government support measures (Kryukov and Shmat, 2023).

Development of petrochemical production in the Eurasian region has very good prospects. The key features of petrochemical value chains in the modern world (*beside the emphasis on increasing flexibility and the role of scientific research and personnel qualification*) include development and expansion of co-operation, primarily in industrial clusters which combine production facilities (plants) and the supporting infrastructure (Kryukov and Shmat, 2020). It is important to note that petrochemical clusters create favourable conditions for the establishment and operation of scientific and research entities, and for active development of allied industries, primarily mechanical engineering and construction.

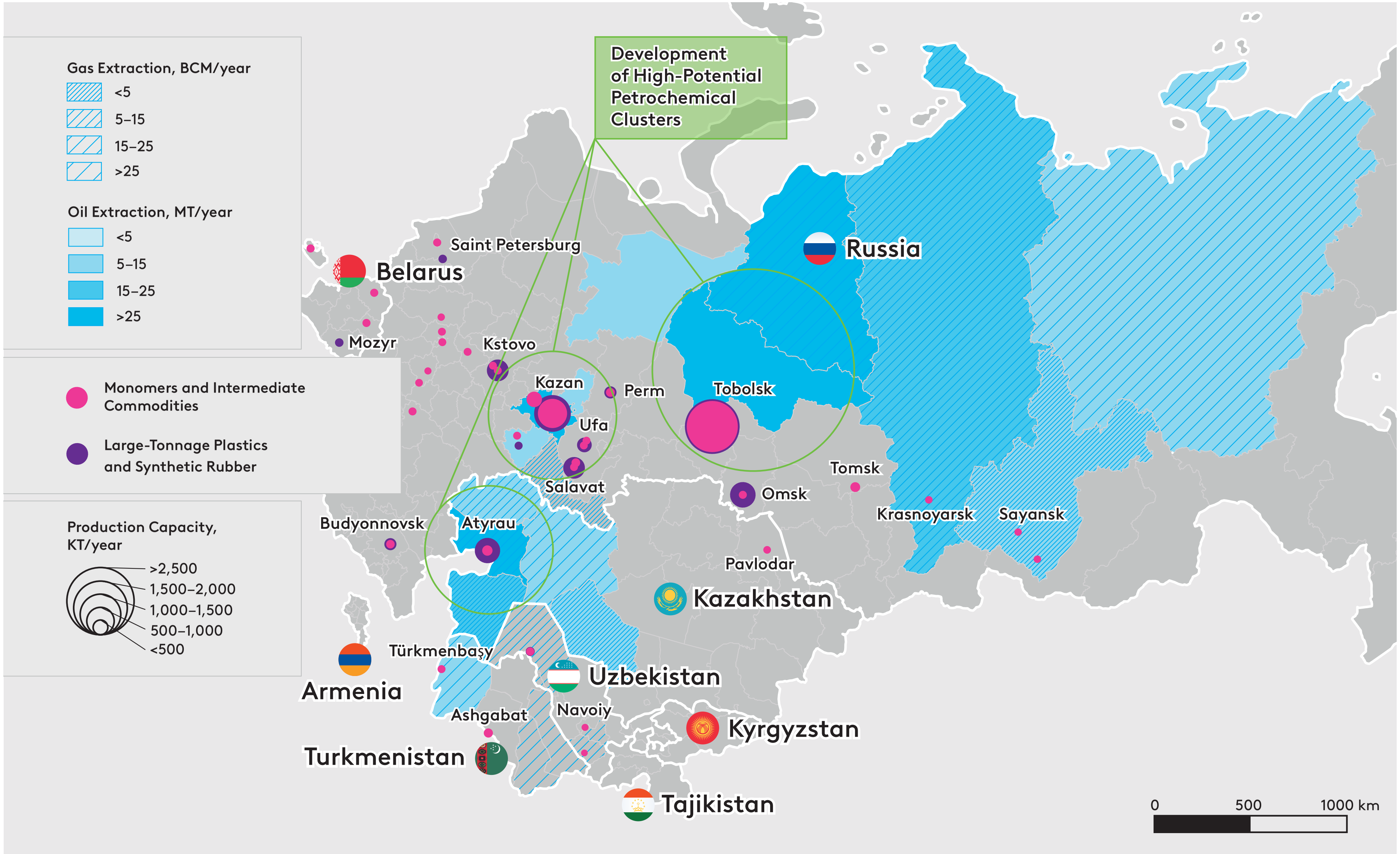
Development of production and distribution chains in the petrochemical industry of Russia and other countries of the Eurasian region is characterised by the following (Braginsky, 2014; Kryukov and Shmat, 2020):

- focus on large-tonnage production of relatively low value-added goods for export;
- importation of lacking petrochemical goods and petrochemical production equipment to meet the needs of the economy;
- substantial dependence on previously implemented projects and solutions;
- placement of petrochemical plants in relative proximity to sources of raw materials (Figure 30);
- significant spatial inertia in the construction, expansion, and modernisation of production facilities;
- isolated corporate nature of projects and solutions (*and failure to expand co-operation in line with overall modern trends*).

One of the critical industry growth drivers is proactive government support aimed at multi-level endorsement of solutions, forging research–production and production–demand links, expanding co-operation among the participants in the hydrocarbon extraction and utilisation process, creating specialised infrastructure, providing scientific support, and developing the workforce potential. The prospects of further expansion of the petrochemical industry in the Eurasian region are contingent upon transition to the knowledge-intensive development path, satisfaction of growing domestic demand for petrochemical products, and "monetisation" of commodity resources. Accordingly, one of the important development areas for the petrochemical industry of the Eurasian region is import substitution of polymers and polymer products.

Over the last several years, many countries of the Eurasian region have taken significant steps to advance their petrochemical industry, including adoption of state support programmes (*see the next section*), and development of related infrastructure (*for example, Russia built a trunk NGL pipeline from Purovsk to Tobolsk*). Petrochemical companies implemented several large-scale projects to create additional monomer production capacity (*primarily pyrolysis plants*), and put in operation several plants for the manufacture of polystyrene, ABS plastics, polyethylene terephthalate, propylene, polypropylene, and polyvinyl chloride.

↓ Figure 30. Distribution of Petrochemical Facilities and the Petrochemical Resource Base in the Eurasian Region



Source: EDB based on data provided by companies and government agencies of the countries of the Eurasian region; plastinfo.ru; Rosstat.

Box 3. Potential Investment Projects

- Projects aimed at clustering of petrochemical production around sources of hydrocarbon feedstock;
- Projects for import substitution of medium- and low-tonnage end products, and of high-value-added products manufactured from polymer feedstock (*polyolefin elastomers, peroxide cross-linked LDPE for cables and pipes, catalysts for new PP and PE grades, extruded polycarbonate, additives, films, etc.*);
- Projects for import substitution of petrochemical production equipment (*blow moulding and thermoforming machines, extrusion machines and related peripherals, injection moulding machines, spare parts*), and development of allied industries and services;
- Projects for development of transport and logistics infrastructure (*International North–South Transport Corridor, Northern Sea Route, product pipelines to the APAC and India, etc.*).

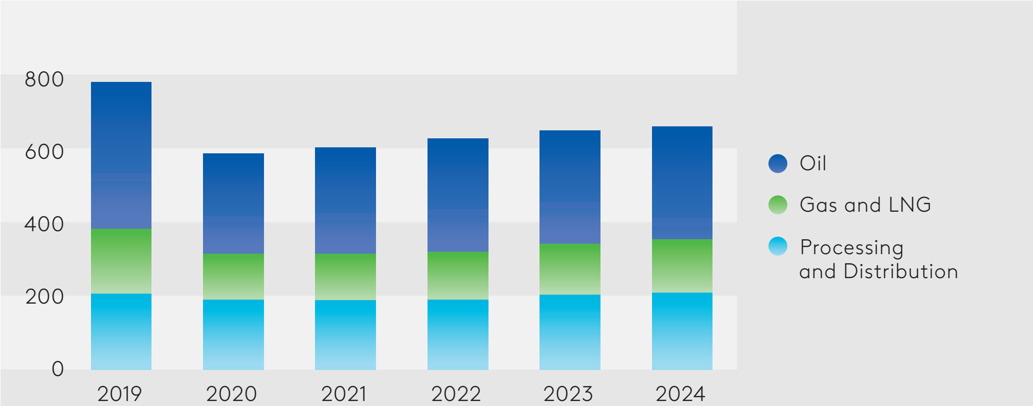
Expansion of production co-operation in the petrochemical industry and consolidation of facilities comprising a single production chain, in combination with government support, generally help to unlock export potential by cutting logistical, infrastructure, and R&D costs, creating new competitive advantages, distributing risks, and reducing the time required to enter new markets.

An important policy issue is the creation and development in petrochemical centres, with active support on the part of the state, of modern petrochemical clusters comprising the full value chain from conversion of oil and petrochemical feedstock to production of final consumer goods. Special attention should be paid to forging deep-conversion value chains yielding end products with high added value, and to establishing close links between petrochemical facilities and consumers, both within such clusters and at their "exit points".

2.4. Parameters of State and Corporate Involvement in the Development of the Petrochemical Industry in the Eurasian Region

Substantial results in the development of the industry are achieved where the state provides support at all stages of the product life cycle, from creating a favourable regulatory environment to participating in risk hedging and designing new technologies. Total investment in the petrochemical industry (Figure 31) is increasing, both globally and in the Eurasian region, because its potential in the global economy is growing, and the state is actively involved in its development.

State involvement in the development of the petrochemical industry primarily takes the form of application of special tools in relation to both manufacturers and consumers of the end product. Those tools include tax incentives, soft loans, subsidies, tariff and non-tariff protection measures, steps to encourage consumption of petrochemical products at the regional level, and creation of international clusters.



← **Figure 31. Global Investment in the Petrochemical Industry by Market, $ billions**

Source: Rystad Energy.

The countries of the Eurasian region designed and adopted various public documents (*national programmes, national projects, development strategies, government programmes, etc.*) aimed at ensuring the strengthening and further development of petrochemical facilities (Table 6). Moreover, the countries of the Eurasian region continue to draft documents designed to support further development of the fuel and energy complex and expansion of petrochemical production.

↓ **Table 6. Main State Strategic Documents and Goals for Petrochemical Industry Development in the Countries of the Eurasian Region**

Country	Strategic Document	Development Goals
Armenia	• No separate strategic document	
Belarus	• Strategy for Development of the Petrochemical Complex until 2030 (Mlenik, 2020)	• Construction of new ethylene and propylene plants • Annual commissioning of at least 50 wells to reach a gross annual oil production target of at least 1.7 MT by 2030
Kazakhstan	• Integrated Plan for the Development of Large-Scale Oil, Gas, and Petrochemical Projects in 2023–2027 (Ministry of Energy of the Republic of Kazakhstan, 2023)	• Implementation of 20 projects with a total value of $37.3 billion • Increase in annual extraction of oil and gas to 105.5 MT and 82.1 BCM, respectively • Increase in annual oil conversion capacity at the Shymkent Refinery from 6 MT to 9–12 MT
Kyrgyzstan	• No separate strategic document	
Russia	• Strategy for the Development of the Chemical and Petrochemical Complex until 2030 (Ministry of Industry and Trade of the Russian Federation, 2016) • Roadmap for Development of the Petrochemical Complex of the Russian Federation until 2025 (Government o Russian Federation, 2023) • Energy Strategy of the Russian Federation until 2035 (Ministry of Energy of the Russian Federation, 2020)	• Increase in the value of goods, works, and services in the chemical complex from ₽2,518 billion in 2014 to ₽6,652 billion in 2030 • Increase in large-tonnage plastics output from 3.5 MT in 2012 to 22.3 MT in 2030 (polyethylene: from 1.4 MT to 12.7 MT) • Increase in large-tonnage polymer output from 6.9 MT in 2022 to 9.9 MT in 2025 • Increase in the share of hydrocarbon feedstock used in petrochemical production from 26.7% in 2022 to 35.2% in 2025 • Maintenance of annual extraction of oil and gas condensate in 2035 at 555 MT • Increase in LNG output from 18.9 MT in 2018 to 140 MT in 2035 • Increase in the share of feedstock (ethane, naphtha, LHG) used in petrochemical production from 23% in 2015 to 35% in 2035 • Increase in the supply of Russian coal to the domestic market from 181 MT in 2018 to 196 MT in 2035

Tajikistan	• Law of the Republic of Tajikistan on Oil and Gas (Khudobakhsh, 2023)	• Total 2022 reserves: 1.33 BT of reference fuel, including gas (863 BCM), oil (113 MT), and condensate (36 MT). Extent of exploration of initial resources (oil and gas) does not exceed 2.6%
Turkmenistan	• Programme for Development of the Oil and Gas Industry of Turkmenistan until 2030 (Turkmenistan: Golden Age, 2022)	• Stage-by-stage increase in the capacity of the Turkmenistan–Uzbekistan–Kazakhstan–China gas pipeline • Construction of the Turkmenistan–Afghanistan–Pakistan–India gas pipeline • Commencement of development of new fields in Bagtýarlyk to achieve the following annual targets by 2030: gas extraction up to 250 BCM; oil extraction up to 67 MT; natural gas exports up to 200 BCM
Uzbekistan	• Conceptual Framework for the Development of the Oil and Gas Industry of Uzbekistan until 2030 (Decree of the President of the Republic of Uzbekistan, 2019)	• Achievement of the following annual targets by 2030: natural gas extraction 66.1 BCM; gas consumption 56.5 BCM

Source: EDB based on analysis of public documents of the countries of the Eurasian region.

One example of state policy is the work performed in the Republic of Kazakhstan. To stimulate the development of the petrochemical complex, the government created the country's first special economic zone, "National Industrial Petrochemical Technopark", where petrochemical product manufacturers are granted various privileges and preferences. In 2022, a polypropylene plant with a total annual production capacity of 500 KT, the first in Kazakhstan and one of the largest in the world, was launched in Atyrau Region. In addition, several government documents list specific steps for further expansion of the petrochemical complex, including measures to regulate hydrocarbon feedstock prices and volumes within the framework of the Law of the Republic of Kazakhstan "On Gas and Gas Supply". Another important document is the *Strategy for Development of the National Oil and Gas Operator JSC KazMunayGas Oil Company*, which envisages expansion of petrochemical capacity and diversification of production in the oil and gas sector.

Eventually the Republic of Kazakhstan launched an active transformation of the fuel and energy sector. In December 2023, the government approved the *Integrated Plan for the Development of Large-Scale Oil, Gas, and Petrochemical Projects in 2023–2027*. The plan envisages 20 large-scale projects in the oil and gas production and processing and petrochemical sectors, with anticipated total investment of $37.3 billion. Examples include the project for the construction of the country's first integrated gas and chemical complex with an annual capacity of 1.25 MT, and the infrastructure project for the construction of a gas separation plant with an annual capacity of 9.1 BCM. This will make it possible to significantly increase the volume of petrochemical production, attract investors, and fully utilise the resource potential of the Tenghiz field.

There are currently more than 20 ongoing large-scale petrochemical projects in the Eurasian region (Annex 5). Some of those projects are included in state programmes, which will have a positive impact on the social and economic development of the relevant countries. Some companies are entering into international agreements to secure feedstock supplies and subsequent sale of finished products. Total investment in the projects will exceed $200 billion. Some of the salient features of those projects are as follows:

- active use of public-private partnerships to achieve national policy goals and strategic targets approved by the involved petrochemical companies;
- use of multiple variants of polymer production to increase conversion ratios and improve performance;

- expansion of available oil and gas reserves through discovery and development of new fields;

- implementation of projects under EPC (engineering–procurement–construction) contracts;

- focus on import substitution and use of proprietary feedstock for the manufacture of high-value-added products;

- launch of new and modernisation of existing facilities using innovative technologies to cut capital expenditures and minimise adverse environmental impact, including creation of new links in production and distribution chains;

- active co-operation with foreign (especially Chinese) partners in the procurement of equipment and co-financing of/investment in projects;

- construction of integrated petrochemical facilities.

By 2030, implementation of the above projects alone will make it possible to increase capacity for oil extraction by 43 MT, gas extraction by 20 MT, and production of hydrocarbon feedstock, rubber, and other items by 16 MT.

2.5. Import Substitution Potential of the Petrochemical Industry of the Eurasian Region

The countries of the Eurasian region are actively involved in foreign trade in polymer products. Russia, Kazakhstan, and Belarus are the largest exporters, and Russia is the largest importer. Over the last several decades, foreign trade volume has grown in all countries of the region (Table 7). The relatively faster increase in the volume of import shows that domestic consumption is not fully covered by domestic production, and may be indicative of the scope of import substitution potential.

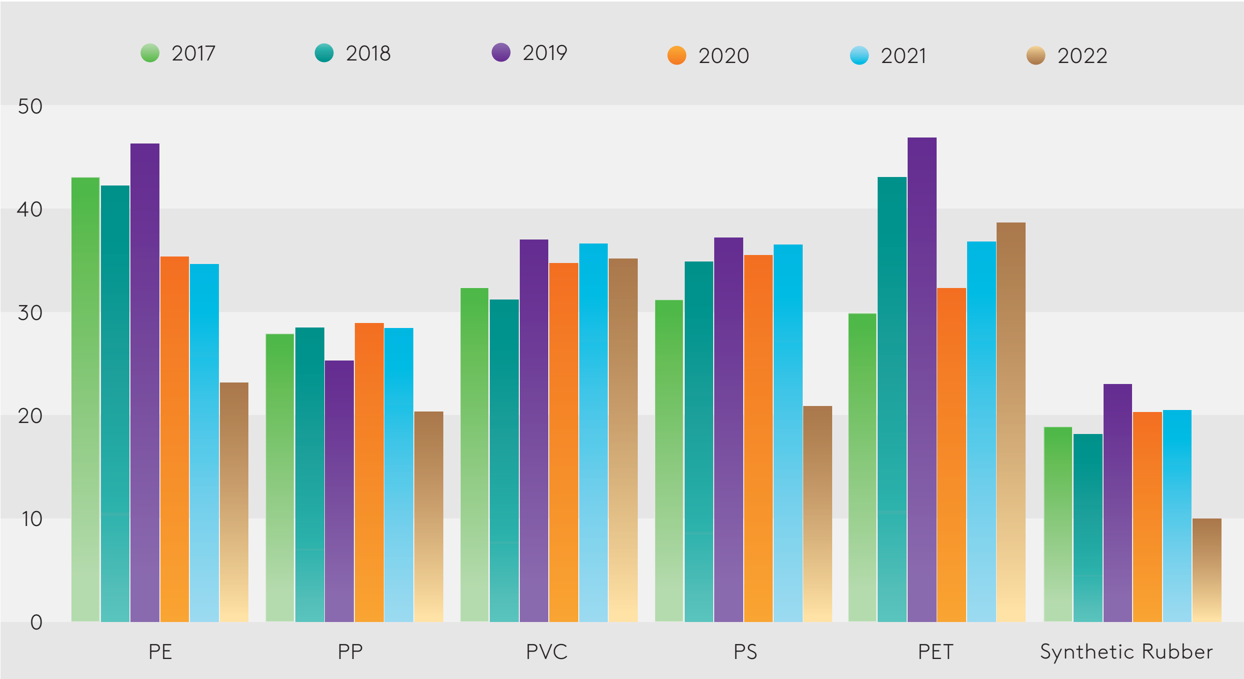
↓ Table 7. Foreign Trade in Polymer Materials, Plastics, Natural and Vulcanised Rubber, and Products Manufactured from Them in the Eurasian Region in 1995–2021, MT

Country	Import/ Export	1995	2000	2005	2010	2015	2020	2021
Armenia	I	4.0	22.8	104.2	225.5	259.8	463.5	537.4
	E	13.6	20.5	71.9	84.7	113	165.7	442.8
Belarus	I	271.9	405.7	802.3	1,875.2	1,630.9	2,048.6	N/A
	E	252.6	339.8	531.2	1,235.5	1,189.8	1,363.2	
Kazakhstan	I	123.6	193.2	664.8	1,552.5	1,547.9	1,849.1	2,388.8
	E	53.9	4.6	25.4	70.0	93.9	116.3	205.3
Kyrgyzstan	I	8.0	22.8	60.1	121.3	167.3	192.9	248.4
	E	2.0	6.1	17.1	9.3	27.3	43.2	39.7
Russia	I	1,303.2	1,389.7	4,825.1	11,482.0	10,361.0	12,975.0	17,533.0
	E	1,539.5	1,415.7	2,597.4	4,980.7	4,836.5	6,403.2	9,746.6
Tajikistan	I	6.2	5.6	17.9	33.8	82.1	116.9	131.9
	E	0.1	0.1	0.1	0.2	0.4	0.5	1.8
Uzbekistan	I	63.5	N/A	N/A	N/A	N/A	1,033.3	1,249.2
	E	5.7					330.9	418.4

Source: CIS Statistics Database.

It should be noted that the Eurasian polymers market is highly dependent on polyethylene terephthalate imports (*over the last five years, the share of such imports increased by 8.6%*), while dependence on polyvinyl chloride imports increased insignificantly by 2.9% from 2017 to 2022 (Figure 32). As regards other polymers, the share of imports in domestic consumption is decreasing: almost by 20% for polyethylene, by 7.6% for polypropylene, by more than 11% for polystyrene, and almost by 50% for rubber.

↓ **Figure 32. Share of Imports in Domestic Consumption of Base Polymers in the Eurasian Region in 2017–2022, %**



Source: EDB.

The balance of trade in such polymers as polystyrene, polyethylene terephthalate, and polyvinyl chloride remains negative due to their high domestic consumption in the Eurasian region, plus insufficiency and underutilisation of production capacity. There is a significant surplus of foreign trade in synthetic rubber, mostly manufactured in Russia, and in polyethylene and polypropylene (following the commissioning of new production facilities in Russia, Kazakhstan, Turkmenistan, and Belarus).

In summary, we can draw the firm conclusion that import dependency of the polymers market of the Eurasian region has significantly decreased; however, in some market segments, domestic production is still not capable of fully satisfying demand. For example, we note the remaining dependency on imports of medium- and low-tonnage chemical products (CSR, 2021).

2.6. Expansion of the Production and Export Potential of the Petrochemical Industry: Assessment and Forecasting Methodology

Our assessment and scenario-based modelling of the expansion of the production and export potential of the petrochemical industry in the countries of the Eurasian region relies on the balance approach: we compute projected production, domestic consumption, and import balances for the main petrochemical products to produce a scenario-based export assessment.

Box 4. Balance Approach Methodology

From the methodological viewpoint, the balance of resources and uses of the i^{th} product type in the j^{th} country can be presented as follows:

$$Z_{ij}^{0} + Prod_{ij} + Imp_{ij} = Cons_{ij} + O_{ij} + Exp_{ij} + Loss_{ij} + Z_{ij}^{1},$$

where

$Prod_{ij}$ is domestic production of the i^{th} product type in the j^{th} country;

Z_{ij}^{0} is reserves of the i^{th} product type at the beginning of the year in the j^{th} country;

Z_{ij}^{1} is reserves of the i^{th} product type at the end of the year in the j^{th} country;

Imp_{ij} is import of the i^{th} product type to the j^{th} country;

Exp_{ij} is export of the i^{th} product type from the j^{th} country;

$Cons_{ij}$ is final consumption of the i^{th} product type in the j^{th} country;

O_{ij} is intermediate use of the i^{th} product type in the j^{th} country;

$Loss_{ij}$ is loss of the i^{th} product type in the j^{th} country in the course of production, processing, and circulation.

At **Stage 1**, we used data published by national statistical agencies, the Eurasian Economic Commission, and the CIS Statistical Committee to form retrospective national balances of resources and uses of base polymers and synthetic rubber which are critical for saturation of the domestic market and realisation of the export potential of the petrochemical industry of the Eurasian region.

Selection of product groups was based on the configuration of the main petrochemical value chains, information contained in the national strategic plans for the development of the petrochemical industry in the Eurasian region, and availability of statistical data.

At **Stage 2**, we performed scenario-based modelling of the production and resource potential of the Eurasian region on the basis of hypotheses on the dynamics of the key petrochemical industry production metrics. Scenario-specific product output projections were computed on the basis of extrapolated 2017–2022 retrospective trends or output targets approved in national petrochemical industry development plans, subject to the existing capacity restrictions.

Output projections were adjusted after the computation of petrochemical product consumption dynamics in the region (iteration after Stage 3), as the dynamics of domestic production of petrochemical products and the rate of growth of demand for such products are mutually dependent. The greater the opportunities for the sale of products in domestic and foreign markets, the higher the production capacity loads and the rates of output growth.

It is important to note that in the course of our modelling we did not consider the possible impact of factors that are difficult to predict (*withdrawal of foreign partners from joint projects, disruptions in the supply of critical production resources*), and may cause strong output fluctuations.

At **Stage 3**, we performed scenario-based forecasting of domestic consumption of petrochemical products in the Eurasian region using the algorithm described by Kapustin and Grushevenko (2023).

By performing correlation analysis, we identified stable retrospective connections among population size, GDP, and consumption of petrochemical products.

Box 5. The Issue of Fragmented Retrospective Data

Fragmented retrospective data on consumption of petrochemical products became one of the main challenges. To deal with that problem, we employed the clustering method and the reasonable analogy method (Mitrova et al., 2015). Consumption data were aggregated into clusters, defined as countries grouped on the basis of their geographic proximity, similarity of social and economic characteristics, or other criteria. Petrochemical products consumption statistics, if available, were accepted "as is". If information was only partially available (*available for some countries included in a cluster, but not for others*), we recovered the missing data by extrapolating known cluster-averaged GDP plastic-intensity and per capita consumption figures. In situations where consumption data for a cluster were not available, we performed a recalculation using GDP plastic-intensity and per capita consumption data from other clusters with similar parameters, adjusting those data for indirect indicators (*such as plastic waste generation, petrochemical feedstock consumption, etc.*).

Calculation of the prospective dynamics of domestic consumption of petrochemical products was performed on the basis of regression modelling, where domestic consumption was assumed to be a function of macroeconomic and demographic dynamics.

For that purpose, we analysed retrospective per capita consumption of petrochemical products and GDP plastic-intensity, with extrapolation of those two indicators to the forecast period. To assess and account for the contribution of economics and demographics to generation of demand, we analysed the correlation among retrospective consumption levels, GDP and population metrics and their derivatives, thereby determining the "weights" to be assigned to the trends under review for subsequent calculations. Then the weighted per capita consumption and economy plastic-intensity trends, together with econometric and demographic parameters, were used to compute the final forecast for domestic consumption of petrochemical products.

Prospective data on population and GDP movement were exogenous factors set in line with scenario assumptions.

As regards the population of Russia, we used the average scenario parameters of the Rosstat demographic forecast until 2023, namely, year-on-year population increments (Rosstat, 2022). UN world population prospects for 2023 were used for the other countries of the Eurasian region (UN, 2022). As with the Russian Federation, year-on-year population increments were added to the baseline population data for the other countries in 2022.

To set the values for projected Russian GDP movements, we used baseline scenario parameters from the medium-term (until 2025) and long-term (until 2036) forecasts of social and economic development published by the Ministry of Economic Development of the Russian Federation (Ministry of Economic Development of the Russian Federation, 2022; Ministry of Economic Development of the Russian Federation, 2018). For the other countries of the Eurasian region, we used the parameters of the medium-term real GDP forecast (*for 2023–2025*) prepared by the World Bank (World Bank, 2023) and adjusted to reflect projected changes in the population of the relevant countries. For the period from 2026 to 2035, we used the inertial development hypothesis and, acting in line with that hypothesis, extrapolated the trends for the retrospective period and for the period from 2023 to 2025.

For models where imports and exports were used as predictor variable components, their projected values were set in line with either inertial logic (*in the inertial scenario, through extrapolation of the share of imports in domestic consumption and extrapolation of the share of exports in output*) or normative logic (*in the target scenario, through predetermined reduction of the share of imports in domestic consumption and modification of the share of exports in output in line with sales markets targets and limitations*). In doing so, we considered balance relations, and made sure that the key balance variables had non-negative values.

At **Stage 4**, we calculated the resource potential of Eurasian exports. That assessment was made on the basis of balance logic, subject to the data on prospective domestic output and import of petrochemical products (reduced by domestic consumption) obtained at the previous stages. The resultant net export figures, expressed in volume and value terms, were used (subject to additional assessment of the potential of foreign markets) to determine the main export destinations.

In addition, we used the "input–output" tables and the production multipliers theory (Ksenofontov et al., 2018) to assess the social and economic impact from realisation of the petrochemical production potential of the countries of the Eurasian region.

2.7. Petrochemical Production Potential of the Eurasian Region by 2035

Based on the analysis of the resource potential and retrospective data on the development of the petrochemical industry in the Eurasian region, we came up with two prospective scenarios covering the period until 2035: the baseline (inertial) scenario and the alternative (target) scenario.

The baseline scenario of development of the petrochemical industry in the countries of the Eurasian region assumes that its growth rates will remain the same as for the last five years. Under the inertial scenario, growth rates are constrained by the retrospectively slow upgrade and expansion of production capacity, lack of economic appeal in new production projects, dependence on imported technologies and investment products, personnel, administrative, and other barriers.

The baseline scenario extrapolates retrospective trends shaping the petrochemical industry development trajectory in the countries of the Eurasian region. Petrochemical production will be increasing in line with the approved projects for the construction of new facilities and more intensive utilisation of existing facilities. The insignificant expansion of production capacity makes it the main model limitation of petrochemical production growth.

Under the inertial scenario, development of the petrochemical complex in the countries of the Eurasian region until 2035 will be characterised by growth rates that are below the projected global average rates, namely, at an annual average rate of 3.6%. During the forecast period, petrochemical production in volume terms will increase by 6.8 MT, or by 65.5%.

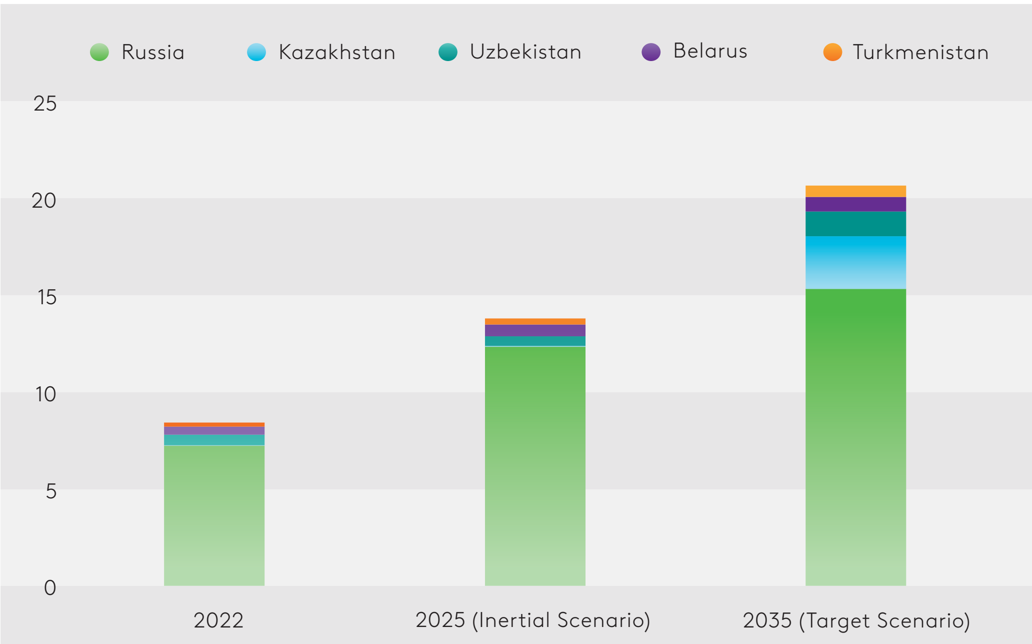
Under the alternative scenario (which is regarded as the target scenario), we applied the development logic in accordance with which the relatively higher (*compared to the inertial scenario*) rates of extensive and intensive growth of petrochemical production may be achieved through the application of proactive state policy measures to stimulate domestic demand and ensure that it is supported with sufficient production capacity.

The purpose of those policy measures is to expand the petrochemical resource base by ensuring intensive growth of production capacity, increasing the share of consumed feedstock in total oil and gas processing volume, and realising the import substitution potential (see Section 2.6).

Accordingly, the target scenario uses the planned petrochemical industry development metrics presented in strategic documents of the countries of the Eurasian region, or the target growth rates of petrochemical production (*provided that they do not exceed the extensive and intensive domestic production growth potential*).

The target scenario assumes a more active launch of large-tonnage polymer and synthetic rubber production facilities built with the support of public and private investors (*including under interstate production co-operation projects*), technical modernisation of existing capacities, reduction of the share of imported petrochemical technologies and investment products, optimisation and expansion of transport and logistical capacity used to supply feedstock and sell finished products, and enhancement of oil and gas processing in the interests of chemical facilities.

Realisation of the target scenario will increase the annual base polymers and synthetic rubber output by 5.8%, a 2.2-fold improvement relative to the baseline scenario. During the forecast period, petrochemical production in volume terms will increase by 10.8 MT, or by 109% (Figure 33). Projected output growth in the EAEU member states until 2035 is shown in Figure 34.

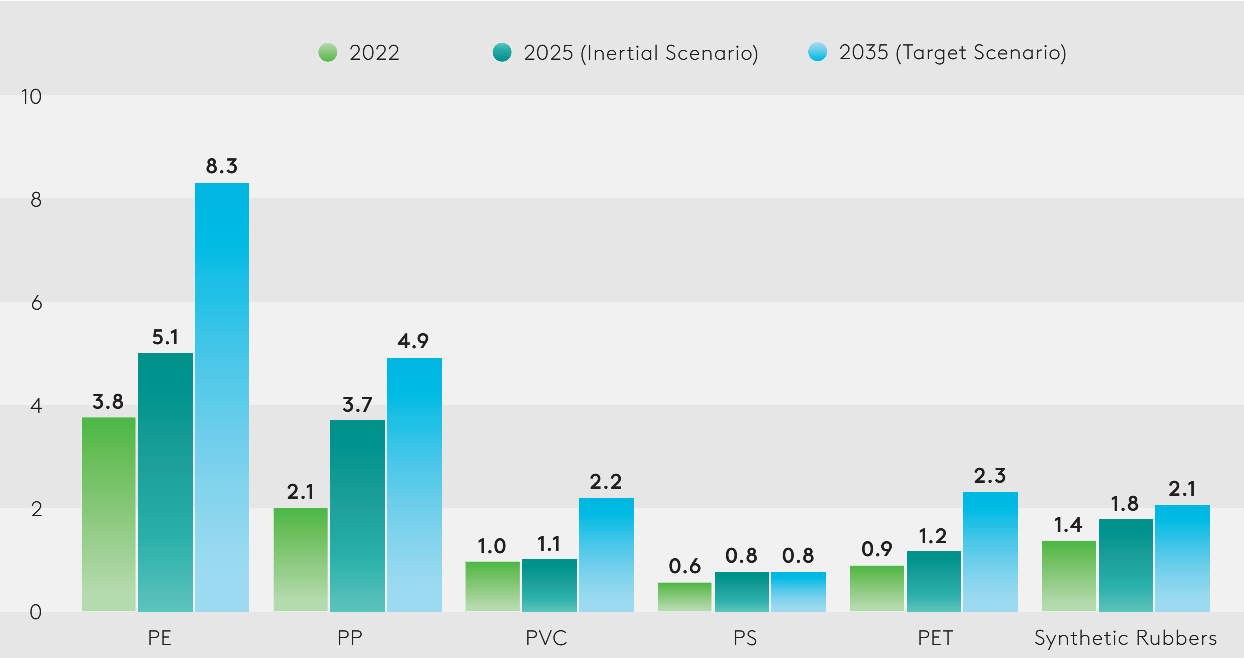


← **Figure 33. Scenario-Based Petrochemical Products Output in the Eurasian Region by Country by 2035, MT**

Source: EDB calculations.

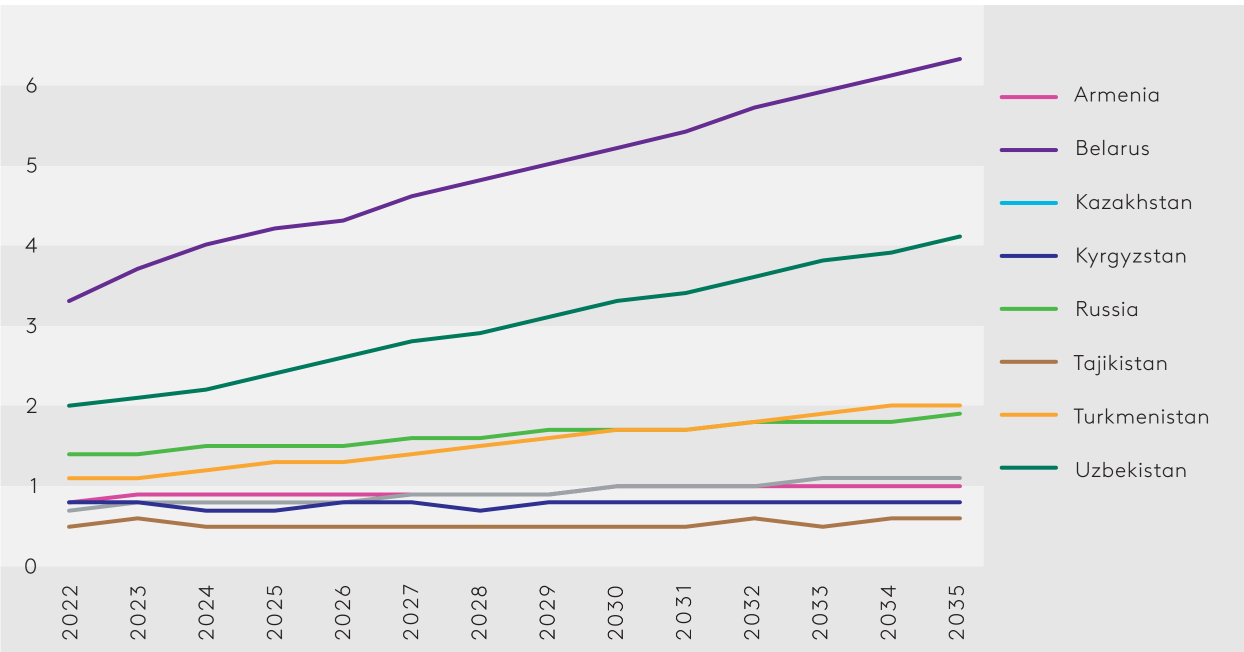
The aggregate estimate of the volume of petrochemical products needed by the countries of the Eurasian region includes consumer and industrial demand. As with the production and resource potential, we developed a baseline scenario and a target scenario. To form the scenario parameters, we built regression models of consumer demand from the population, and of petrochemical products consumption by the economy subject to per capita consumption of polymers and plastic-intensity of the economy (Figures 35–37). Under the inertial scenario, retrospective factor dynamics were retained with adjustment by production capabilities and foreign trade dynamics; under the alternative scenario, consumption levels were determined either by target indicators defined in strategic documents (*for Russia, Kazakhstan, Uzbekistan*), or by approximation to plastics consumption levels in developed countries (*for the other countries of the Eurasian region*).

↓ Figure 34. Potential Petrochemical Products Output in the Eurasian Region by 2035, MT



Source: EDB calculations.

↓ Figure 35. Plastic Intensity of Eurasian Economies in 2022–2035, kg/$K (in 2022 constant prices by Purchasing Power Parity)

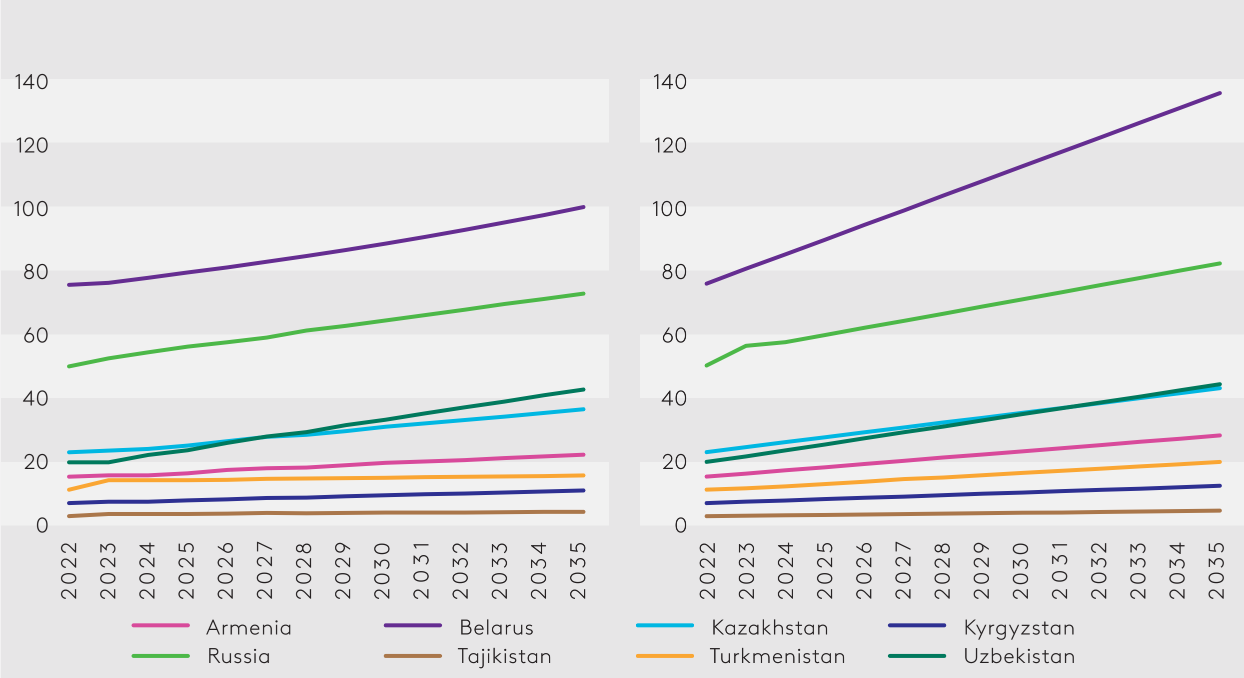


Source: EDB calculations.

Scenario-based estimates of petrochemical products consumption in the countries of the Eurasian region until 2035 point to a slower increase in average annual consumption growth rates (compared to production) under both the inertial scenario and the target scenario: 3.6% and 5.4%, respectively.

↓ Figure 36. Consumption of Polymers and Synthetic Rubber in the Countries of the Eurasian Region in 2022–2035 under the Inertial Scenario, kg per capita

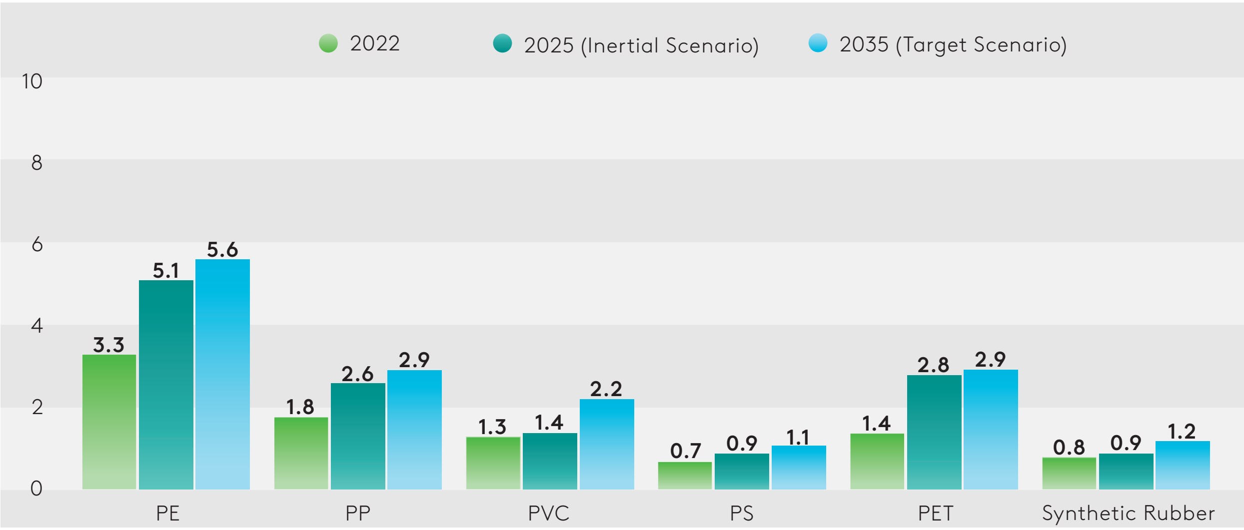
↓ Figure 37. Consumption of Polymers and Synthetic Rubber in the Countries of the Eurasian Region in 2022–2035 under the Target Scenario, kg per capita



Source: EDB calculations.

Total domestic consumption in the Eurasian region by product types may be increasing, as shown in Figure 38.

↓ Figure 38. Potential Petrochemical Products Consumption in the Eurasian Region by 2035, MT



Source: EDB calculations.

Estimates of future domestic demand for petrochemical products indicate a possible transition of the countries of the Eurasian region to the realisation of the import substitution potential and expansion of exports, as projected petrochemical production levels are significantly higher than projected consumption levels. It should be noted that, inasmuch as over the last five years the Eurasian petrochemical industry has already demonstrated rather impressive growth rates, both scenarios are perceived as positive. The target scenario indicators can be achieved only if the state actively supports the industry and stimulates domestic demand for petrochemical products.

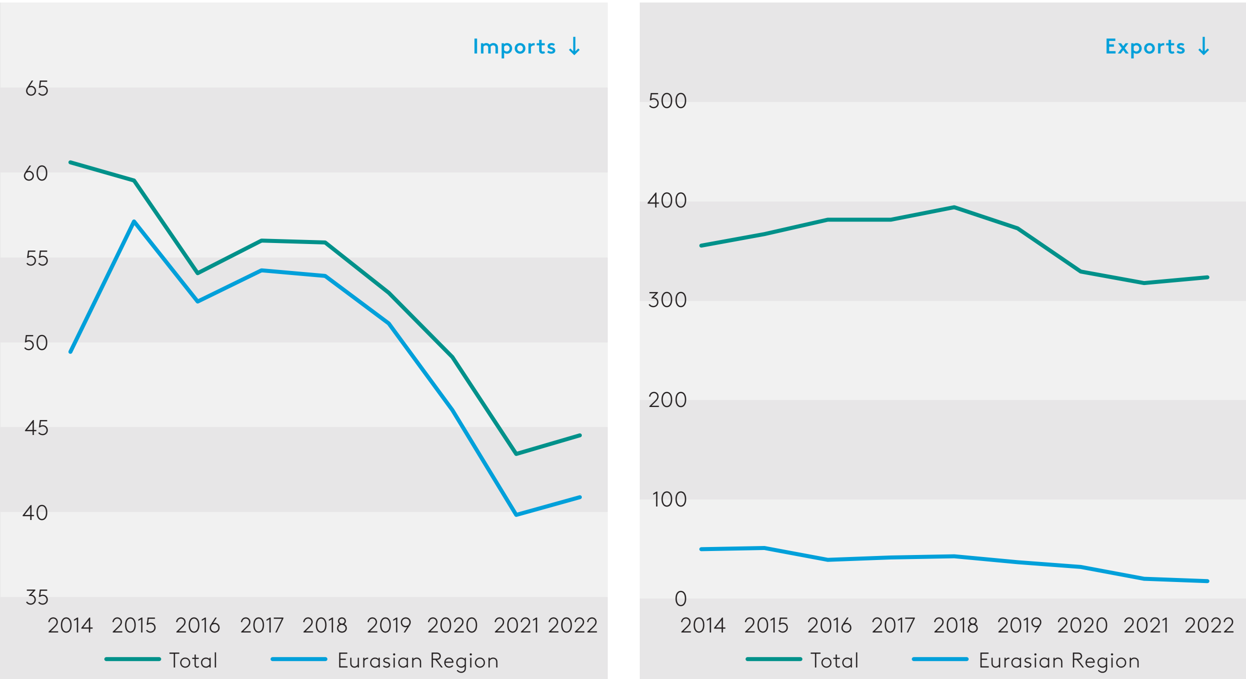
3. SCENARIO-BASED ESTIMATES OF THE EXPORT POTENTIAL OF THE EURASIAN PETROCHEMICAL INDUSTRY UNTIL 2035

3.1. Current State of Foreign and Mutual Trade in Petrochemical Products in the Eurasian Region

For the last several decades, the world petrochemical market has been demonstrating steady growth. At the same time, with each passing year, the problems related to the manufacturing and processing of plastic products are becoming more and more urgent. The countries of the Eurasian region are increasing their production capacity to support the growing population of the planet and improve people's lives. However, when developing production, it is more important to improve the quality and technological sophistication of the end products than to build up output.

Foreign trade in polymer products and feedstock required for their manufacturing in the countries of the Eurasian region is rather extensive, but currently its volume is tending to decline both inside and outside the Eurasian Region (Figure 39).

↓ Figure 39. Foreign and Mutual Trade in Polymer Materials in the Eurasian Region in 2014–2022, MT



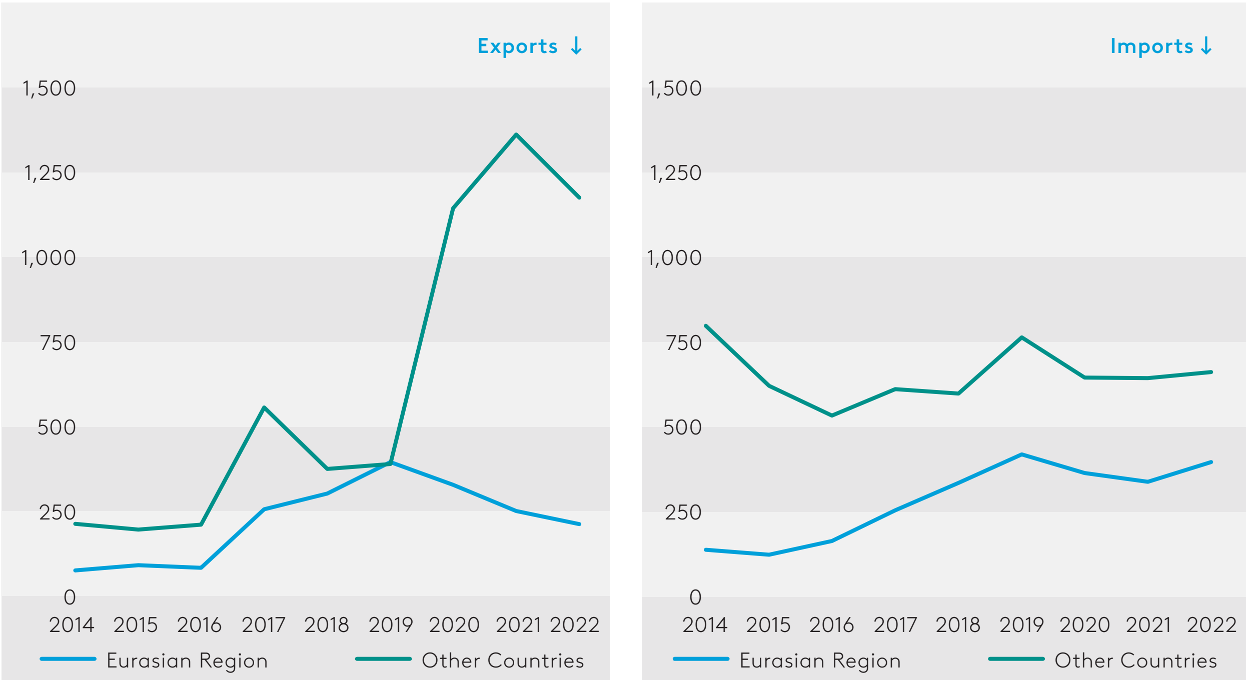
Source: EDB based on TradeMap data.

In most countries of the Eurasian region, domestic markets account for the bulk of imports. The trends affecting the volume of petrochemical imports in the Eurasian region are similar to global trends. The build-up of export capabilities is linked to expansion of production capacity, and the countries of the Eurasian region are meeting foreign market needs in an environment of increasing demand for polymers and polymer products. Demand for polymer products in the domestic market of the Eurasian region remains virtually unchanged, as indicated by the volume of imports.

As for the export of polymer products, it may be noted that such products are mainly supplied to markets external to the Eurasian region. Exports to other countries of the region are insignificant at 8% of the total, and tending to decline.

Imports of **polyethylene** within the Eurasian region are growing faster than imports from foreign countries (Figure 40). Over the last several years, the amount of polyethylene purchased in foreign countries has remained relatively steady. Exports of polyethylene to foreign countries have increased almost 2.5-fold since 2019, while intraregional export are tending to decline.

↓ Figure 40. Foreign and Mutual Trade in Polyethylene in the Eurasian Region in 2014–2022, KT

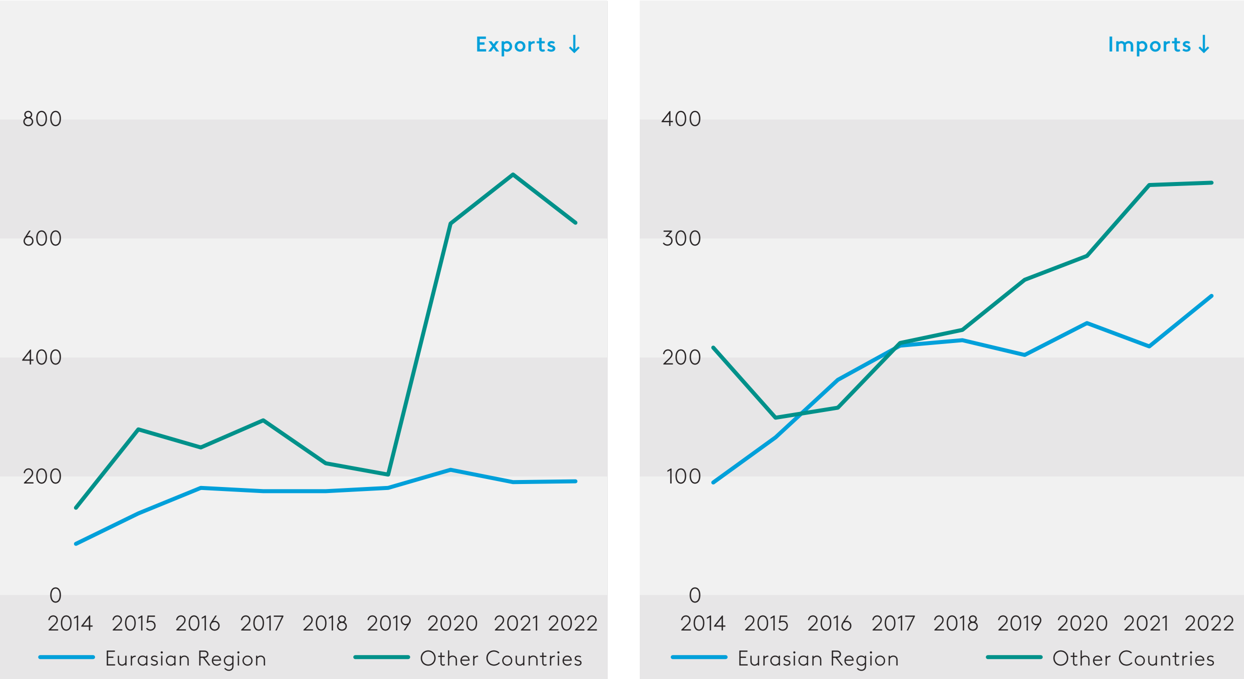


Source: EDB based on TradeMap data.

During the period under review, imports of **polypropylene** within the Eurasian region and from foreign countries have been the same; both import flows have tended to increase since 2018, but imports from foreign countries are growing at a faster rate (Figure 41). Exports of polypropylene within the Eurasian region are stable, while exports to foreign countries rapidly increased in 2018 (although a downward trend is already becoming visible).

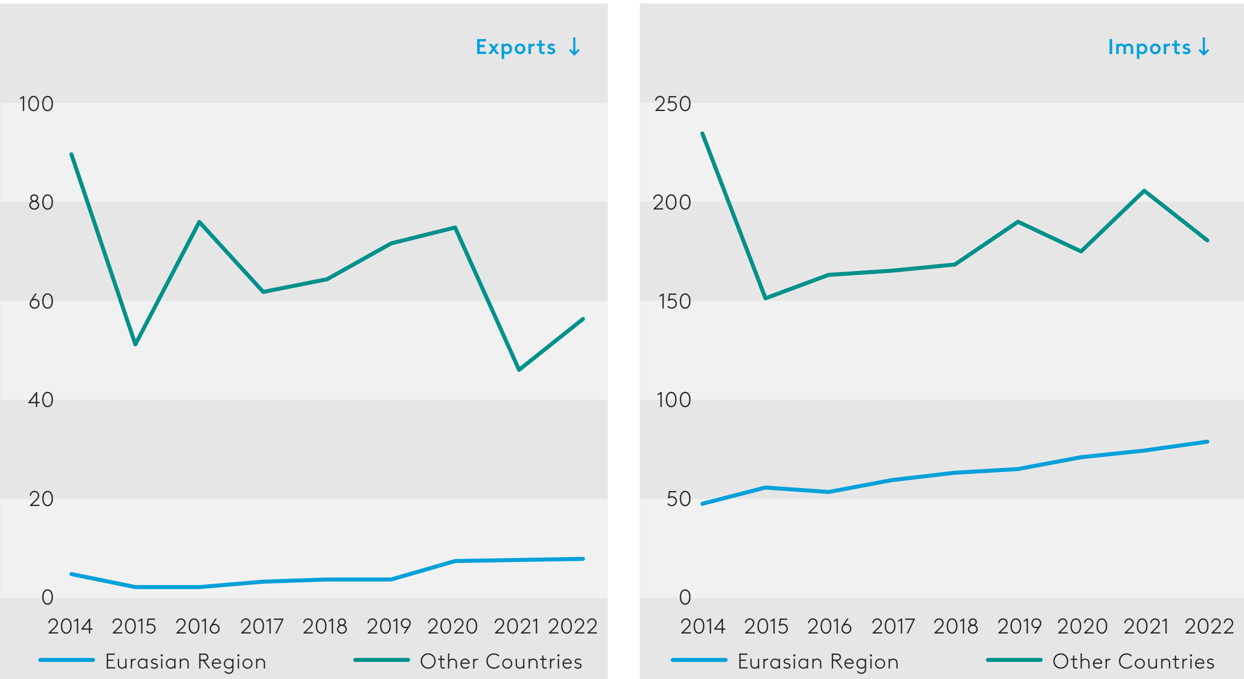
Imports of **polystyrene** from foreign countries nosedived in 2015, and since then have changed little, if at all. Imports within the Eurasian region also remain stable, and do not exceed 100 KT (Figure 42). Almost all exported polystyrene goes to foreign countries. The volume of annual exports within the Eurasian region stay below 6 tonnes, while the average volume of annual export to foreign countries has remained at 46 KT since 2014.

↓ Figure 41. Foreign and Mutual Trade in Polypropylene in the Eurasian Region in 2014–2022, KT



Source: EDB based on TradeMap data.

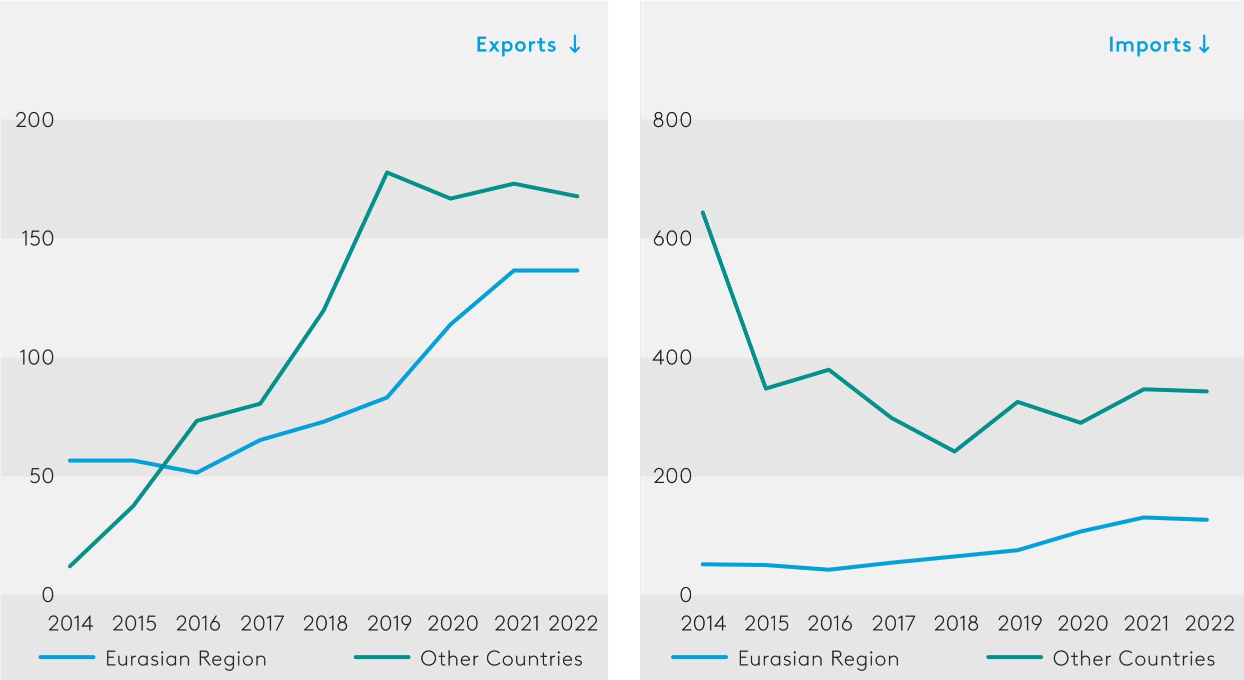
↓ Figure 42. Foreign and Mutual Trade in Polystyrene in the Eurasian Region in 2014–2022, KT



Source: EDB based on TradeMap data.

The volume of imports of **polyvinyl chloride** within the Eurasian region and from foreign countries has tended to change in different directions: since 2014, the latter has doubled, while the former has decreased by half (Figure 43). Exports of that polymer in 2014 were directed primarily to the countries of the Eurasian region, but in 2016 exports to other countries of the world began to increase at a faster rate, and the trend has persisted ever since.

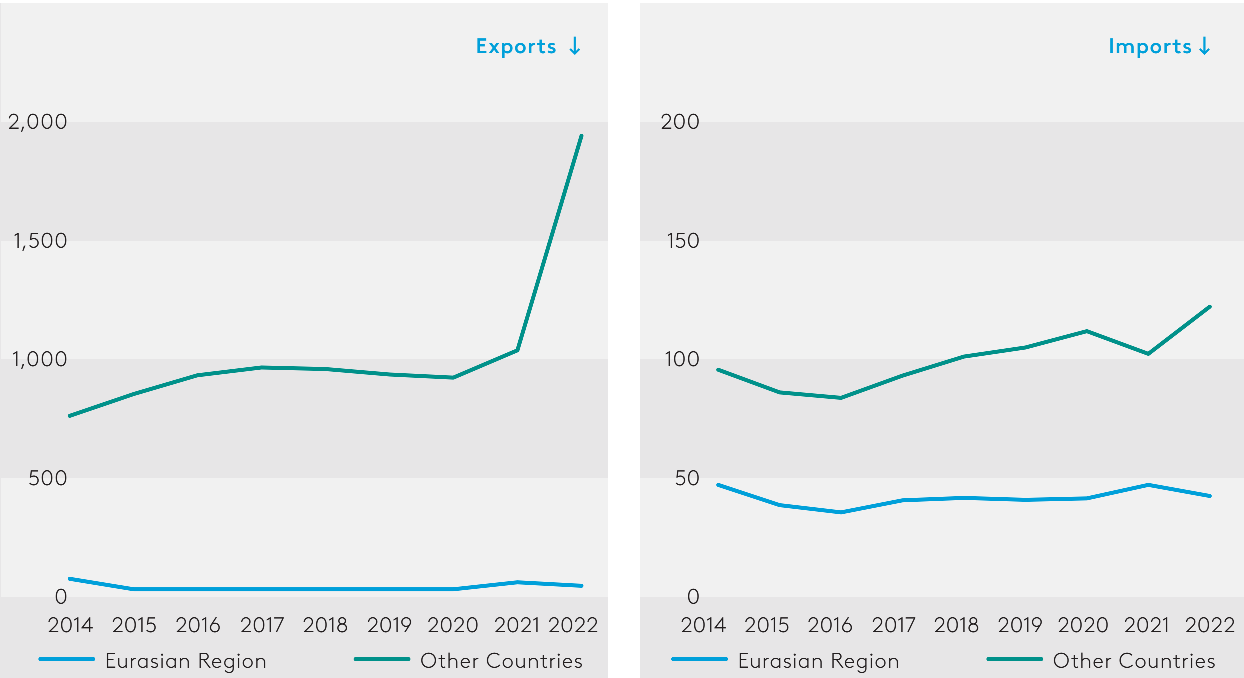
↓ **Figure 43. Foreign and Mutual Trade in Polyvinyl Chloride in the Eurasian Region in 2014–2022, KT**



Source: EDB based on TradeMap data.

During the period under review, the import of **synthetic rubber** did not have any pronounced spikes or drops, but since 2014 the volume of imports from foreign countries has increased by almost one third. Demand for those products in the domestic markets of the countries of the Eurasian region remains stable (Figure 44). As with the import of synthetic rubber within the Eurasian region, the volume of their exports has not changed since 2014. In 2021, the volume of exports of synthetic rubber to countries outside the region soared, although it had been at a high and stable level even before that.

↓ **Figure 44. Foreign and Mutual Trade in Synthetic Rubber in the Eurasian Region in 2014–2022, KT**



Source: EDB based on TradeMap data.

We conclude that manufacturers of the main types of polymer products tend to target foreign markets, and that demand for those products remains steady, as does their output.

Among the countries of the Eurasian region, Russia and Belarus are the largest importers, and Russia and Kazakhstan are the largest exporters. As for external markets, the countries of the Eurasian region most frequently co-operate with the countries of the Middle East (*Qatar, Saudi Arabia, UAE*) and East Asia (*China, Republic of Korea*). Active partner and trade relations have also been established with some European countries (*Germany, Italy*) and the USA.

The countries of the *Asia-Pacific Region* (*APAC*) *and Africa* have high potential in terms of foreign trade geography because of their high growth rates and the increasing plastic-intensity of their economies. Several APAC countries are already actively engaged in polymer trade with the Eurasian region, and may be used as a foothold for expanding co-operation in the future. Development of polymer plants will encourage manufacturing of high-value-added products, giving an impetus to allied industries, and producing a multiplier effect on the economy of the region.

3.2. Scenario-Based Estimate of the Export Potential of the Eurasian Region's Petrochemical Industry

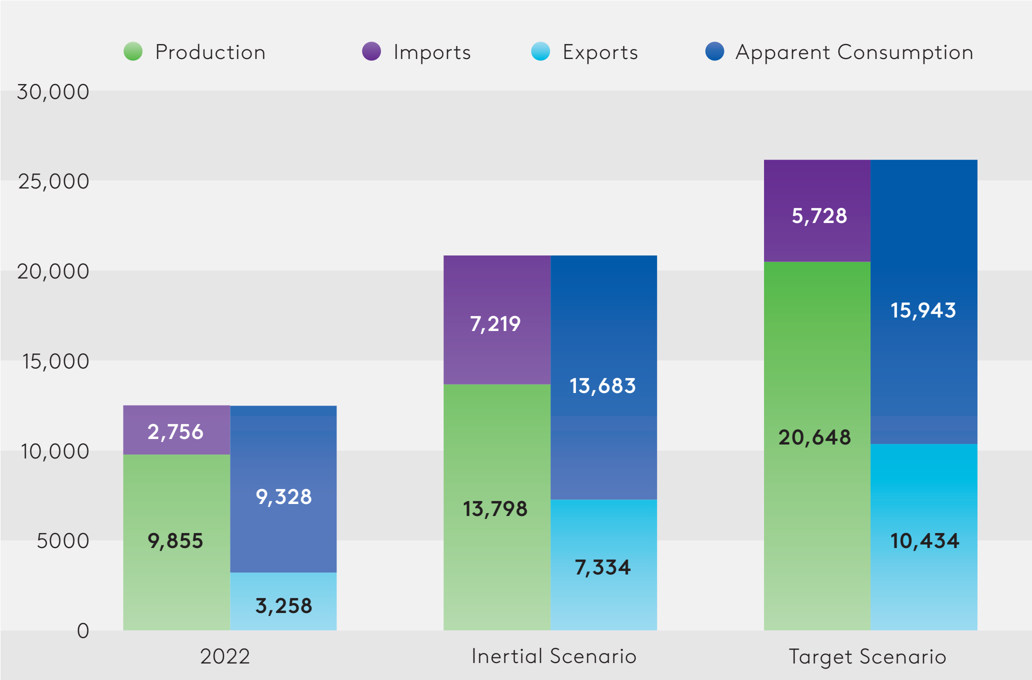
Scenario-based calculation of the resource export potential of the Eurasian region is the final stage of our research. That calculation was made on the basis of balance logic, subject to the scenario-based estimates of prospective domestic production and imports of petrochemical products, reduced by domestic consumption for production purposes, obtained earlier (*at the previous stages of the research*).

The results indicate that the export potential of the Eurasian region may increase because domestic production is growing faster than domestic consumption. By 2035, total exports of petrochemical products may increase in volume terms relative to 2022 by a factor of 2.2 under the inertial scenario (*by 4,076 KT to 7,334 KT*), and by a factor of 3.2 under the target scenario (*by 7,176 KT to 10,434 KT*). By 2035, net exports may amount to 115 KT and 4,705 KT (*2017–2022 average: 536.9 KT*).

Exports will increase for most base polymer types, with the resource potential of petrochemical exports for the entire macro-region expected to decrease only with respect to polystyrene production. Any increased volume of exports of synthetic rubber is projected to be insignificant, primarily due to the anticipated increase in petrochemical products consumption by the population of the manufacturing countries during the period under review. The inertial scenario assumes an increase in the volume of exports of all base polymers and synthetic rubber under review due to a slower rate of growth of petrochemical products consumption in the countries of the Eurasian region.

Under the inertial scenario, total export potential of the macro-region, taking into account mutual trade, is estimated as follows: polyethylene 3.77 MT (*99% of total domestic output in the Eurasian region in 2022*); polypropylene 1.79 MT (*85%*); polyvinyl chloride 0.29 MT (*29%*); polystyrene 0.14 MT (*25%*); polyethylene terephthalate 0.16 MT (*23%*); and synthetic rubber 1.13 MT (*79%*).

Total macro-region export potential estimates under the target scenario are higher (Figure 45): polyethylene 4.83 MT (*127%*); polypropylene 2.43 MT (*115%*); polyvinyl chloride 0.84 MT (*82%*); polystyrene 0.15 MT (*26%*); polyethylene terephthalate 0.73 MT (*81%*); and synthetic rubber 1.46 MT (*101%*).

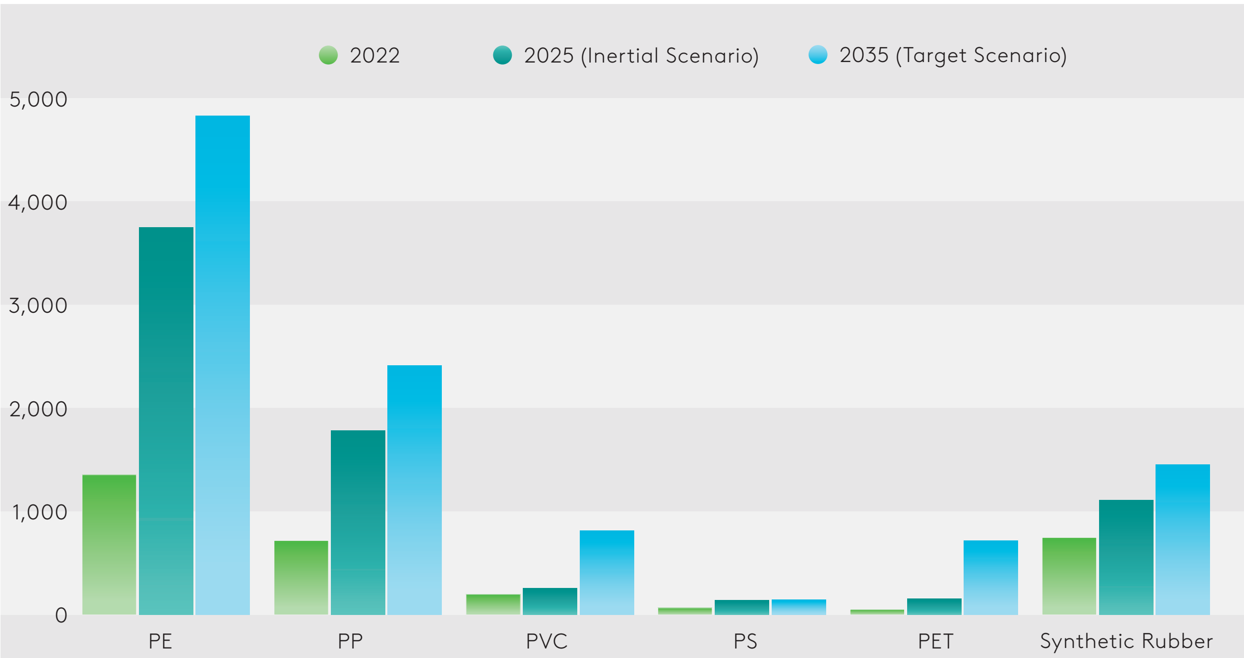


← **Figure 45. Key Parameters of the Inertial and Target Scenarios for 2035, KT**

Source: EDB.

By 2035, net export from the entire Eurasian region should constitute a significant share of domestic production of synthetic rubber (*50% and 42% under the inertial scenario and the target scenario, respectively*) and polypropylene (*31% and 40%*), while the share of polyethylene will increase quite significantly (*1% and 32%*). As regards polyvinyl chloride, net imports will be replaced by net exports (*27% and 3%, respectively*); for other products, imports from third countries will prevail, in particular, the ratio of net polyethylene terephthalate imports to total production volume will change from 130% to 25%, and for polystyrene the share of net imports will increase from 16% to 36% (Figure 46).

↓ **Figure 46. Potential Volume of Export of Base Polymers and Synthetic Rubber from the Countries of the Eurasian Region, KT**



Source: EDB.

The largest contribution to the increase in petrochemical exports until 2035 will be made by the production of polyethylene and polypropylene and, to a lesser extent, synthetic rubber. The largest volumes of export and export increases are noted for Russia and, to a lesser extent, for Belarus, Kazakhstan, and Uzbekistan. The impact of Armenia, Kyrgyzstan, and Tajikistan on export metrics remains insignificant. Armenia has no petrochemical facilities or plans for the development of petrochemicals and, accordingly, any increase in domestic consumption of petrochemical products reduces exports (Table 8).

↓ Table 8. Scenario-Based Estimates of Export of Base Polymers and Synthetic Rubber from the Countries of the Eurasian Region in 2035 (KT; %)

Country	2017–2022 Average	2025 (Inertial Scenario)	2035 (Target Scenario)	2017–2022 Average	2025 (Inertial Scenario)	2035 (Target Scenario)
Armenia	2.1	6.7	5.6	0.1	0.1	0.1
Belarus	154.8	157.7	210.1	4.8	2.2	2.0
Kazakhstan	57.6	92.7	2,344.8	1.8	1.3	22.5
Kyrgyzstan	5.6	1.5	2.1	0.2	0.0	0.0
Russia	2,637.8	6,652.9	6,844.8	81.0	90.7	65.6
Tajikistan	0.0	0.0	0.0	0.0	0.0	0.0
Turkmenistan	115.3	230.5	398.3	3.5	3.1	3.8
Uzbekistan	284.7	192.1	628.3	8.7	2.6	6.0
Total	**3,257.9**	**7334.1**	**10,433.9**	**100.0**	**100.0**	**100.0**

Source: EDB.

Expansion of domestic petrochemical production should strengthen the competitive positions of suppliers from the countries of the Eurasian region in the global market, enabling them to make a substantial contribution to the satisfaction of petrochemical product needs of buyer countries.

3.3. Prospective Scope of External Demand for Petrochemical Products Manufactured in the Eurasian Region

Methodology. To measure the possible geographic structure of potential exports and the projected capacity of markets to absorb petrochemical products manufactured in the Eurasian region, we performed conditional scenario-based calculations in two variants: the inertial variant, which does not assume active development of foreign trade in the Eurasian region; and the target variant, which assumes active trade expansion into developing markets (*China, India, Africa*). In those calculations, we used plastic-intensity and per capita plastics consumption forecasts published by Kapustin and Grushevenko (2023). The forecast built on the basis of retrospective data on foreign trade in base polymers includes calculation of the share of the Eurasian region in global trade with a breakdown by major importers, and presents the potential capacity of export markets with a breakdown by products (Table 9).

↓ Table 9. Projected Capacity of Petrochemical Export Markets for the Countries of the Eurasian Region by 2035

Trade Partner	Total Volume of Imports in 2035 (Forecast), tonnes	Imports from the Eurasian Region, tonnes	Share of the Eurasian Region in the Country's Imports in 2022, %	Market Capacity, KT	
				share retained	share increased
Polyethylene					
China	30,638,802.7	69,638.0	0.4	131,467.9	2,663,929.7
Latvia	78,128.5	41,272.0	57.2	44,680.7	65,615.2
Lithuania	155,727.6	4,230.0	2.9	4,579.4	9,767.5
Turkey	2,464,447.2	95,365.0	4.2	103,241.4	220,206.5
Africa	4,194,278.5	0.0	0.0	209,713.9	447,304.8
India	5,218,400.2	545.0	0.0	1,028.9	800,970.1
Total				***498,220.9***	***4,215,277.4***
Polypropylene					
Belgium	1,369,274.4	87,328.0	6.9	94,540.6	201,648.3
Vietnam	2,155,695.0	28,528.6	2.5	52,945.5	112,929.0
Germany	1,938,891.0	6,322.9	0.4	6,845.1	14,600.1
Italy	573,664.5	39,978.7	7.5	43,280.7	92,314.6
China	9,053,721.9	78,379.1	1.6	147,970.1	342,406.6
Poland	1,000,176.5	58,335.3	6.3	63,153.4	134,701.6
Serbia	89,494.6	16,900.1	20.4	18,295.9	39,023.8
Turkey	2,603,558.2	193,597.0	8.1	209,586.6	447,033.1
India	2,884,476.0	1,693.6	0.1	3,197.3	7,398.6
Africa	2,816,790.5	0.0	5.0	140,839.5	265,573.9
Total				***810,621.2***	***1,721,546.3***
Polystyrene					
Germany	772,891.7	2,231.0	0.3	2,415.3	5,151.6
Italy	609,832.8	412.0	0.1	446.0	951.3
China	5,645,866.3	6,137.3	0.2	11,586.4	68,189.2
Lithuania	60,889.3	4,349.7	7.7	4,709.0	10,043.9
Poland	511,744.5	3,801.5	0.8	4,115.5	8,778.0
Finland	86,511.0	2,157.0	2.7	2,335.2	4,980.8
Switzerland	85,935.1	9,647.5	12.2	10,444.3	22,277.0
India	435,259.2	0.0	0.0	21,763.0	50,360.1
Africa	566,215.9	0.0	0.0	28,310.8	65,511.9
Total				***115,509.2***	***298,917.4***
Polyvinyl Chloride					
Brazil	568,732.7	2,748.6	0.7	4,172.0	7,867.0
Germany	807,139.5	2,635.7	0.4	2,853.3	5,380.4

Trade Partner	Total Volume of Imports in 2035 (Forecast), tonnes	Imports from the Eurasian Region, tonnes	Share of the Eurasian Region in the Country's Imports in 2022, %	Market Capacity, KT	
				share retained	share increased
India	4,141,555.9	57,832.6	2.6	109,180.7	205,876.5
Italy	765,654.6	3,072.7	0.4	3,326.5	6,272.6
Lithuania	53,605.6	7,843.6	15.8	8,491.5	16,011.9
Morocco	134,248.5	9116.1	10.7	14,344.5	27,048.6
UAE	250,233.1	1,770.9	1.0	2,406.4	4,537.6
Poland	450,535.8	10,929.8	2.6	11,832.5	22,311.9
South Korea	92,241.4	2,082.8	2.6	2,375.1	4,478.6
USA	598,849.9	1,908.4	0.4	2,616.6	4,934.1
Turkey	955,976.4	22,670.6	2.6	24,543.0	46,279.5
Switzerland	68,783.6	6,675.9	10.5	7,227.3	13,628.2
Africa	1,819,611.0	0.0	0.0	90,980.6	171,557.4
Total				***299,637.8***	***565,011.8***
Synthetic Rubber					
Belgium	567,984.1	6,890.5	1.3	7,459.6	14,066.2
Brazil	483,100.1	30,725.8	9.7	46,638.7	87,944.3
Hungary	160,590.6	56,906.0	38.4	61,606.0	116,167.3
Germany	551,823.2	37,536.0	7.4	40,636.2	76,625.6
India	1,009,985.2	94,526.0	17.7	178,453.3	336,500.4
Indonesia	636,297.2	5,715.3	1.7	10,606.8	20,000.7
Italy	335,242.0	7,577.0	2.4	8,202.8	15,467.6
China	8,918,113.9	165,614.8	3.5	312,660.1	589,567.2
Netherlands	223,699.2	3,916.5	1.9	4,240.0	7,995.1
Pakistan	97,569.1	4,278.3	6.0	5,813.4	10,962.0
Poland	312,047.4	106,512.8	37.0	115,309.9	217,433.9
South Korea	169,159.7	8,455.8	5.7	9,642.6	18,182.5
Romania	159,225.5	40,602.8	27.6	43,956.2	82,886.0
Serbia	56,790.6	15,233.0	29.0	16,491.1	31,096.5
USA	931,242.0	55,616.0	8.2	76,254.6	143,789.4
Turkey	485,442.9	93,020.0	20.7	100,702.7	189,890.0
France	238,102.1	12,994.0	5.9	14,067.2	26,525.8
Japan	185,538.7	12,472.0	7.7	14,222.6	26,818.8
Africa	419,923.7	0.0	5.0	20,996.2	39,591.4
Total				***1,101,207.7***	***2,076,491.3***

Note: The table presents data only on major importers of petrochemical products, or countries with strong dependence on imports from the Eurasian region.
Source: EDB calculations based on TradeMap data.

Under the inertial scenario, the share of the countries of the Eurasian region in global exports was assumed to be equal to the 2018–2022 average. Under the target scenario, we assumed a significant increase in the share of exports to the countries of Asia and Africa as the most attractive petrochemical markets with friendly trade relations with the countries of the Eurasian region. It should be noted that, according to TradeMap data, no polymer trade is currently carried out with the countries of Africa (*and, for some products, with India*). A comparison of the dynamics, geographic and commodity structure of global petrochemical imports with projected levels of exports from the countries of the Eurasian region makes it possible to estimate the scope of prospective demand in the existing and potential sales markets.

Results. According to projections of per capita consumption and plastic-intensity, during the period ending in 2035, the highest increase in plastics consumption will be in China (by up to 5% per year), the developing countries of the APAC and Africa (up to 4%), as well as in Latin America and the CIS (up to 3%). This is largely attributable to high economic and population growth rates leading to larger consumption of petrochemical products in those countries. In developed countries, polymer consumption will be growing at a slower rate: for example, in NAFTA, EU, and OECD member states, the increase in the demand for polymer products will range from 1% to 2% per year.

The results show that under the inertial scenario, the probability of realisation of the export potential tends to zero due to the operation of two factors: (1) market saturation in the countries with the strongest dependence on petrochemical products supplied from the Eurasian region, and (2) weak interaction with the most actively expanding markets.

Under the target scenario, the export potential, assuming expansion in all markets, is estimated as follows:

- *polyethylene* — increase in supplies by 4.2 MT, including 2.7 MT to China, 0.8 MT to India, and 0.45 MT to Africa;

- *polypropylene* — increase in supplies by 1.7 MT, including 450 KT to Turkey, 342 KT to China, and 266 KT to Africa;

- *polystyrene* — increase in supplies by 298 KT, primarily to China, India, and Africa;

- *polyvinyl chloride* — increase in supplies by 565 KT, including 206 KT to India, and 172 KT to Africa;

- *synthetic rubber* — increase in supplies by 2.1 MT, primarily to China, India, Turkey, the USA, and Poland.

This scenario looks rather optimistic and, to ensure its realisation, it will be necessary to accelerate expansion of production capacity, streamline transport and logistics infrastructure, and eliminate possible barriers to the promotion of petrochemical products manufactured in the Eurasian region.

For most products, external market capacity projections for 2035 are lower than Eurasian region export potential projections. First, market capacity projections do not take into account the increase in the consumption of petrochemical products within the Eurasian region. Second, the list of partner countries can be expanded by diversifying geography of supplies to include previously untapped markets. Third, projected recession in the EU and the USA may significantly increase the shares of the Eurasian region in petrochemical products markets.

4. ECONOMIC AND ENVIRONMENTAL EFFECTS OF DEVELOPMENT OF THE PETROCHEMICAL INDUSTRY IN THE EURASIAN REGION

4.1. Macroeconomic Effects of Development of the Petrochemical Industry, Industrial Co-operation, and Formation of Regional Production and Distribution Chains in the Eurasian Region

Industrial co-operation and formation of regional production and distribution chains in the course of evolution of the petrochemical industry gives rise to significant macroeconomic effects, both in the petrochemical sector and in allied sectors (up and down the production chain — in extraction and transportation of oil and natural gas, construction and mechanical engineering, production of rubber and plastic goods, etc.). Moreover, new petrochemical investment projects and spending of the resultant income by businesses, the state, and the population generate additional effects that have a significant impact on provision of services, production of consumer and investment goods, and the evolution of infrastructural and related sectors.

One of the most convenient and widely used approaches to evaluating such macroeconomic effects relies on "input–output" methodology and the production multipliers theory. The basics of that methodology were described by Miller and Blair (2009), and the methods for the computation of industry-specific production multipliers using "input–output" tables by Ksenofontov et al. (2018).

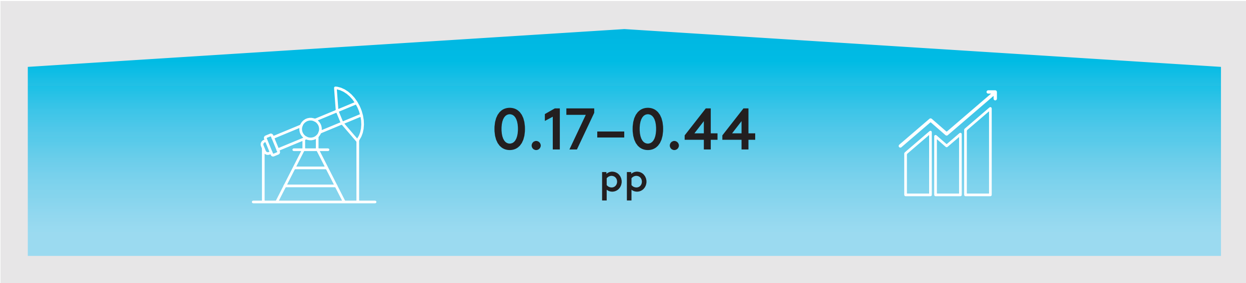
Expansion of polymer production requires new investment projects in the petrochemical industry, which generates additional macroeconomic effects in the countries of the Eurasian region, related to output growth in the fundamental sectors of the economy, primarily construction and mechanical engineering.

At the same time, a fuller disclosure of the potential impact of petrochemical projects on the economies of the countries of the Eurasian region requires an analysis of opportunities and limitations related to the expansion of production of finished rubber and plastic goods, construction materials, and mechanical engineering products. The assessment of the macroeconomic effects produced by the development of the petrochemical industry, as presented in this paper, should be regarded as preliminary and conservative.

Our analysis of macroeconomic effects covers the impact on gross output, GDP, and output in the manufacturing industry, both in individual countries and in the entire Eurasian region. The impact is calculated based on investments and output increase in the petrochemical industry (*in 2023 prices*).

Development of the petrochemical industry will have a direct impact on GDP growth in the countries of the Eurasian region. The annual GDP growth rate attributable to development of the petrochemical industry in the Eurasian region is generally expected to range from 0.17% to 0.44%, depending on the development scenario (Figure 47).

↓ Figure 47. Annual GDP Growth Rate Attributable to Development of the Petrochemical Industry in the Eurasian Region, in two scenarios — inertial and targeted



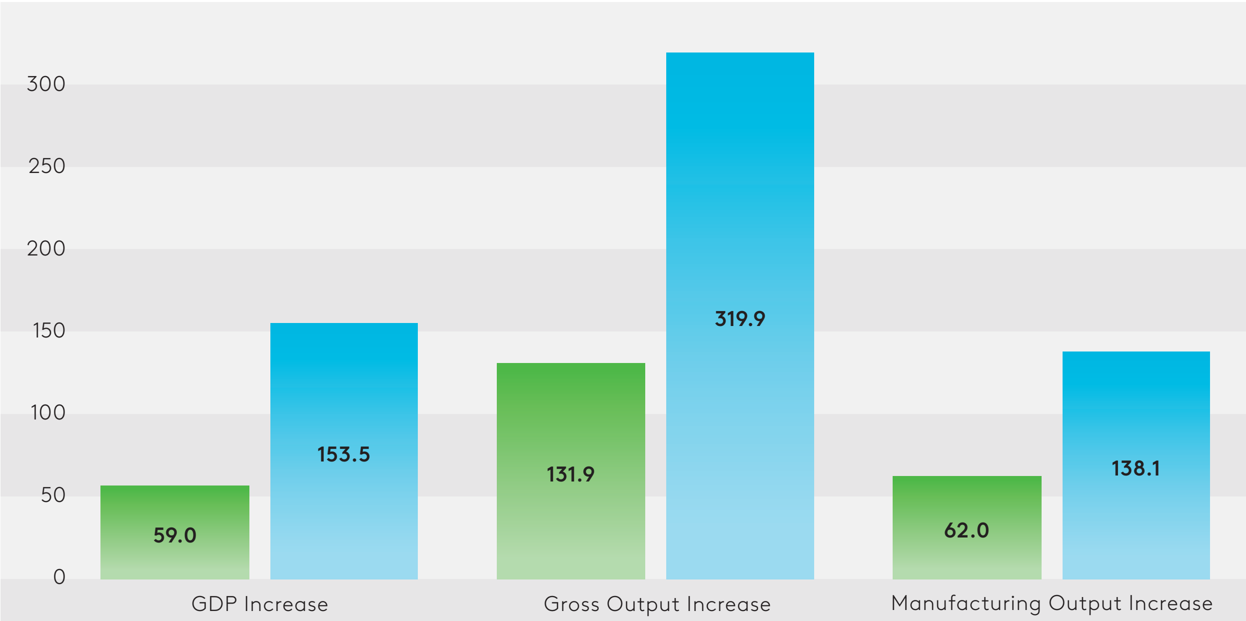
Source: EDB.

A relatively small increase in the region's GDP growth rate actually entails a colossal GDP increase in nominal terms. In 2023–2035, GDP increase attributable to the development of the petrochemical industry in the countries of the Eurasian region may amount to $59 billion under the inertial scenario, and to $153.5 billion under the target scenario. The average annual GDP increase may be as high as $4.5 billion and $11.8 billion, respectively.

In 2023–2035, **total gross output increase** in the countries of the Eurasian region may amount to $132 billion under the inertial scenario, and to $320 billion under the target scenario. The average annual gross output increase may reach $10.1 billion and $24.6 billion, respectively. The largest contribution to total effects on gross output (about 95% under the inertial scenario and 65% under the target scenario) is made by the Russian Federation, with Kazakhstan capable of contributing up to 25% under the target scenario.

The manufacturing industry will also receive a long-term development impetus. In 2023–2035, total output increase in the industry will amount to $62.0 billion and $138.1 billion, respectively (Figure 48).

↓ Figure 48. Macroeconomic Effects of Development of the Petrochemical Industry of the Eurasian Region, total increase by 2035



Source: EDB.

4.2. Environmental Effects

Development of the petrochemical industry in the Eurasian region creates not only macroeconomic effects, but also an additional environmental load. As with any other industry, growth of production capacity leads to a proportional increase in environmental impact, in particular, in greenhouse gas emissions, both directly in the course of manufacturing of petrochemical products, and in the allied sectors, such as generation of energy, extraction of crude oil and natural gas, and transport. By 2035, total **greenhouse gas emissions** may amount to 86.7 mln tCO_2e under the inertial scenario, and 231.6 mln tCO_2e under the target scenario (*annual average: 6.7–17.8 mln* tCO_2e).

It is expected that by 2035, projected growth of domestic consumption will increase total generation of **polymer waste** (*relative to 2022*) to 18 MT under the inertial scenario, and to 28 MT under the target scenario (*annual average: 1.4–2.2 MT*).

We also forecast **increased water consumption,** which by 2035 may reach 27 MCM under the inertial scenario, and 63 MCM under the target scenario (*annual average: up to 2.1–4.8 MCM*). The Russian petrochemical industry consumes the most water (59.6%), but under the target scenario, water consumption in Kazakhstan will also increase quite substantially (*25.2%*) (Figure 49).

↓ **Figure 49. Environmental Impact of Development of the Petrochemical Industry of the Eurasian Region**

Source: EDB.

There are several types of adverse environmental impact: generation of atmospheric emissions, generation of pollution runoff, introduction to the biosphere of known harmful substances, depletion of soil resulting from commercial extraction of mineral resources, radiation contamination, disruption of hydrological and biological regimes and habitats, etc. The contribution of industries to various contamination types is described in research papers, but there are still no generally recognised methods that would enable an environmental impact assessment covering all types of contaminating activities (Kostin, 2021).

Any isolated harmful environmental impact can be eliminated or significantly reduced by chemical recycling of polymer waste, minimising release of plastic particles into the environment, and employing the best available petrochemical technologies to minimise emissions, collect particulate contaminants, and control the use of natural resources. Technical progress provides us with tools to reduce the "cost" of our negative environmental impact.

On the other hand, in practical terms, the use of petrochemical end products can also produce a **positive environmental impact**. The use of polymers in the economy reduces harmful environmental effects over the long term. Some examples of such positive impact in several areas are provided below.

First, polymers can replace some conventional energy-intensive materials. For example, the amount of emissions generated in the production of 1 tonne of aluminium is 7.1 tCO_2e, while production of 1 tonne of polymers generates only 0.2 tCO_2e (Figure 50).

↓ Figure 50. Carbon Footprint from Production of 1 Tonne of Source Materials

Source: Kostin, 2021.

Second, polymers increase energy efficiency of conventional products. For example, a 1cm thick polymer thermal insulation board can be used instead a 50cm thick board made of conventional materials to ensure effective conservation of heat in residential houses (Figure 51). Not only does it save resources, but it also changes construction standards.

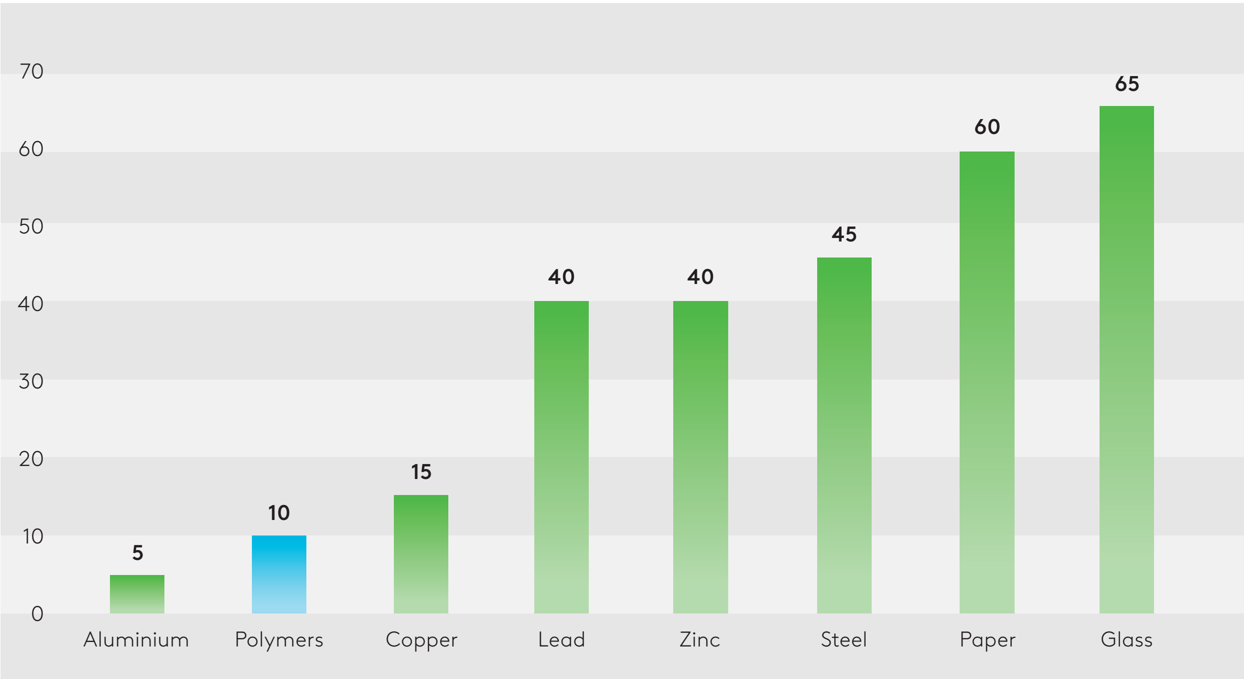
↓ Figure 51. Equivalent Thickness of Various Materials to Achieve Heat Transfer Resistance of 4.2 $m^2{}^\circ C/W$

Source: Kostin, 2021.

Third, environmentally safe polymers can reduce harmful impact on (invasion of) ecosystems. For example, the use of polymer pipes protects not only the products transported through them, but also the environment around them. Polymer pipes are corrosion-resistant; they do not release contaminants into soil and water as they decay; and they prevent infestation by biological life forms, preserving the quality of transported substances.

Fourth, polymers intensify production processes, making them less resource-intensive and more environmentally sound. For example, polymer recycling is an extremely profitable activity. It requires merely 10% of the energy consumed during primary polymer production (Figure 52), but yields a product with almost identical physical properties and quality parameters. To compare, recycling of mineral glass requires almost 65% of the initial energy consumption.

↓ Figure 52. Share of Energy Consumption During Production of 1 Tonne of Secondary Materials in Total Energy Consumption During Production of Primary Material, %



Source: Kostin, 2021.

There are other good examples of the positive impact that use of polymers may have on natural resources. For example, the use of plastics instead of paper reduces deforestation, while the use of plastic cups instead of conventional tableware prevents the spread of diseases (*for example, during the COVID pandemic, the Starbucks coffee shop network banned the use of reusable cups and switched to plastic cups*).

Polymer products stimulate expansion of production in allied industries (*medicine, aircraft building, construction, space industry, production of electronic and communication equipment, the agroindustrial complex, packaging industry, production of goods for sports, tourism, and leisure, and production of household goods*). For example, bread packaging is made from polypropylene film, plastic bottles from polyethylene terephthalate, and mayonnaise from polypropylene laminates; hothouses from cellular polycarbonate, drainage fabric from polypropylene; barrels, canisters, watering cans, and buckets from polypropylene and polyethylene; kayaks from polyvinyl chloride, life vests from polyamide and foam polystyrene, bicycle tyres from synthetic rubber, backpacks from polyamide, sleeping bags from polyamide and polyether, tents from nylon and polyurethane, etc.

Probably one of the best examples of the benefits associated with the use of polymers instead of conventional materials is the replacement of cast-iron pipes with polymer pipes in the housing and public utilities system. In addition to economic and physical advantages (*polymer pipes are 11 times less expensive, and lighter by up to 70% — a PE pipe with a diameter of 16 cm weighs 3.7 kg, a steel pipe 17.5 kg, and a cast-iron pipe 28 kg*), this solution has certain environmental advantages. Polymer pipes are fully resistant to corrosion, and their material does not release any contaminants into soil, water, or air; they are resistant to various chemical reagents, which excludes their deformation and decomposition into harmful chemical elements; polymers are not infested with living organisms, and have biological resistance to transported substances (*for example, water*). Accordingly, it is important to note that **the environmental impact from the use of polymers can also be positive (to a certain extent).**

5. STEPS TO UNLOCK THE PRODUCTION AND EXPORT POTENTIAL OF THE PETROCHEMICAL INDUSTRY IN THE EURASIAN REGION

5.1. Barriers to Industry Development

Heavy Wear and Tear on Basic Production Assets (BPAs)

One of the factors that constrains the unlocking of the petrochemical production potential in the countries of the Eurasian region is the wear and tear on equipment used by oil and petrochemical facilities. According to Rosstat, in 2022 the general wear and tear rate of BPAs in Russia was 61.4% (Rosstat, 2023). In Belarus, the wear and tear rate of the BPAs installed at polymer fibre and thread production facilities stood at 50%. In Uzbekistan, the wear and tear rate of chemical equipment was 60% (Website of the President of the Republic of Uzbekistan, 2020).

High Dependence on Imported Technologies, Materials, and Equipment

The manufacturers of polymer products in some market segments are highly dependent on imported polymer feedstock, equipment, and technologies, which strongly deters development of the industry in the Eurasian region.

Russia currently experiences no import dependency in the large-tonnage base polymer production segment (Table 10), while the bulk of demand for low- and medium-tonnage products is satisfied with imports, and production of many strategic products is rather highly import-dependent. According to the Association of Plastic Processors, domestic production of base large-tonnage polymers currently satisfies about 80% of domestic demand (*with the exception of emulsion PVC* (*PVC-E*) *and polyethylene terephthalate* (*PET*)), while the share of imported super engineering plastics (*polyphenylene sulphide, polysulfone, polyetherketone, polyphenylene oxide, ultra-high molecular weight polyethylene, aramid fibre*) used in high-tech industries currently stands at 98%, making this feedstock segment the most import-dependent (Katsevman, 2023).

↓ **Table 10. Share of Imports in PVC and PET Consumption in Russia, % of total**

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
PVC-E	83.2	83.9	85.6	87.3	89.3	92.2	82.0	79.8	75.8	79.2	80.9	80.4
PVC-S	40.1	45.0	39.2	36.3	31.2	12.0	17.5	7.2	2.2	8.2	5.5	7.3
PET	48.3	44.9	34.1	34.1	33.3	19.2	17.8	20.2	20.5	26.3	22.7	25.6

Source: Fuel and Energy Analytical Centre, Ministry of Energy of Russia.

According to JSC Trade Policy Development Centre "QazTrade" under the Ministry of Trade and Integration of the Republic of Kazakhstan, that country is almost fully dependent on imports of virtually all chemical products, as the existing production capacity is not sufficient to meet domestic demand, with dependency rates for primary ethylene polymers and propylene polymers reaching 99% and 78%, respectively (QazTrade, 2022).

The share of imported equipment and technologies used by the Russian petrochemical industry is estimated by the Ministry of Trade of Russia to be rather high, ranging from 80% to 95%. The highest degree of import dependency is noted for the following types of equipment, devices, components, and services for the oil and gas complex (TEK, 2022):

- subsurface well-completion equipment with selective control systems, steam-generating units, and insulated heat-resistant pipes (*share of imports: 95%*);
- hydraulic fracturing and other productive strata and bottom-hole area treatment technologies (*share of imports: 92%*);
- rotary steerable systems, drilling tools positioning equipment, drilling rigs control equipment (*share of imports: 83%*);
- application software (*share of imports: 90%*);
- engineering software (*modelling software*) (*share of imports: 90%*);
- industrial software (*computerised process control systems*) (*share of imports: 91%*);
- high- and low-pressure cryogenic LNG pumps (*share of imports: 80%*);
- LNG dispensing columns with commercial metering capability (*share of imports: 90%*);
- on-board fuel systems for motor vehicles using LNG as motor fuel (*share of imports: 90%*).

The high share of imports in the base polymers production and processing segment in Kazakhstan and Russia has an adverse impact on the expansion of low-tonnage chemical capacity, and hinders manufacturing of high-value-added products.

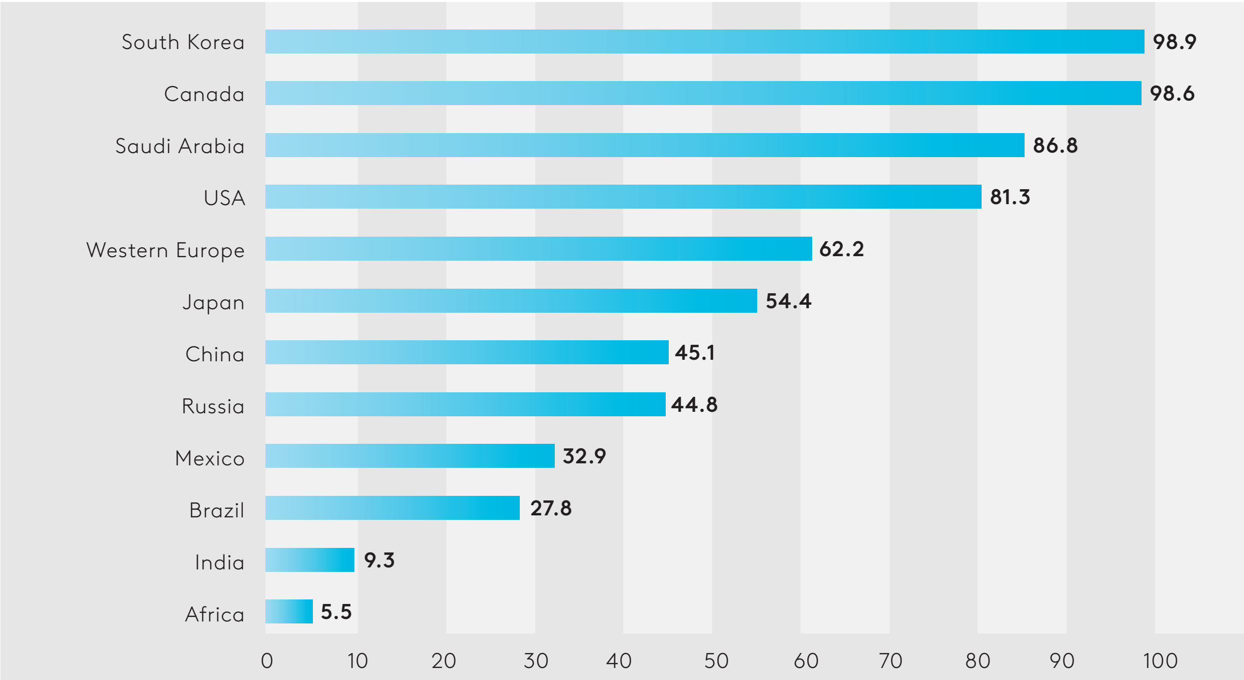
Economic Unattractiveness of Advanced Process Stages

Implementation in Russia of projects envisaging creation of many medium- and low-tonnage chemical production facilities is currently unprofitable because of the high volatility of global market prices for Russian large-tonnage petrochemical products, high shipment costs combined with weak customs and tariff protection, and limited access of Russian companies to foreign investment capital and cheap debt financing which impairs the competitiveness of Russian projects due to their high capital costs (CSR, 2021). As a result, creation of new medium- and low-tonnage facilities implies the need for significant capital expenditures (*often associated with high risk*). That is why the share of expensive high-tech, low-tonnage chemicals in the Russian Federation recently (*in 2021*) amounted to about 8% of total chemical industry output, while in developed economies is about 40% (*USA: up to 60%*) (Engineering Chemical Technology Centre, 2023).

Narrow Domestic Sales Market

The Eurasian region is characterised by relatively low domestic consumption of chemical products compared to the world's leading economies (Figure 53). The volume of consumption of polymers and synthetic rubber in the region is approximately half of the global level, mainly due to insufficient demand for polymer products on the part of construction, housing and public utilities, and agriculture. According to SIBUR, polymer-processing capacity is underutilised by 24%, with the finished products export potential supported at 690 KT per year (in polymer weight) (Komyshan, 2023).

↓ Figure 53. Per Capita Polymer Consumption, kg/person



Source: IEA, Statista.

Rise of Polymer Prices in the Domestic Market

Prices for large-tonnage polymers in the Russian market strongly depend on the economic situation. In 2023, prices for certain types of base plastics in Russia increased by 10–15% (Mordyushenko, 2023). Prices for most polymers in the Russian Federation are higher than in Southeast Asia, which makes it hard for Russian companies, especially small processing businesses, to compete against Chinese and Turkish products.

Logistical Barriers

Following the imposition of economic sanctions against Russia, major shipping companies (Maersk, Mediterranean Shipping Company, CMA CGM, Ocean Network Express, Hapag-Lloyd, Yang Ming, Hyundai Merchant Marine) withdrew from the country, and Russian vessels and cargoes were banned from European ports. This brings to the foreground the matter of the effectiveness of the transport and logistics infrastructure.

The World Bank estimates that in 2023 the logistics performance of Eurasian countries and their partners was below average. According to the Logistics Performance Index (World Bank, 2023), Kazakhstan and Belarus shared the highest position among the countries of the Eurasian region with an LPI Rank of 79, while Kyrgyzstan brought up the rear with an LPI Rank of 123. To eliminate the existing limitations, it is necessary to ensure that the Eurasian region have a cohesive transport and logistics infrastructure. The countries of the Eurasian region can easily increase export freight traffic of polymer products using the Eurasian transport corridors.

Customs and Tariff Barriers

The existing customs and transit procedures and the excessive paperwork required to cross the borders between the countries of the Eurasian region hinder free movement of cargoes, and push up logistical costs.

In September 2023, the Government of Russia introduced flexible duties on exportation from the EAEU customs territory of primary and secondary polymers and rubber, including polyethylene (PE), polypropylene (PP), polyvinyl chloride (PVC), polystyrene (PS), polyethylene terephthalate (PET), polyamide (PA), polycarbonate (PC), and other polymers, with the exception of polyurethanes, epoxy, and silicone resins. The flexible export duties also apply to all finished and semi-finished plastic and rubber products. The imposition of duties on export of polymers may have an adverse effect on the amount of revenues received by Russian petrochemical companies, as production of base polymers and synthetic rubber in Russia is profitable. Accordingly, there is a risk that producers will cut their investment and R&D costs, which will hinder development of their own technologies and procurement of feedstock for the manufacturing and processing of polymer products.

5.2. Recommendations

The experience of successful petrochemical countries shows that one of the critical industry growth drivers is proactive government support aimed at multi-level endorsement of solutions, forging research–production and production–demand links, creating specialised infrastructure, providing scientific support, and developing the human potential.

Development of the petrochemical industry in the Eurasian region can proceed on the basis of the following principles:

- emphasis on locally extracted raw materials and a qualified workforce, including continued expansion of processing of their own feedstock within the region;

- commitment to innovation, creating high-tech production facilities at initial process stages, and manufacturing high-value-added end products; and focus on boosting the investment appeal of the polymer industry.

Our key recommendations are as follows:

1. Clustering and formation of the optimal path for improvement of production and distribution chains

An important policy element is creation and development in petrochemical centres, with active support on the part of the state of modern petrochemical clusters comprising the full value chain from development of one's own production technologies and manufacturing of required equipment, to the production of final consumer goods.

Special attention should be paid to forging deep-conversion value chains yielding end products with high added value, and to establishing close links between petrochemical facilities and consumers, both within such clusters and at their "exit points". This needs to be done primarily in industrial clusters, to achieve economies of scale, facilitate comprehensive utilisation of hydrocarbon materials, pipelines, and infrastructure facilities, and create technoparks and technopolises for relatively small high-tech and innovative production projects.

The main barriers identified in the course of our research that can be eliminated by applying this principle are as follows:

- heavy wear and tear on equipment used by oil, gas, and petrochemical facilities;

- dependence of Eurasian polymer manufacturers on imported technologies, feedstock, and equipment;

- disruption of technological links with western partners, and termination of joint petrochemical projects.

To build up the petrochemical production chain, it is necessary to:

- design and deploy mechanical engineering facilities to produce petrochemical equipment (for example, blow moulding and thermoforming machines, extrusion machines and related peripherals, injection moulding machines, etc.);

- reformat projects to manufacture products that are not critically dependent on foreign technologies and materials;

- accelerate expansion of pyrolysis capacity in resource base areas, and build additional logistical facilities (product pipelines, sea terminals);

- implement projects envisaging import substitution of feedstock and medium- and low-tonnage end products (polyolefin elastomers, peroxide cross-linked LDPE for cables and pipes, catalysts for new PP and PE grades, extruded polycarbonate, additives, films, etc.);

- develop and commercialise processes used to convert methane (the main natural gas component) into valuable petrochemical products, including light olefins and aromatic hydrocarbons (through methanol using the "methanol-to-olefin" and "methanol-to-aromatics" processes, or through chloromethane using the "methyl chloride-to-olefin" process);

- develop and manufacture high-performance adsorbents and catalysts for petrochemical production;

- train qualified chemical engineers under three-way agreements among the student, the state, and the employer (with mandatory involvement of enterprises in the development of curricula and the establishment of specialised departments).

To carry out the steps listed above, it will be necessary to secure long-term investments from a consortium of oil, gas, and petrochemical companies, the state, and diverse financial institutions.

We suggest the following priority measures:

- Build up domestic mechanical engineering facilities required to satisfy the needs of both oil and gas production and the petrochemicals industry. For example, the value of annual petrochemical equipment imports to the Eurasian region varies from $8 billion to $10 billion; in 2022, it dropped to $6.8 billion due to the ongoing regional conflict and imposition of economic sanctions. The list of key imports includes shutoff and control valves, vacuum pumps, compressors, pumps equipped with flow meters and control sensors, reciprocating fluid-flow displacement pumps, pressure-regulating valves, piping, cabling, and wiring products.

- Taking into consideration the heavy wear and tear and significant obsolescence of petrochemical equipment in the countries of the Eurasian region (*as noted above, most facilities in the region were built in the 1960s–1970s*), take comprehensive measures to improve the state of repair of petrochemical assets and, in particular, promptly replace obsolescent and deploy modern equipment and technologies, identify problems, and monitor the state of production and logistics infrastructure. In addition, development and implementation of large-scale investment projects (*including public-private partnership-based projects*) will make it possible to upgrade existing and install new equipment at operating facilities, and launch new petrochemical complexes in compliance with all applicable modern standards.

- Taking into consideration the high added value generated by medium- and low-tonnage petrochemical facilities, these will need to be upgraded on a priority basis with state support. For example, in 2021 the Government of the Russian Federation approved a list of the so-called "pulling" low- and medium-tonnage projects (*projects benefitting multiple sectors, in particular, allied sectors*); the list includes 73 projects with a total potential investment value of ₽498 billion and a 3,900-strong workforce (Government of the Russian Federation, 2021). In the other countries, similar measures would make it possible to build up low-tonnage chemical production and increase its potential to the average Eurasian level.

That will necessitate a reformatting of state development programmes, for example, by offering integrated indirect financial support in the form of feedstock price subsidies, interest rate subsidies, and soft lease terms. In some countries, governments are taking similar proactive measures to support small and medium-sized feedstock-processing companies, including application of reduced VAT rates to feedstock procurement contracts and finished product export contracts, accelerated implementation of high-tech export programmes, and provision of various environmental and tax incentives.

2. Stimulation of Domestic Demand for Finished Petrochemical Products

The most viable development path for maximising social and economic benefits for the countries of the Eurasian region is to build up their own petrochemical facilities specialising in high-value-added products (including end products used by other sectors of the economy and by the population), and targeting both foreign and domestic markets.

Various tax and non-tax petrochemical production incentives have already been developed, and are widely used. Therefore, it appears logical to continue to stimulate the industry by generating additional domestic demand for finished petrochemical products and consumer goods manufactured from such products.

The barriers that can be eliminated by stimulating domestic demand for finished petrochemical products include the following:

- economic unattractiveness of advanced process stages of the petrochemical industry;

- tightness of domestic markets for petrochemical products in the countries of the Eurasian region;

- insufficient realisation of the transport potential in terms of domestic shipping of petrochemical products.

We suggest the following key directions for stimulating consumer demand for petrochemical products:

- Regulation of public procurement and procurement for state-owned companies. One of the mechanisms that can be used to stimulate consumption of petrochemical products from the Eurasian region is the bans on importation of certain petrochemical products by state and municipal bodies and state-owned companies, which can also strengthen national security in the region.

- Energy efficiency requirements. Consumption of polymer products can be stimulated by a reform of the hosing and public utilities sector, in particular, transition to polymer pipeline systems. Replacement of cast-iron and steel pipes with polymer pipes by housing and public utilities companies can be financially burdensome, and may require additional funding (government subsidies, bank financing).

- Technical regulation in construction. Prompt updates of city planning and technical standards and regulations help to remove barriers to increasing domestic demand for petrochemical products. For example, normative documents can be adjusted to encourage the use of polymers instead of conventional materials (concrete, steel, wood) for:
  - manufacture of bridges and bridge components (superstructures, concrete slabs, sidewalks, etc.) from polymer composite materials;
  - use of non-metal composite bars to reinforce concrete structures;
  - use of composite materials to reinforce the existing metal and ferro-concrete structures;
  - use of composite materials in low-load structures (guardrails, trench drains, etc.);
  - use of polymers for heat insulation of residential and industrial buildings, etc.

3. Implementation of Petrochemical Transport Logistics Projects

The countries of the Eurasian region can easily increase domestic and export freight traffic of polymer products using the Eurasian transport corridors. According to World Bank estimates, in 2023, logistics performance of Eurasian countries and their partners was below average. To eliminate existing limitations, it is necessary to ensure that the Eurasian region has a cohesive transport and logistics infrastructure.

Efforts in this area can help to remove the following barriers:

- tightness of the domestic market;
- insufficient realisation of domestic transport potential;
- reduced volume of export supplies due to logistical limitations.

Development of alternative logistical corridors and export routes should reduce the adverse impact of freight traffic constraints. Development of new transport and logistics solutions to support supplies of polymer products to emerging markets in the Middle East and the Asia-Pacific Region will ensure better utilisation of the transport potential of the countries of the Eurasian region.

In the new geopolitical reality, the new transport channel — the International North–South Transport Corridor (INSTC) — has become particularly important. Its development will open new routes for business co-operation with India, Iran, Pakistan, and the countries of the Middle East. Our recommendations in this area have been presented in previous EDB publications (Vinokurov, 2021; Vinokurov, 2022).

The Northern Sea Route, a potentially stable logistical option, also warrants attention due to the importance of maritime routes to Southeast Asia.

4. Regulatory Policy

The existing regulatory support of petrochemical production facilities needs to be adjusted to account for the industry's specific features (long project payback periods due to the challenges associated with introducing new products to the market, high financing costs, import substitution exigencies, etc.); this is particularly relevant for the expansion of medium- and low-tonnage petrochemical production.

Such adjustment will enable elimination of the following barriers:

- rise in domestic prices for petrochemical products;

- customs and tariff barriers.

The main policy measures required to support the petrochemical industry (in addition to those already in place) are as follows:

- establishment of a large-tonnage polymers exchange on the basis of an existing commodity exchange, or creation of a new institution to perform that function in all countries of the Eurasian region;

- optimisation of the laws and regulations in the countries of the Eurasian region to simplify customs procedures and stimulate domestic consumption of large-tonnage plastics;

- additional investment tax exemptions to facilitate petrochemical R&D and stimulate investment projects aimed at improving petrochemical products conversion ratios and increasing low- and medium-tonnage petrochemical production;

- prohibitive duties on exportation of low value-added products and importation of high-value-added products to encourage development of domestic deep-conversion production facilities.

5. Implementation of Circular Economy Projects

Subject to the environmental aspects of evolution of the petrochemical industry in the Eurasian region, it is advisable to take into consideration global circular production and rational consumption trends, primarily in connection with the deployment of circular economy mechanisms. To do that, it is necessary to support recycling of by-products of oil and gas extraction (especially plastics); promote chemical recycling of polymer waste; minimise release of plastic particles into the environment; procure and deploy the best available petrochemical technologies designed to minimise emissions and streamline the use of natural resources.

Circular economy implies utilisation of available materials as long as possible, mostly through their repeated recycling. Recycling of polymers can be very profitable in terms of utilisation of resources. It requires merely 10% of the energy consumed during primary polymer production, but yields a product with almost identical physical properties and quality parameters. To compare, recycling of mineral glass requires almost 65% of initial energy consumption.

Organisation of effective recycling of petrochemical products requires an orderly approach with coordination at the regional level. A robust waste-recycling process should be set up, covering all stages from collection and sorting to the manufacture of end products. That involves creation in the region of facilities offering the full range of recycling services (their own networks of separate waste collection containers, bin lorries, sorting and processing plants). To obtain the best possible results, it is necessary to involve the general population, and instil an appropriate culture, encouraging people to care for the environment instead of discarding rubbish in an irresponsible manner. Other useful activities include social advertising and promoting proper conduct at special school and university classes. Active participants (both businesses and the population at large) should be granted various incentives, including tax exemptions, deductions, direct cash subsidies, and bonuses. As with other social projects, it can only be possible with full-scale government involvement through public awareness and support programmes.

6. State Support and Financial Involvement of Multilateral Development Banks

International best practices in petrochemical projects illustrate the importance of government support in financing capital-intensive investment projects with long payback periods.

In 2010–2020, more than $238 billion was invested in 56 large petrochemical projects (projects with capital expenditures of $1+ billion). Of that amount, $205 billion was provided by private institutions, and $33 billion (14%) by public institutions, including the following: national development banks (guarantees for loans, credits, and fixed-income instruments); state-owned companies operating in the gas and oil industry, or in the petrochemical industry; national welfare funds; central banks (acquisition of bonds); export credit agencies (guarantees for loans or fixed-income instruments); bilateral banks and development funds (grants, soft loans, guarantees, and, in rare cases, equity participations).

Multilateral development banks (MDBs) are the most important sources of public financing of petrochemical projects. They offer the same financial instruments as bilateral development banks in developing countries, but are less exposed to the influence of national political or commercial interests. For example, MDBs can support large-scale projects by financing related low-tonnage chemical production projects through mobilisation of tied funds or provision of affordable long-term loans.

Public and private financing are closely linked. For example, MDB involvement in the financing of large capital-intensive projects guarantees a certain level of trust, and acts as a catalyst for the attraction of private capital. In addition, companies with state equity participation (primarily extracting companies) are often classified as private. In fact, the boundaries between public and private companies in the industry are often blurred. Loan syndication is also widely used to finance petrochemical projects (*the number of stakeholders in large-scale projects may be as high as 50*).

ANNEXES

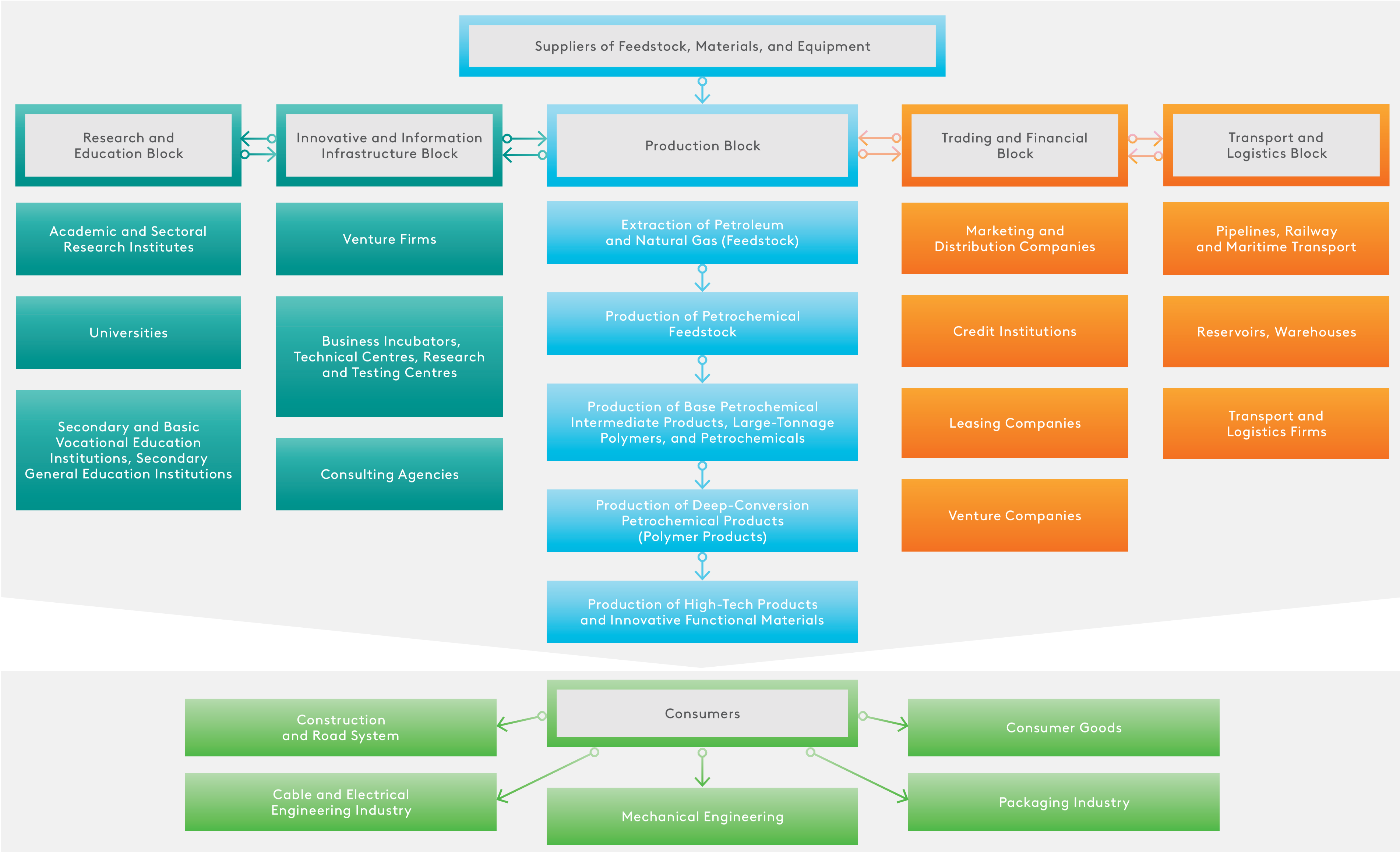
↓ Annex 1. Areas of Application of Base Polymers

Area	Base Polymers				
	Polyethylene	Polypropylene	Polyvinyl Chloride	Polyethylene Terephthalate	Polystyrene
Construction and Road System	Insulation of pipelines, pipes, and pipeline parts	Pipes, pipe fittings, nonwoven fabrics (geotextiles, etc.), road embankments, vibration and heat insulation materials	Retroreflectors, window and door profiles, window blinds, window sills and other profiled and linear articles, accessories, fittings, wall panels, foamed sheets, furniture films, pipes (drainage, cold water supply, sewage), foamed linoleum layer, finishing profiles (angle plates, liners), sheets, soft flooring materials (linoleum), wallpaper, tent covers, carpeting	Structural items	Extruded PS for noise, heat, and water insulation boards, sheets, veneers and decorative materials (ceiling tiles, floor mouldings, etc.), foamed insulation boards, sandwich panels, formwork, façade systems
Cable and Electrical Engineering Industry	Insulation, cable sheathing	Casings for household, office, and electrical equipment, electrical insulation	Cable insulation, electric wiring pipes		Casings for household, office, and electrical equipment
Mechanical Engineering	Panels, ropes, wharf lining, parts for machines and mechanisms	Interior panelling elements, rugs, battery housings, bumper casings, automotive parts	Car seats	Composite materials	Car interior and exterior finishing elements, dashboards, hubcaps
Consumer Goods	Shoe covers, head covers, toys, lids, containers, bottles, profiled and linear items, helmets and bullet-proof vests, body armour, sport goods (fencing armour, kayak frames, mountaineering equipment, oar blades, artificial covering for hockey rinks), orthopaedic goods, corrosive liquid containers	Garden and office furniture, disposable tableware, dispenser casings, marker pens, toys, medical items (syringes, pipettes), barrels, canisters, containers, watering cans, buckets	Gloves, oilcloths, artificial leather, hoses, toys, kayak spray decks, baidarkas, rubber boots	Fibres, threads	Disposable tableware, toys, stationery, disposable medical instruments, construction sets, plumbing items, sports goods, garden equipment

Area	Base Polymers				
	Polyethylene	Polypropylene	Polyvinyl Chloride	Polyethylene Terephthalate	Polystyrene
Packaging industry	Food, technical, and agricultural films, bags, containers for food, perfumery and cosmetics, automotive and household chemicals, fuel tanks and barrels, various packaging films, sacks, multilayer stretch films for automated and manual packaging, covering materials	Biaxially oriented polypropylene films for flexible packaging of food and non-food products and manufacturing of bags, labels, and adhesive tapes, transparent polypropylene films	Packaging and printing films, heat shrinkable films	Preforms for blow-moulding various receptacles (mostly bottles), heat shrinkable films	Food containers, non-food packaging (CD casings, bottles, etc.), polymeric foam for packaging food products, household devices, and electronic equipment

Source: EDB.

↓ Annex 2. Universal Structure of a Petrochemical Cluster



Source: EDB.

↓ Annex 3. Production Facilities Operated by Eurasian Region Manufacturers of Base Monomers and Intermediate Petrochemical Products, KT/year (as of mid-2023)

Enterprise	Ethylene	Propylene	Aromatics*	Butadiene	Styrene
Russia	**4,919**	**3,361**	**2,943**	**669**	**778**
PJSC SIBUR Holding					
ZapSibNeftekhim (Tyumen Region, Tobolsk)	1,500	1,010		207	
Nizhnekamskneftekhim (Tatarstan, Nizhnekamsk)	617	300	312	250	318
Kazanorgsintez (Tatarstan, Kazan)	652	60			
SIBUR-Kstovo (Nizhny Novgorod Region, Kstovo)	435	180	106		
Tomskneftekhim (Tomsk)	300	139			
SIBUR-Khimprom (Perm)	60	97	220		135
Polyom (JV with PJSC Gazpromneft) (Omsk)		210			
Neftekhimia Research and Production Plant (JV with PJSC Gazpromneft) (Moscow)		150	150		
SIBUR-Neftekhim (Nizhny Novgorod Region, Dzerzhinsk)			80		
PJSC Rosneft Oil Company					
Ufaorgsintez (Bashkortostan, Ufa)	235	185	60		
Angarsk Polymer Plant (Irkutsk Region, Angarsk)	200	100	60		44
Novokuybyshevsk Petrochemical Company (Samara Region, Novokuybyshevsk)	100	40			
Bashneft-Ufaneftekhim (Bashkortostan, Ufa)			228		
PJSC Lukoil Oil Company					
Stavrolen (Stavropol Province, Budyonnovsk)	350	140	130		
LUKOIL-Nizhegorodnefteorgsintez (Nizhny Novgorod Region, Kstovo)		330			
LUKOIL-Permnefteorgsintez (Perm)			60		
PJSC Gazprom					
Gazprom neftekhim Salavat (Bashkortostan, Salavat)	380	170	195	92	220
Gazpromneft-ONPZ (Omsk)			700		
Omsk Kauchuk (Titan Group) (Omsk)	90	250			
KINEF (Kirishinefteorgsintez) (Leningrad Oblast, Kirishi)			301		
Togliattikauchuk (PJSC Tatneft) (Samara Region, Togliatti)				120	
JSC Plastic (Tula Region, Uzlovaya)					60
Other			341		
Uzbekistan	**540**	**43**			
Uz-Kor Gas Chemical (Ustyurt GCC) (Karakalpakstan)	400	43			
Shurtan GCC (Shurtan)	140				

Enterprise	Ethylene	Propylene	Aromatics*	Butadiene	Styrene
Belarus	**150**	**100**	**330**		
OJSC Naftan					
Polymir (Vitebsk Region, Novopolotsk)	150	100			
Novopolotsk Oil Refinery (Vitebsk Region, Novopolotsk)			280		
Mozyr Oil Refinery (Mozyr-11)			50		
Kazakhstan		**500**	**767**		
Atyrau Oil Refinery (KazMunayGas) (Atyrau)			767		
Kazakhstan Petrochemical Industries Inc. (Atyrau Region)		500			
Total for the Eurasian Region	**5,609**	**4,004**	**4,040**	**669**	**778**

* Aromatic hydrocarbons (benzene, toluene, xylene).
Source: plastinfo.ru; Rosstat; corporate data.

↓ Annex 4. Production Facilities Operated by Eurasian Region Manufacturers of Primary Plastics and Synthetic Rubber, KT/year (as of mid-2023)

Company, Enterprise	PE	PP	PVC	PS	PET	Synthetic Rubber
Russia	**3,908**	**2,191**	**1,126**	**658**	**730**	**2,330**
PJSC SIBUR Holding						
ZapSibNeftekhim (Tyumen Region, Tobolsk)	1,500	1,000				
Kazanorgsintez (Tatarstan, Kazan)	770					
Tomskneftekhim (Tomsk)	296	165				
Polyom (JV with PJSC Gazpromneft) (Omsk)		218				
Neftekhimia Research and Production Plant (JV with PJSC Gazpromneft) (Moscow)		150				
RusVinyl (JV with SolVin) (Nizhny Novgorod Region, Kstovo)			330			
Nizhnekamskneftekhim (Tatarstan, Nizhnekamsk)	230	180		240		820
SIBUR-Khimprom (Perm)				100		
Polyef (Bashkortostan, Blagoveshchensk)					219	
Sibur-PETF (Tver)					75	
Voronezhsintezkauchuk (Voronezh)						361
Krasnoyarsk Synthetic Rubber Plant (Krasnoyarsk)						48
PJSC Rosneft Oil Company						
Angarsk Polymer Plant (Irkutsk Region, Angarsk)	77			15		
Ufaorgsintez (Bashkortostan, Ufa)	90	120				4
Stavrolen (PJSC Lukoil Oil Company) (Stavropol Province, Budyonnovsk)	300	120				
Gerobplast (Tatarstan, Kazan)	12					
Gazprom neftekhim Salavat (Bashkortostan, Salavat)	161			65		
PENOPLEX SPb (Styrovit) (Saint Petersburg)				50		
JSC Plastic (Tula Region, Uzlovaya)				12		
Sayanskkhimplast (Irkutsk Region, Sayansk)			300			
Bashkir Soda Company (Caustic) (Bashkortostan, Sterlitamak)			265			
JSC CAUSTIC (Volgograd)			100			
Polygran (Tver)			50			
Biokhimplast (Nizhny Novgorod Region, Dzerzhinsk)			30			
Vladimir Chemical Plant (Vladimir)			18			
Polyplast Production and Commerce Firm (Bashkortostan, Ishimbay)			12			
Ecopet (Kaliningrad)					240	
SENEGE New Polymers Plant (Europlast) (Moscow Region, Solnechnogorsk)					100	

Company, Enterprise	PE	PP	PVC	PS	PET	Synthetic Rubber
PLARUS Plastic Processing Plant (Moscow Region, Solnechnogorsk)					10	
Togliattikauchuk (PJSC Tatneft) (Samara Region, Togliatti)						235
Sintez-Kauchuk (Bashkortostan, Sterlitamak)						144
Omsk Kauchuk (Titan Group) (Omsk)						100
Sterlitamak Petrochemical Plant (Bashkortostan, Sterlitamak)						72
Kazan Synthetic Rubber Plant (Tatarstan, Kazan)						14
Efremov Synthetic Rubber Plant (Tula Region, Efremov)						6
Other	472	238	21	176	86	525
Uzbekistan	**512**	**83**	**100**			
Uz-Kor Gas Chemical (Ustyurt GCC) (Karakalpakstan)	387	83				
Shurtan GCC (Shurtan)	125					
Navoiyazot (Navoiy-5)			100			
Turkmenistan	**386**	**171**			**9**	
Kiyanly Gas Chemical Complex (Turkmengaz) (Ashgabat)	386	81				
Türkmenbasy Refinery Combine (Türkmenbasy)		90				
Other					9	
Belarus	**140**				**215**	
Polymir (OJSC Naftan) Vitebsk Region, Novopolotsk)	140					
Mogilevkhimvolokno (Mogilev)					215	
Kazakhstan		570		5		
Neftekhim Ltd. (Pavlodar)		70				
Kazakhstan Petrochemical Industries Inc. (Atyrau Region)		500				
Other				5		
Total for the Eurasian Region	**4,946**	**3,015**	**1,226**	**663**	**954**	**2,330**

Legend: PE — polyethylene, PP — polyethylene, PVC — polyvinyl chloride, PS — polystyrene, PET — polyethylene terephthalate.
Source: plastinfo.ru; Rosstat; corporate data.

↓ Annex 5. Pool of Public and Private Investment Projects for the Construction of Petrochemical Facilities in the Countries of the Eurasian Region

Project	Company	Period	Products	Capacity	Investments	Jobs	Co-operation
Armenia							
There were no petrochemical projects at the time of database creation							
Belarus							
Reconstruction of the ethylene-propylene plant in Novopolotsk	Polymir	2021–2025	ethylene; propylene	300 KT	$500 million	–	CITIC Construction
Kazakhstan							
Construction of a polyethylene production complex	KazMunayGas	2023–2028	polyethylene and its derivatives	1.25 MT	$7.7 billion	876	Sibur Holding, Univation, Air Liquide Eastern Europe S.A., Chevron Philips
Gas processing plant at the Kashagan field	QazaqGaz	2021–2025	commercial gas; liquefied gas; sulphur; gas condensate	1 BCM	$1.25 billion	600	North Caspian Operating, Technip Energies
Gas Chemical Complex for the production of methanol	Zhaik Petroleum	2022–2025	methanol and its derivatives	130 KT	$228 million	220	CITIC Construction and China Huanqiu Contracting & Engineering
Expansion of production capacity at the Shymkent Oil Refinery	Ministry of Energy of Kazakhstan	2023–2029	petroleum products	12 MT	Under development		
Plant for the production of butadiene and synthetic rubber	KazMunayGas	2021–2025	styrene-butadiene-styrene; divinyl-styrene synthetic rubber; butadiene; isobutene-isobutylene fraction; methyl tert-butyl ether	356 KT	$1 billion	700	Tatneft, Lummus Technology, BASF, Tengizchevroil

Project	Company	Period	Products	Capacity	Investments	Jobs	Co-operation
Gas Distribution Complex at the Tenghiz field	KMG PetroChem	2023–2025	ethane; propane	2 MT	$2 billion	–	Tengizchevroil LLP
TFA and PET production plant in Atyrau	KazMunayGas	2023–2025	PTA; PET	1 MT	$1 billion	–	Sinopec; Atyrau Refinery
Kyrgyzstan							
Modernisation of Kyrgyz Petroleum Company	Kyrgyz Petroleum Company	2020–2025	oil and associated products	500 KT	$410 million	–	Kyrgyzneftegaz
Russia							
Production of rubber compounds on the basis of organosilicon rubber	Kazan Synthetic Rubber Plant	Under development	mixtures of rubber organosilicon K-69, K-69T, K-1520	40 KT	Under development		
Methanol Plant in Volgograd	GTM One	2023–2027	methanol and its derivatives	1 MT	$1.1 billion	1,000	China National Chemical Engineering Co., Ltd.
Arctic LNG-2	Novatek	2023–2025	liquefied natural gas; gas condensate	19.8 MT	$25 billion	–	Novatek, TotalEnergies, CNPC, CNOOC, Japan Arctic LNG, Technip, Linde, and Siemens
Vostok Oil	Rosneft	2019–2024	oil and associated products	30 MT	$113 billion	2,000	Inter RAO, Vitol S.A., and Mercantile & Maritime Energy Pte. Ltd.
Amur Gas Chemical Complex	SIBUR Holding	2016–2024	polyethylene; various propylene brands	2.7 MT	$10.7 billion	1,000	China Petroleum & Chemical Corporation, Linde, NIPIGAS, Univation Technologies, Chevron Phillips, and LyondellBasell, Sinopec
Amur Gas Processing Plant	Gazprom	2015–2025	helium; ethane; propane; pentane-hexane fraction; butane	42 BCM	$14 billion	2,500	NIPIGAS, Priority Development Area “Svobodny”, Linde AG, China Petroleum Engineering & Construction Corporation, Tecnimont, Sinopec, Renaissance Heavy Industries LLC

Project	Company	Period	Products	Capacity	Investments	Jobs	Co-operation
Ust-Luga Plant	Gazprom	2017–2025	LNG; ethane fraction; liquefied hydrocarbon gases (propane and butane) pentane-hexane fraction	45 BCM	$11 billion	5,000	RusKhimAlyans LLC, RusGazDobycha
Baltic Gas Chemical Complex	RusGazDobycha	2021–2025	high-density polyethylene; linear low-density polyethylene; metallocene low-density polyethylene	3 MT	$8 billion	-	Baltic Gas Chemical Complex, China National Chemical Engineering & Construction Corporation Seven, LTD (CC7), Lummus Technology, Univation Technologies LLC
Reconstruction of Ilsky Oil Refinery LLC	KNGK-INPZ	2020–2027	AI-92-K5 petrol; AI-95-K5 petrol; petroleum xylene; automobile propane-butane; commercial butane	1,520 KT	$900 million	1,000	MontazhTekhStroy
Construction of a plant for the production of micronised silica gels and stable silica sols	Russilica	2023–2028	micronised silica gels; stable silica sols	54 KT	$90 million	Under development	
Tajikistan							
Danghara Oil Refinery	JV TK-Oil	2015–2024	oil and associated products	1.2 MT	$80 million	-	Dong Ying heli Investment and Development
Turkmenistan							
Modernisation of the Türkmenbasy Complex and the Seydi Oil Refinery	Türkmenbasy Refinery Combine	Under development					

Project	Company	Period	Products	Capacity	Investments	Jobs	Co-operation
Uzbekistan							
MTO Gas Chemical Complex	Sanoat Energetika Guruhi	2019–2024	low-density polyethylene; ethylene-vinyl acetate; polyethylene terephthalate; polypropylene	500 KT	$3.1 billion	1,500	Chemtex, Scientific Design, Grace Catalysts and Technologies, Sinopec, HIS Markit, Wood, Nexant, White & Case, and Mott Macdonald
Construction of a gas chemical complex at the Mustakillikning 25 Yilligi field	Surhan Gas Chemical Operating Company	2018–2023	commercial gas; granulated sulphur	5 BCM	$5 billion	2,200	ERIELL Group, Shell Global International B.V., Amec Foster Wheeler — Wood
Modernisation of the Fergana Oil Refinery	Jizzakh Petroleum	2020–2023	AI-92 petrol; Euro-5 diesel fuel; base and commercial oils (API groups II+/III); TS-1 and Jet A-1 aviation fuels	2 MT	$300 million	-	

Note*: Some investment amounts are shown in US dollars at the exchange rate as of November 2023.
Sources: UNECE; Website of the Prime Minister of the Republic of Kazakhstan; Website of the President of the Republic of Uzbekistan; Ministry of Energy of the Republic of Kazakhstan, Resolution of the EAEU SEEC, data provided by petrochemical companies; KazEnergy; Migranyan, A. (2019).

↓ **Annex 6. Unit Feedstock Consumption in the Manufacturing of Various Types of Petrochemical Products, kg of feedstock per 1 tonne of end product**

Product	Feedstock	Minimum Consumption	Maximum Consumption
Low-Density Polyethylene (tube wall reactor)	Ethylene	1,015	1065
	Propane	1.2	1.5
Polyethylene (gas-phase process)	Ethylene for Comonomer Manufacturing		1,022
	Ethylene + Aggregation of Comonomers	1,117	1,117
Polyethylene (liquid-phase process)	Ethylene		1,027
Polypropylene (gas-phase process, horizontal reactor)	Propylene	1,030	1,060
Polypropylene (solvent suspension process)	Propylene	1,038	1,096
Polypropylene (propylene suspension process)	Propylene	1,040	1,040
	Propylene and Ethylene for Comonomers	1,100	1,100
Emulsion Polyvinyl Chloride	Vinyl Chloride Monomer	1,015	1,060
Suspension Polyvinyl Chloride	Vinyl Chloride Monomer	1,005	1,070
Suspension Polystyrene (expanding)	Styrene	960	1,060
	Pentanes	70	80
High-Viscosity Granulated Crystalline Polyethylene Terephthalate	Terephthalic Acid	839	850
	Ethylene Glycol	333	340
	Isophthalic Acid	20	21
	Diethylene Glycol	5.5	5.7
Cis-Polyisoprene Rubber	Isopentane	13	35
	Isoprene	980	1,050
Butadiene Rubber (titanium catalyst)	Butadiene	1,015	1,025
Cis-Polyisoprene Rubber (lithium catalyst)	Butadiene	1,100	1,100
Suspension Butyl Rubber	Isobutylene and Isoprene		1,034
Solution Butyl Rubber	Isobutylene	980	1,020
	Isoprene	25	30

Source: Reference Manual of Best Available Technologies. Production of Polymers, Including Biodegradable Polymers (BAT Bureau, 2017).

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ABBREVIATIONS

APAC	Asia-Pacific Region
BP	British Petroleum
BPAs	basic production assets
CERA	Cambridge Energy Research Associates
CIS	Commonwealth of Independent States
COVID-19	Coronavirus disease 2019
CSR	Centre for Strategic Research
EAEU	Eurasian Economic Union (Armenia, Belarus, Kazakhstan, Kyrgyzstan, Russia)
EEC	Eurasian Economic Commission
EIA	Energy Information Administration
EPS	expanding polystyrene
EU	European Union
Eurasian region	countries of the Eurasian Economic Union plus observer countries and countries interested in integrating in the EAEU (Tajikistan, Turkmenistan, Uzbekistan)
GCC	gas chemical complex
GDP	gross domestic product
GHG	greenhouse gas
$GtCO_2$ per year	billion tonnes of carbon dioxide per year
HDPE	high-density polyethylene
HFT	hydraulic fracturing treatment
IEA	International Energy Agency
JSC	joint stock company
JV	joint venture
LDPE	low-density polyethylene
LED	light emitting diode
LHG	liquefied hydrocarbon gas
LLC	limited liability company
LLDPE	linear low-density polyethylene
LNG	liquefied natural gas
NGL	natural gas liquids
NRU HSE	National Research University of the Higher School of Economics
OECD	Organisation for Economic Co-operation and Development
OPEC	Organisation of the Petroleum Exporting Countries
PE	polyethylene
PET	polyethylene terephthalate
PJSC	public joint stock company

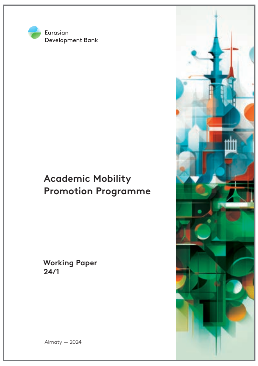
PRC	People's Republic of China
PP	polypropylene
PS	polystyrene
PSA	product sharing agreement
PVC	polyvinyl chloride
RB	Republic of Belarus
R&D	research and development
RES	renewable energy sources
RF	Russian Federation
SEZ	special economic zone
TRS	total return to shareholders
UAE	United Arab Emirates
UAV	unmanned aerial vehicle
USSR	Union of Soviet Socialist Republics
VAT	value-added tax
WEF	World Economic Forum
WIPO	World Intellectual Property Organisation
bbl	barrel
BDM	billion cubic metres
BPD	barrels per day
Gbbl	billion barrels
KBPD	thousand barrels per day
MBPD	thousand barrels per day
MCM	million cubic metres
MMbbl	million barrels
MT	million tonnes
TCM	trillion cubic metres
$	US dollar
₽	rouble
bn	billion
kg	kilogramme
m	metre
m^3	cubic metre
mln	million
pp	percentage point
T	trillion
K	thousand

RESEARCH AT THE EDB WEBSITE

Report 24/2
(RU/EN)

Economic Cooperation in Eurasia: Practical Solutions

The EDB's report "Economic Cooperation in Eurasia: Practical Solutions" contains a "menu" of pragmatic applied solutions that can be enabled relatively fast and with flexible configurations among participating countries aimed at fostering mutually beneficial economic cooperation among Eurasian countries.



Report 24/1
(RU/EN)

Academic Mobility Promotion Programme

The EDB's working paper "Academic Mobility Promotion Programme" contains a comprehensive analysis of problems and specific practical solutions to ensure the sustainable growth of interuniversity relations and educational exchanges across the Eurasian region (the EAEU and CIS countries).

Macroeconomic Outlook
(RU/EN)

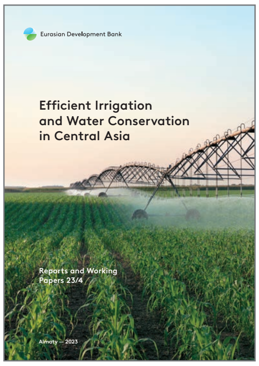
EDB Macroeconomic Outlook 2024–2026

Macroeconomic Outlook presents a preliminary overview of economic developments in the EDB's member states for 2023, along with key macroeconomic projections for 2024, as well as 2025 and 2026.

Report 23/5
(RU/EN)

EDB Monitoring of Mutual Investments — 2023

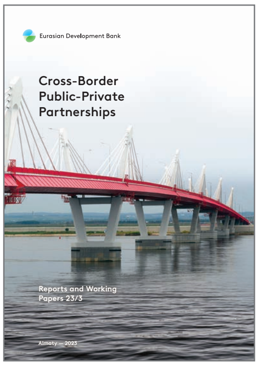
Eurasian countries' FDI stock reached $48.8 billion by mid-2023, following a 5.4% increase in 2022 and with continued growth in 2023.



Report 23/4
(RU/EN)

Efficient Irrigation and Water Conservation in Central Asia

A new EDB study outlines ten practical steps for preserving irrigated land potential and promoting water conservation. The list includes four recommendations for adoption at the regional level and six at the national level.



Report 23/3
(RU/EN)

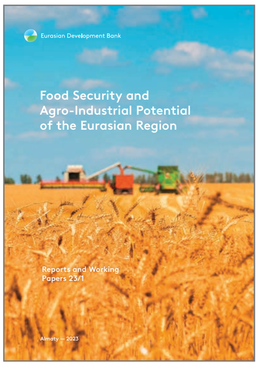
Cross-Border Public-Private Partnerships

The report outlines the criteria and scope of cross-border PPP projects, evaluates their potential for fostering cross-border infrastructure development in the EAEU, Central Asia, and the South Caucasus, and suggests guidelines for the successful implementation of cross-border PPPs in the region.

Report 23/2
(RU/EN)

Global Green Agenda in the Eurasian Region. Eurasian Region on the Global Green Agenda

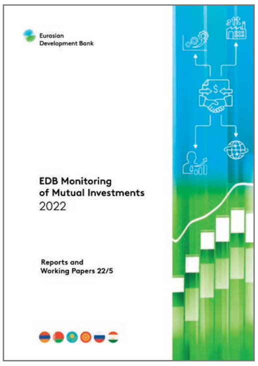
The report provides a comprehensive analysis of the challenges and prospects for low-carbon transition in Eurasia, covering EAEU countries, Tajikistan, and Uzbekistan.



Report 23/1
(RU/EN)

Food Security and Agro-Industrial Potential of the Eurasian Region

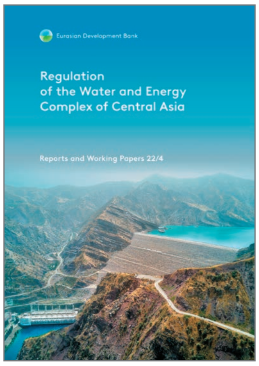
Based on the balance approach, the report analyses the production, resource, and export potential of the agro-industrial complexes of the EAEU countries, Tajikistan, and Uzbekistan for the period until 2035.



Report 22/5
(RU/EN)

EDB Monitoring of Mutual Investments — 2022

This report continues the series of publications detailing the findings of a long-standing research project monitoring mutual direct investments of the CIS countries and Georgia.



Report 22/4
(RU/EN)

Regulation of the Water and Energy Complex of Central Asia

The report scrutinises historical data and international experience to suggest five institutional solutions for effective regulation and development of Central Asia's water and energy complex that would benefit all countries of the region.

Report 22/3
(RU/EN)

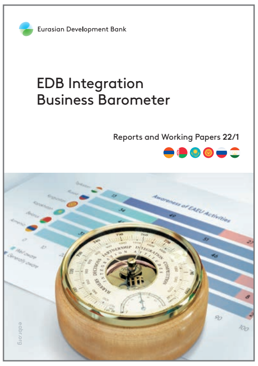
The Economy of Central Asia: A Fresh Perspective

The report provides a renewed perspective on Central Asia as a large, dynamic and promising economic region and analyses its current structural changes and major growth areas.

Report 22/2
(RU/EN)

International North–South Transport Corridor: Investments and Soft Infrastructure

The study assesses the investment potential of the INSTC, identifies barriers to its development and provides recommendations on how to eliminate them.



Report 22/1
(RU/EN)

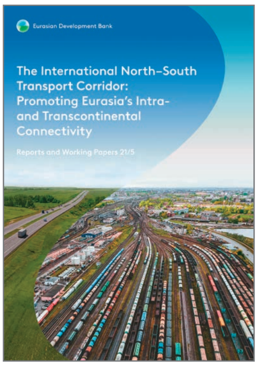
EDB Integration Business Barometer

About 73% of companies feel positive about the EAEU and say it makes doing business easier.

Joint report by the Eurasian Development Bank and the Global Energy Association
(RU/EN)

Green Technologies for Eurasia's Sustainable Future

The report is prepared by the key international industry experts and young scholars. It contains the results of technical research aimed at solving today's energy challenges and helping to reduce the carbon footprint in Eurasia.



Report 21/5
(RU/EN)

The International North–South Transport Corridor: Promoting Eurasia's Intra- and Transcontinental Connectivity

Linking up the INSTC with Eurasian latitudinal corridors could ensure around 40% of container traffic.

Eurasian Development Bank

RESEARCH DEPARTMENT
EURASIAN DEVELOPMENT BANK

Your comments and suggestions
concerning this document
are welcome at: pressa@eabr.org

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