Ministry of Development Funds and Regional Policy
Republic of Poland

Attachment_

NDC2050
National
Development
Concept

ATTACHMENT 1 TO NDC 2050

DEVELOPMENT TRENDS IN THE 2050 PERSPECTIVE

This document has been prepared based on the GOSPOSTRATEG-III/0032/2020 project entitled: Operationalisation of the Polish Development Management System. Improving and introducing innovative and effective solutions to the socio-economic and spatial system as part of long-term development policy planning.

The source reports are available at: https://krk2050.pl/baza-wiedzy/opracowania/

Warsaw 2025

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INTRODUCTION

The changes taking place in Poland and the development processes undertaken are largely dependent on global transformations, known as megatrends. Megatrends are multi-year processes occurring on a global scale that drive wide-ranging change. These changes occur in various areas and at various levels. The document presents the results of an analysis of the changes taking place globally, in Europe and in Poland, in social, economic, environmental and spatial terms.

'Megatrends affect individual spheres of life of people living in different administrative or functional areas (countries, regions and smaller territorial units). They are shaped by diverse phenomena and processes, sometimes running in different directions – trends. Trends are the directions in which specific phenomena are changing and are likely to change'[1]. This document describes the megatrends that have the greatest impact on Poland and will continue to do so in the future. These are:

- The emergence of a new economy;
- Technological acceleration;
- The growth of global social problems;
- Increasing pace of environmental and climate change;
- Rearrangement of space;
- Transformation of the global order.

Depending on the needs, both current and long-term, development processes should strengthen, maintain or adapt to changes and take advantage of opportunities arising from megatrends.

The identification of megatrends and global trends that make them up, as well as their national manifestations, presented in this document, is based on reports by the Institute of Urban and Regional Development and the Institute of Environmental Protection – National Research Institute, available at https://krk2050.pl/baza-wiedzy/opracowania/. They were used as a starting point for defining the vision, scenarios and development challenges for Poland in the perspective of 2050.

[1] Dziemianowicz 2023b.

MEGATREND: THE EMERGENCE OF A NEW ECONOMY

For a relatively long time, the structure of the global economy, distribution of its centres and the relationship between them remained largely unchanged. As recently as the 1970s, a concept known as the triad, comprising economies that were key from a global perspective and whose strength lay in capital flows in the form of foreign direct investment: the US, EU countries and Japan, was considered relevant. Later, economists also pointed to the importance of the BRIC group (Brazil, Russia, India and China). Today, despite the passing of time, the US remains the world's largest economy, increasing its lead over the European Union in recent years. In 2022, eight European countries were among the 20 largest economies in the world. However, the situation is much more dynamic than it used to be. Economic centres of gravity are shifting, as illustrated by the fact that only three of the 20 fastest-growing economies in the world are European[2].

It is not only changes in the geographical distribution of global economic centres that are influencing the transformationof the traditional economic structure. The shape of today's economy is significantly influenced also by its technological transformation. Disruptive technologies such as Artificial Intelligence and the processes of robotisation, digitisation and automation of work have significant economic and social consequences. Due to the pace and nature of change, technological and energy transformation around the world, indicators of quality of life other than GDP or complementary to it are gaining in importance. One more process is also gaining importance – the energy transition. Current trends influencing the shape of the economy at the national level, such as the aforementioned robotisation, digitisation and automation of work, are resulting in a shift away from the traditional economy. However, this process does not mean a decline in energy demand; in fact, it may be associated with increasing consumption in the future. This will lead to further development of technologies related to increasing energy efficiency and its so-called clean origin. The acceleration of the economy's absorption capacity and demand for such solutions will be the result of the ongoing debate and measures taken to mitigate climate change. At the same time, energy turbulence in the economy prompts reflection on how the economic transition will affect the competitiveness of individual countries and changes in economic relations between them, as exemplified by the difficulties in the energy market following Russia's aggression against Ukraine and the conflict in the Middle East. Changes in supply chains are also among the significant changes affecting the shape of the modern economy. The importance of this issue has been highlighted by recent developments related to the COVID-19 pandemic. Attention has begun to focus on the need to build supply chains with a limited geographical reach, which makes producers and consumers more resilient to external fluctuations and increases the stability of their operations. Although developed countries have been relocating their corporate subsidiaries to countries with lower production costs for many years, the demand for building local chains is gaining momentum. Shortening supply chains and regionalising them provides an opportunity to strengthen the importance of Poland and the Polish economy on the international arena, as well as to increase the activity of Polish exporters ready to compete in the field of innovation on a global scale.

Trends contributing to the megatrend:

- Increasing competition in the area of innovation;
- Advancing digitalisation of the economy;
- Growing automation of work and flexibility of employment;
- Energy transition;
- Clash between globalism and localism;
- Transformation of agriculture caused by climate change, technological changes, and new consumption patterns.

INCREASING COMPETITION IN THE AREA OF INNOVATION

Poland will be significantly affected by the global trend associated with intensifying global competition in the area of innovation. Expenditure on research and development (R&D) is growing globally, especially in highly developed countries. Asian countries, mainly China, are playing an increasingly important role in the creation of innovation. To benefit from an innovative economy, Poland must participate effectively in competition. Over the past 10 years,

[2] World Economic Outlook 2024, International Monetary Fund, 2024.

there have been no significant changes in Poland's position in the innovation ranking. Globally, Poland ranks 41st. Among the regions with the highest incomes, it ranks 36th, and in Europe alone, 26th. Building a position as an important player among innovation providers requires systemic actions and high expenditures. The level of innovation, both in terms of R&D expenditure and innovation potential, varies greatly across Polish regions.

Table 1. Global Innovation Index for Poland in 2011–2024

	2011	2017	2021	2022	2023	2024
Score (GII)	**38.02**	**41.99**	**39.95**	**37.5**	**37.7**	**37.0**
Poland globally	**43**	**38**	**40**	**38**	**41**	**40**
Poland in Europe	**28**	**25**	**27**	**24**	**26**	**25**

Source: The Global Innovation Index (GII) report (2011, 2017, 2021, 2022, 2023, 2024)

The openness of Poles to projects with an innovative approach and risk represents potential that can be exploited in the development of an innovative economy, including the development of social innovation. It is important not only to increase funding for such activities, but above all to involve as many people as possible.

Projected trend effects in Poland:

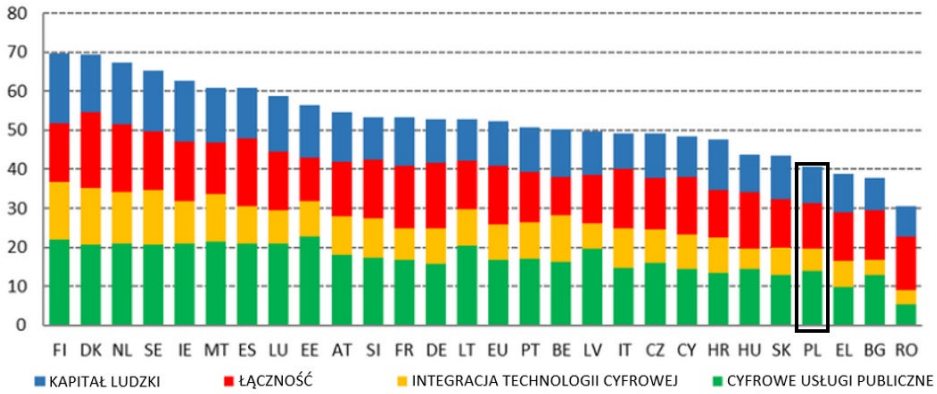
- Domestic innovation leaders will require systemic support as they face increasing competitive pressure from foreign entities. Ensuring the competitiveness of domestic innovators will also require systemic strengthening of links between business and science. Growing pressure and competition in the field of innovation will also create a difficult market situation for low-level entities. Innovation that reduces the demand for human labour, and thus increases its price, may cause some entities that base their competitiveness on cheap labour to move their businesses outside Poland.
- In environmental terms, the most significant consequence of the increase in the level and pressure for innovation in the economy may be the *rapid* development of pro-environmental technologies, the application of which may translate into a reduction in anthropogenic pressure on the natural environment. In addition, the country's level of competitiveness and self-sufficiency may increase.
- The increasing use of technology in the economy and everyday life will also translate into changes in the Polish space. For some groups of activities, traditional economic location factors such as distance from the market will lose importance. Key factors are becoming, among others, access to information and communication technologies (ICTs), in particular telecommunications infrastructure, without which it is impossible for modern businesses to function, and to affordable, stable and clean energy.
- Living spaces will also change, thanks to the further development of intelligent systems using modern real-time technology or satellite data. *Smart cities* and *smart villages* will develop nationwide. The development of *smart spaces* will be fastest in large cities, with the greatest potential for creating and absorbing this type of innovation. This can be achieved through public-private partnership (PPP) investments as an instrument to support innovation. PPP projects are an essential part of public investment, and this formula is successfully used to support innovative activities.
- In the approach to education, the dynamic development of innovation and technological progress will need to be considered. Adapting the education system to changes in the labour market and everyday life will require an increased emphasis on digital skills and creativity. Higher education and science will also be oriented towards closer cooperation with the economic sector in order to best support the innovation creation and implementation chains. An institutional and more structured approach will also require social policies that provide access to innovative technologies.

ADVANCING DIGITALISATION OF THE ECONOMY

The progress of digitisation in the global economy is evidenced, among other indicators, by the fact that the share of ICT companies in total global exports is growing year on year. In 2022, it was valued at USD 971 billion, with as much as USD 389 billion coming from EU economies. The digitalisation process will gradually deepen the impact of global trends on the Polish economy. The competitiveness of Poland's economy will depend on its level of digitalisation and the ability to create its own internationally competitive entities, as well as the ability to create demand for innovation. At the moment, Poland's economy is characterised by a relatively low level of digitalisation

(out of 27 EU countries, Poland ranks 24th in terms of the summary index[3]). However, the dynamics of this process are strong both on a European and global scale.

Figure 1: Digital Economy and Society Index (DESI 2022)



KAPITAŁ LUDZKI	HUMAN CAPITAL
ŁĄCZNOŚĆ	COMMUNICATIONS
INTEGRACJA TECHNOLOGII CYFROWEJ	INTEGRATION OF DIGITAL TECHNOLOGY
CYFROWE USLUGI PUBLICZNE	DIGITAL PUBLIC SERVICES

Source: Digital Economy and Society Index (DESI) for 2022.

Projected trend effects in Poland:

- The digitalisation of the economy will increase the pressure to improve the digital competences of society throughout life. It will also be important to develop people's ability to work with Artificial Intelligence and other digital technologies that are increasingly present in our lives. Digitalisation may also affect social relationships, which may be largely transferred to the virtual world.
- In light of the economic situation, this trend will undoubtedly contribute to the further growth of ICT companies in the Polish economy. Digital businesses will become an increasingly attractive place to work and will attract greater interest on the market. A highly digitalised economy, thanks to its detachment from material resources, may be more resistant to various types of tensions and fluctuations and may be a guarantor of economic security (however, it should be remembered that digital activities also require a raw material base, e.g., silicon and rare earth elements). On the other hand, however, a high level of digitisation will increase cyber threats to the economy and give rise to new types of threats.
- In environmental terms, digitalisation, like the increase in innovation described earlier, can translate into a reduction in the negative environmental impact of the economy. However, this result can only be achieved if the digital economy will be based on eco-innovation.
- Digitalisation, like the development of innovation, will increase the importance of access to telecommunications infrastructure as one of the key factors in the location of economic activity. This process provides an opportunity to reduce economic disparities in spatial terms. However, this will require access to internet connections of an appropriate quality.
- In institutional terms, the education system will need to be transformed, with greater emphasis placed on human interaction with Artificial Intelligence. Existing and new public e-services will also continue to develop, enabling more and more administrative matters to be dealt with from home. Digitalisation also offers potential for the development of e-democracy, which can help to increase social engagement and participation.

INCREASING AUTOMATION OF WORK AND FLEXIBILITY OF EMPLOYMENT

The labour market is currently undergoing a strong transformation as a result of its automation and digitalisation. These processes are leading to job losses, the development of professions that can only be performed by humans, and the emergence of new occupations. Poland is among the countries that will be strongly affected by the

[3] International *Digital* Economy and Society Index.

automation of work: according to analyses, up to one in three jobs in Poland may be automated (approx. 33% of jobs may be automated by 2030[4]). Polish agriculture may be significantly affected by this process, which will translate into changes in rural areas. At the same time, Poles are open to hybrid and online working (77% of respondents indicate hybrid working as a desirable type of work[5]), which may facilitate the development of flexible working. The potential for automation and digitalisation varies greatly across sectors, which means that the effects and responses to these processes will differ significantly between sectors.

Projected trend effects in Poland:

- In social terms, this trend may cause an increase in social tensions and concerns, especially among groups at risk of losing routine jobs. This may also translate into regional differences in these concerns (e.g., greater intensity in agricultural areas). The development of automation will also lead to changes in human-machine relations and the emergence of completely new types of relations (e.g., communicating with technical devices using thoughts or the implantation of electronic components into the human body). In combination with flexible forms of employment, this may reduce people's privacy due to enhanced control within flexible employment. Remote working will increase the freedom to choose where to live, which in turn will affect the tax system. Meanwhile, intensified relations between humans and technology may lead to professional burnout and mental health problems.
- Economically, these processes have the most serious consequences for the traditional professions. This is linked to the competitive model they follow, based on low costs and low skills. At the same time, companies involved in the automation process itself and providing it to other entities will gain significant potential and development opportunities. Digitisation will also give companies access to new markets, and employees – due to the development of AI and the decreasing importance of language skills – will gain greater access to international labour markets.
- Due to the ongoing automation of work and increasing flexibility of employment, the structure of land use may change (reduced demand for land by companies), which provides an opportunity to strengthen the green infrastructure network in the country. By using clean energy solutions in automation and new forms of employment, it is also possible to reduce anthropogenic pressure on the environment.
- The impact of these trends may also mean that ensuring access to high-quality internet and ICT infrastructure will become one of the most important factors shaping spatial processes.
- In institutional terms, new forms of employment and the replacement of some human labour with machines will require adjustments to social security policies, labour law reforms and changes to the education system to adapt it to the needs of a changing labour market.

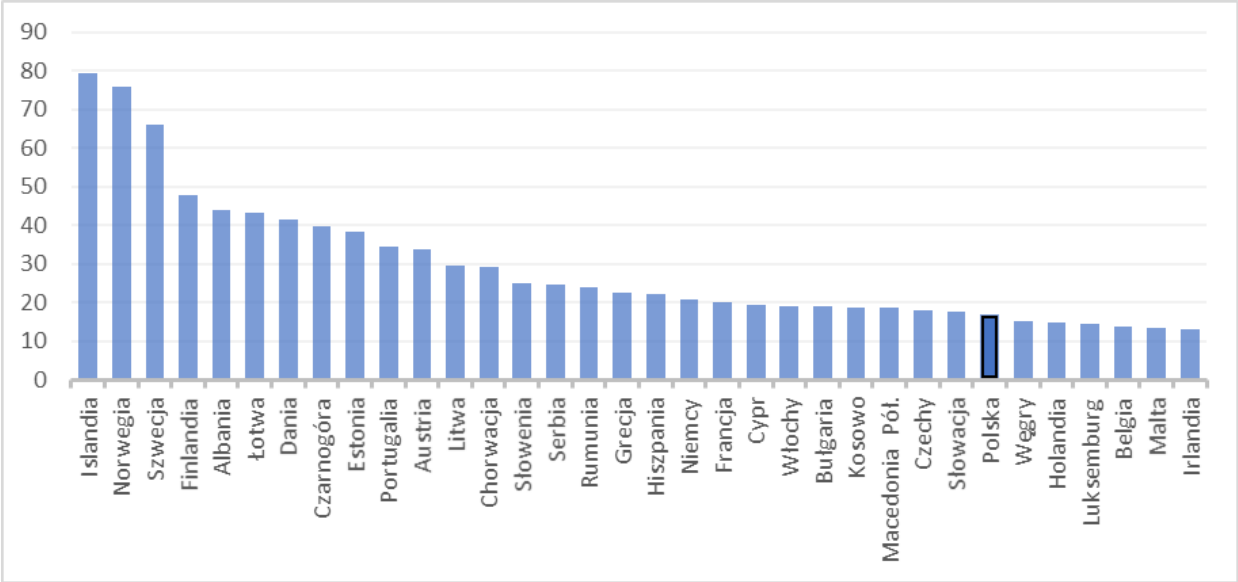
ENERGY TRANSITION

Measures to ensure energy security for countries and reduce the negative impact of energy production on the climate and environment are being taken at global, regional and local levels. Work is constantly underway to make more effective use of renewable energy sources (RES), develop nuclear energy and other new sources of energy generation, and create an electricity system adapted to the increased share of RES and nuclear energy. Energy resources remain a key strategic resource. Among European countries, Poland ranks at the bottom in terms of the use of RES in energy production (in 2021, Poland ranked seventh from the end among EU countries in terms of the share of RES in the energy mix), while at the same time exceeding the European average in terms of the dynamics of this process – during the last 10 years, Poland has been among the 10 EU countries with the highest growth in RES capacity. In contrast, Poland does not currently have nuclear power in its energy mix, but according to the Polish nuclear energy programme, it is planning to build nuclear power plants with a capacity of approximately 6 GWe to approximately 9 GWe. As is the case worldwide, electricity consumption and demand are also growing in Poland. However, this growth is relatively slow. Poland's average energy demand per capita in 2010-2020 ranked the country 29th out of 35 European countries[6]. In the long term, it is important to consider how the diversity of energy sources in Poland will develop and what share of total energy consumption will be generated domestically.

[4] *Will robots really steal our jobs? An international analysis of the potential long term impact of automation 2018, cited in: Jurkiewicz et al. 2023.*
[5] *The future of the labour market. The Polish perspective. PwC survey Upskilling Hopes & Fears 2021, 2021, as cited in: Jurkiewicz et al. 2023.*
[6] Jurkiewicz et al. 2023 based on Eurostat data.

Transmission lines and distribution networks will undergo further modifications and modernisation, due to, among other factors, the increasing diversification and dispersion of energy sources and the wider use of alternative sources, as well as nuclear energy. In terms of investments in energy transition, public-private partnerships (PPP) offer potential for investments in this area. The involvement of private capital to finance investments, the optimisation of investment costs versus maintenance costs, the use of new technologies and the experience of specialised entities, as well as the sharing of risk between the parties to the agreement, make PPP a more effective form of investment than the traditional model. Achieving energy and economic benefits through PPP projects is even more significant in view of the deteriorating financial condition of local governments and rising energy prices. PPP may be the answer to the need of increasing investment in renewable energy sources and improving the energy efficiency of urban infrastructure. It can also have a significant impact on urban development, including improving the energy efficiency of buildings, the development of electromobility and *smart* technologies or the spread of blue-green infrastructure.

Figure 2: Share of renewable energy sources in the energy balance [%] in 2022.



Source: own elaboration based on Eurostat data

Projected trend effects in Poland:

- The energy transition is largely linked to raising environmental awareness among the public. It can be assumed that as it accelerates, this awareness will continue to grow. At the same time, various restrictions related to the energy transition may reduce the energy security of Polish citizens. The closure of mines and the move away from traditional energy sources may cause social unrest. On the other hand, the change may translate into greater openness of Polish society to new energy sources and the demonopolisation of the energy market.
- From an economic point of view, the energy transition will shake up the positions of the current leaders on the energy market, including a large number of state-owned companies. Simultaneously, the importance of prosumer production and its share in the energy market will increase. This process, together with the increasingly widespread use of RES and the development of nuclear energy, may lead to a decrease in energy production costs in the future.
- A further increase in the share of renewable energy sources, nuclear energy and new sources in energy production will translate into an increase in the share of clean energy in the overall market, and thus a reduction in the negative impact of the energy sector on the climate and the environment. In addition, there will be a further, intensified release of some of the land previously used by the energy industry (e.g., mining areas), allowing it to be reclaimed and renaturalised. This also provides an opportunity to strengthen the green infrastructure elements or other functions of these areas.
- The transformation of the energy sector will also have spatial consequences. The increased number of energy sources, together with the development of prosumer energy, will lead to the emergence of an increasing number of energy-generating installations, including in areas where this function has not been performed before. New energy storage facilities will also require new land. However, some of the areas previously used by the

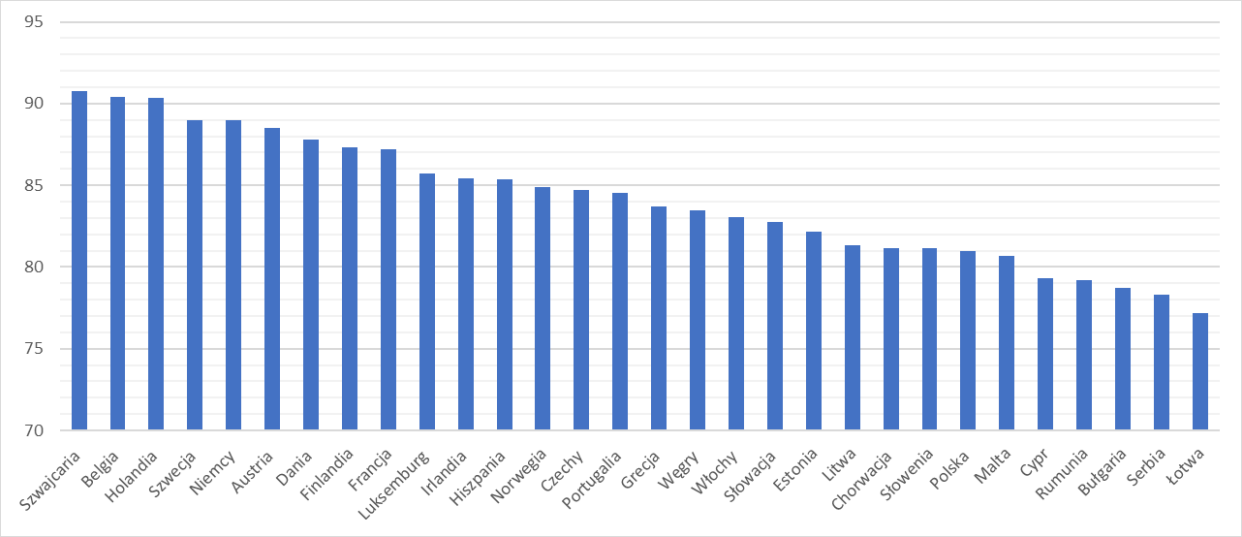
energy sector will be released from their current use (e.g., coal mines) due to the cessation of their operation. They will be able to serve as a land reserve for new types of development.

- Public institutions will be forced to adapt the law to the realities of the new energy sector. It should facilitate the use of new energy sources and the development of prosumer energy, using efficient energy storage facilities. Energy policy will also be one of the important elements in ensuring state security.

THE CLASH BETWEEN GLOBALISM AND LOCALISM

The modern, globalised world creates a network of interconnections. This has been confirmed by the COVID-19 pandemic and the war in Ukraine, revealing the difficulties of the economy functioning in conditions of international crises. As a result, the demand for shorter supply chains is becoming increasingly popular. However, experts are divided about the direction of their development – there is talk of both their likely shortening and the possibility of further increasing their range, which may be caused, among other things, by the ever-growing level of global consumption. Poland is integrated into the global economy mainly through its largest cities and companies (according to the synthetic globalization index, it ranks 28th globally in this respect, significantly below the EU average[7]). This deepens the already visible spatial polarisation of the country—capital is located in places with developed socio-economic functions, where links with the global economy already exist, which further increases stratification. In addition, Poland continues to be among the countries where foreign investment exceeds the sum of domestic companies' investments abroad (in terms of outward investment, Poland is one of the least active countries in the Community[8]). But the negative effects can be offset by the growing importance of local economic factors for doing business. It may result in greater specialisation of individual regions and reduce development differences between them.

Figure 3: Globalisation index in Europe in 2023.
[0-100]



Source: own elaboration based on Statista data.

Projected trend effects in Poland:

- The shift in economic centres of gravity, mainly due to the growing power of Asia, particularly China and India, will lead to an increase in the importance and spread of cultural patterns that differ from those currently dominant in culture and the economy. This may contribute to the polarisation of society. At the same time, local communities and social capital will be strengthened at the local level in response to the standardisation of cultural patterns as a result of globalisation.
- In economic terms, the competitiveness of Polish companies will increasingly depend on their participation in international relations. Competition between Polish municipalities and regions to attract foreign capital will continue to increase. Investments by Polish companies outside the country will also grow.

[7] Gygli et al. 2019 [in:] Jurkiewicz et al. 2023.
[8] Jurkiewicz et al. 2023 based on Eurostat data.

- The quality of the environment as a factor in the location of economic activity will also gain in importance. Companies operating increasingly independently of material resources and transport costs will seek liveable locations for their employees.
- The increasing importance of international links will lead to further spatial polarisation, coinciding with the key location factors for today's economic activity. The most attractive areas for business will be metropolitan areas, where most of these factors are present. On the other hand, small urban centres will also develop, based on the use of local characteristics and a high quality of life compared to metropolitan areas, at significantly lower costs.
- In an increasingly globalised world, the role of the state and state institutions in supporting the position of Poland and Polish companies on the international arena will be important. Maintaining and strengthening strategic partnerships with other countries and Poland's participation in international organisations will also be crucial.

TRANSFORMATION OF AGRICULTURE CAUSED BY CLIMATE CHANGE, TECHNOLOGICAL ADVANCES AND NEW CONSUMPTION PATTERNS

Agriculture is a sector that has undergone significant changes worldwide in recent times. Two trends have had a particularly strong impact on these changes. The first is climate change. This can lead to reduced agricultural productivity, the exclusion of certain areas from cultivation and other negative effects, which may translate into a decline in food security. The second trend, which has more positive consequences for agriculture, is its technological development. This can help to offset the negative consequences of climate change, while supporting efforts to stop these changes. Polish rural areas are characterised by a lower level of development compared to the rest of the country, which may negatively affect their ability to absorb new technological solutions. At the same time, Poland is a significant food producer on a continental scale, which increases the importance of adapting agriculture to climate change as a key sector of the economy. Without active involvement in innovation, Poland's position as a major European food producer may be undermined. The situation of agriculture also varies greatly from region to region, particularly in terms of farm structure, type of production, but also in terms of the share of organic farming. Poland has one of the highest shares of farms run by natural persons in the total number of farms (99.4% in 2020). At the same time, between 2010 and 2020, the decline in this indicator was one of the lowest in Europe (0.3 pp.). In a few European countries (including Norway, Austria and Switzerland), there was an increase in the share of farms run by natural persons in the total number of farms during this period, but this was accompanied by significant declines in the total number of farms in these countries.

Projected trend effects in Poland:

- Due to, among other factors, increasing environmental awareness among the public as well as people's attachment to local values, support for national and local agricultural production will grow. There will also be increasing social pressure to shorten supply chains in agricultural production (from farm to fork) and to increase access to local products. Environmental awareness will also increase public openness to cellular food production[9].
- Agricultural production will increase its efficiency thanks to bioengineering and pro-environmental solutions. However, at the same time, employment in agriculture will decline as the demand for labour in this sector decreases. New types of agricultural activity will emerge (e.g., the aforementioned cellular food or the growing importance of insect protein) as well as new types of agricultural production organisations (e.g., the spread of clusters or agricultural cooperatives). Production in shortened supply chains will also be better adapted to the individual characteristics and needs of consumers located close to the place of production.
- Reduction in the area of land used for agriculture may contribute to strengthening green infrastructure and protecting the climate and the environment.

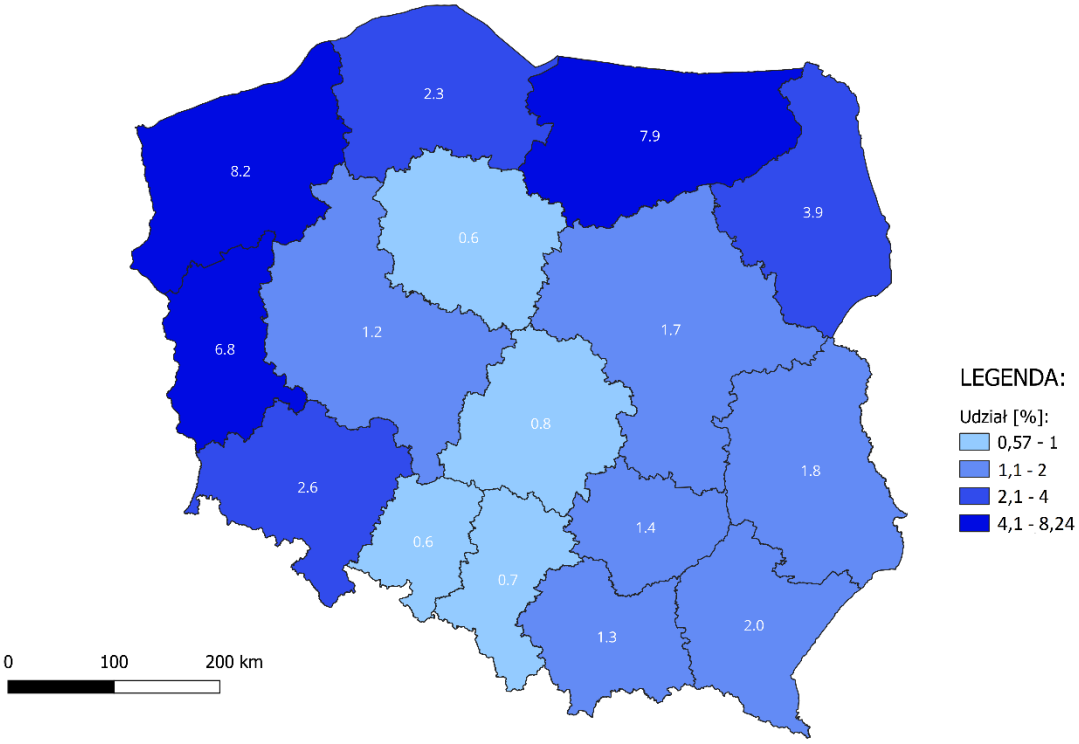
[9] Cellular agriculture focuses on producing agricultural products from cell cultures using biotechnology, tissue engineering, molecular biology and synthetic biology to create and design new methods of producing proteins, fats and tissues that would otherwise come from traditional agriculture.

- Development of modern agriculture, including regenerative agriculture, can have a positive impact on the environment. Rational water management solutions, including those improving water availability, such as water retention on farms, will also play an important role.

Regional variations in megatrends:

Development trends, like any phenomenon that occurs and affects space, vary spatially and can have different intensities in different places. Megatrends are highly complex issues, which makes them difficult to illustrate using simple statistical indicators. But they do illustrate how different the situation in a given area can be in different regions of the country. Three indicators, described below, were used to illustrate regional differences in the megatrend for the evolution of the new economy.

Map 1: Share of organic farms in total agricultural area in 2020.

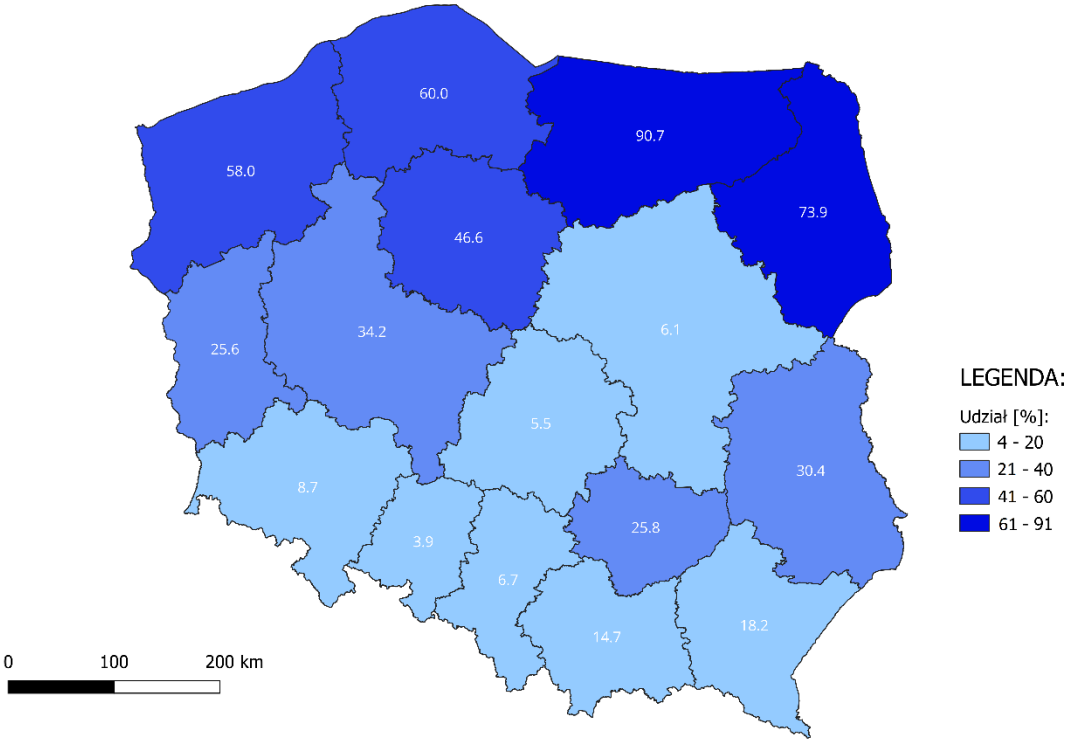


Source: own elaboration based on data from the Local Data Bank of Statistics Poland (GUS)

LEGENDA	KEY
Udział [%]	Share (%)

The first indicator is the share of organic farms in the total agricultural area. The percentage of organic farms in the regions ranges from less than 1% in the central and southern voivodships of Poland to over 8% in Zachodniopomorskie (Western Pomerania). The highest share of organic farms can be found in the north-eastern (Podlaskie (Podlachia) and Warmińsko-Mazurskie (Warmia-Masuria)) and north-western (Lubuskie (Lubusz) and Zachodniopomorskie) regions of the country.

Map 2: Share of renewable energy in total electricity generation in 2021.

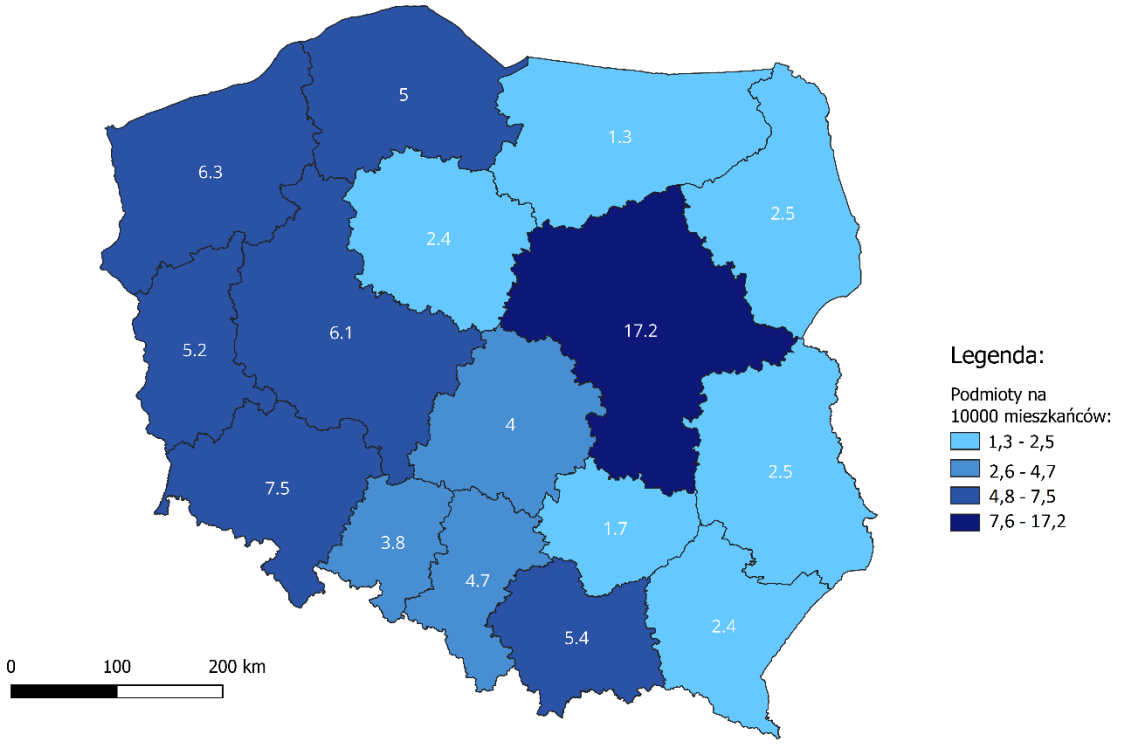


Source: own elaboration based on data from the Local Data Bank of Statistics Poland (GUS)

LEGENDA	KEY
Udział [%]	Share (%)

The second indicator reflecting pro-environmental changes in the economy is the share of renewable energy sources in total energy production. This issue varies more significantly between regions. The phenomenon differs between north and south, with northern regions characterised by a high share of RES (from 40% to 90%), while in southern (below 20%) and central (below 10%) regions this share is significantlylower. Such a division is even visible in the macro-region of Eastern Poland, where the Podkarpackie (Lower Carpathia) Voivodship (the southernmost of the macro-region) has a significantly lower share of RES in energy production than the other voivodships of Eastern Poland.

Map 3: Economic entities with foreign capital per 10,000 inhabitants in 2021.



Source: own elaboration based on data from the Local Data Bank of Statistics Poland (GUS)

LEGENDA	KEY
Podmioty na 10000 mieszkańców:	Entities per 10,000 inhabitants:

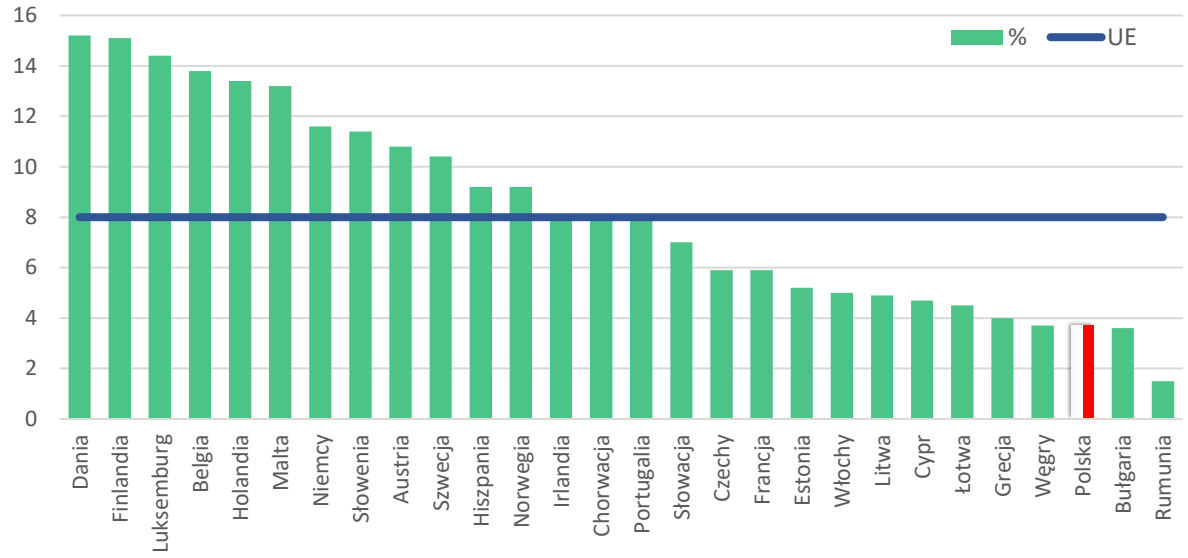
The number of companies with foreign capital per 10,000 inhabitants is an indicator that reflects, to some extent, the international economic links of voivodships. In this case, there is a clear division of the country into the east, with a low share of foreign capital, and the west, with a significantly higher level of foreign capital. The entire macro-region of Eastern Poland is characterised by low values of this indicator. At the same time, the Mazowieckie (Mazovia) Voivodship, which, excluding the statistical region of Warsaw, is also part of Eastern Poland, has the highest level of this indicator in the country, more than twice that of the Dolnośląskie (Lower Silesia) Voivodship, which ranks second in this respect.

MEGATREND: TECHNOLOGICAL ACCELERATION

Technological progress and innovation have long been an important element in building the competitive position of countries and regions. This is particularly evident in the case of knowledge-based economic entities, which are strongly linked to innovation and new technologies. In recent years, these trends have become even more significant. The current dynamics of such phenomena are described as turbo-acceleration and technological convergence[10]. Technological changes are important not only because of their rapid pace, but also because of their multidimensional impact on other phenomena. Technological acceleration is identified by many experts and institutions as the main factor in social, economic, environmental and spatial processes.

One manifestation of technological acceleration is the spread of the Internet of Things (simplified as a system of electronic devices that can automatically communicate and exchange data via a network without human intervention[11]) and increasingly advanced Artificial Intelligence. In terms of market size for the Internet of Things, Europe lags behind Asia and America, but forecasts predict its dynamic growth in the coming years. The estimated growth of the Internet of Things market in Poland in 2024 (compared to 2023) will reach nearly $200 billion[12]. Among the technologies that make up the Internet of Things, the fastest growing and currently most popular is the *smart home*[13]. This points to the need to educate the public about the technological changes taking place. The pace of change also make it difficult to adapt new legal regulations to them.

Figure 4: Percentage of companies that used at least one AI technology in 2023.



Source: own elaboration based on Eurostat data

Another trend that is important from the point of view of technological transformation is the growing importance of biotechnology. As with the Internet of Things and Artificial Intelligence, the development of biotechnology has multiple implications. Innovations in this area can have positive effects, such as increased agricultural productivity, more effective nature conservation and advances in medicine. Uncontrolled activities in this area can pose serious risks related to the accidental creation of dangerous pathogens or unregulated research. Misuse of biotechnology development also poses a military threat. The COVID-19 pandemic has highlighted the need for biotechnology development, pointing to the importance of public support for this sector.

The third key issue for technological acceleration is the growing threat of cyberattacks. Tensions and disputes in global geopolitics mean that cybersecurity is becoming a priority from the point of view of state and citizen security. Globally, there has been a significant annual increase in the number of cybercrimes and incidents related to cyber threats. With the ever-increasing activity of humans and Artificial Intelligence on the internet and the transfer of

[10] Diamandis, Kotler, 2021, as cited in: Dziemianowicz 2023a.
[11] According to the IoT definition.
[12] Statista Market Insights, 2024.
[13] *Smart home. Smart cities. Smart world. Development of the Internet of Things* (IoT), 2020, as cited in: Yurkiewicz, Dziemianowicz, 2023.

more and more aspects of life to the virtual world, it can be anticipated that the number of incidents compromising cybersecurity will also continue to grow.

Trends contributing to the megatrend:

- Increasingly widespread Internet of Things and increasingly advanced Artificial Intelligence;
- Growing importance of biotechnology;
- Growing importance of cybersecurity.

INCREASINGLY WIDESPREAD INTERNET OF THINGS AND INCREASINGLY ADVANCED ARTIFICIAL INTELLIGENCE

Europe, together with North America and Asia, forms the largest market for the Internet of Things, but the situation in these regions varies internally. Poland and Eastern Europe currently rank low in terms of companies using the Internet of Things on a continental scale. However, forecasts indicate dynamic growth of this technology in our region, which will place Poland in the top ten European countries with the highest number of Internet of Things connections within a few years[14].

In Poland, the projected growth in the use of the Internet of Things in 2023 was 24%[15]. *The most popular type of this technology now used in the country is smart home.* People often use it without being aware of it, which is why it is important to raise the technological knowledge and competence of the population. It is also important to adapt legal regulations to the dynamic changes taking place.

When it comes to Artificial Intelligence, Poland ranks low in terms of its use in Europe. Only 3% of Polish companies use Artificial Intelligence in their operations, while the EU average is 8%[16]. However, it should be noted that in terms of the number of Artificial Intelligence specialists, Poland ranks first in Central and Eastern Europe[17]. The situation also varies greatly within the country, with a high concentration of AI specialists in several regions, particularly in the largest urban centres (over 75% of AI specialists work in five Polish cities)[18].

Technological progress is a very dynamic phenomenon, and at the same time, this change is exponential in nature. Combined with the current convergence of technologies, this means that the effects of this process will have a strong and widespread impact.

Projected trend effects in Poland:

- Possible increasing polarization of society due to relatively low digital skills and lack of technological awareness among part of the population, combined with the transfer of more and more activities to the virtual world.
- Progressive transfer of the economy to the digital world. These transformations will be associated with radical changes in the labour market. Competition between companies will also change – it will focus on technological competition.
- In environmental terms, the use of the Internet of Things and Artificial Intelligence will increase the effectiveness of environmental protection thanks to the development of modern tools (e.g., solutions for real-time environmental monitoring or spatial analysis of environmental data).
- Changes in space and its perception. With more and more activities moving to the virtual world, physical space may lose its significance in some areas. The criteria for evaluating space may also change – its potential for hyperconnectivity will be assessed, which may gain in importance in relation to physical connectivity. At the same time, these changes may help to reduce spatial disparities in development by making them partially independent of spatial determinants of development.
- Development of public e-services, which may improve their accessibility in places that have been marginalised in this respect. At the same time, the development of public services provided virtually will increase the threat to cybersecurity and put pressure on the introduction of solutions to ensure it. At the institutional level, Artificial Intelligence can be used in decision-making processes. This will also transform the legal system so that it can use AI while protecting against its misuse.

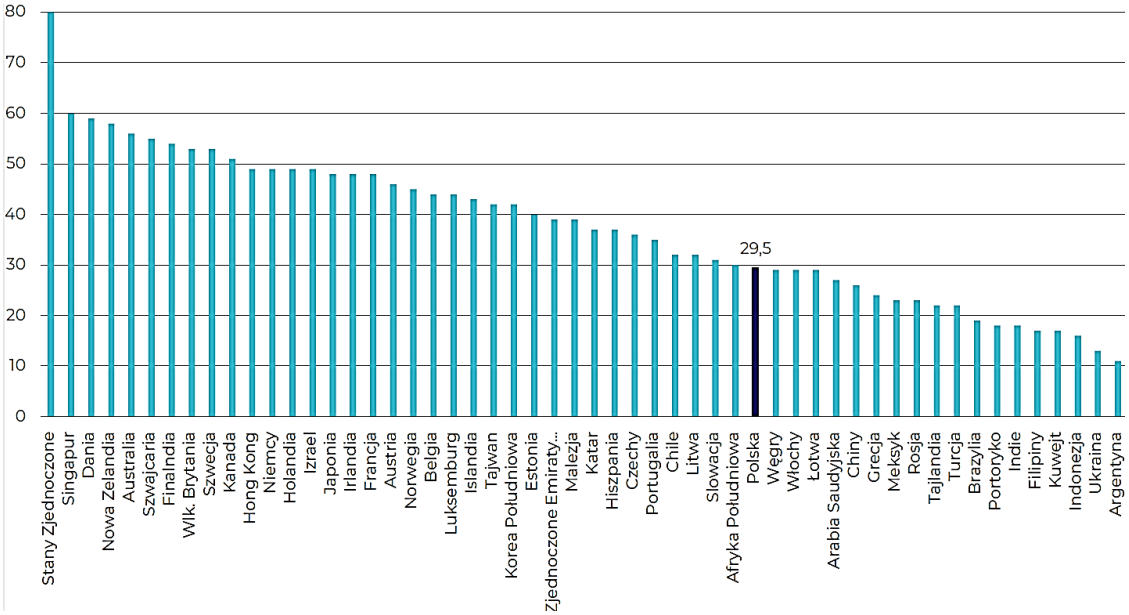
[14] Top 10 IoT-Connected Countries In Europe 2025 (GMSA data), 2021, as cited in: Jurkiewicz, Dziemianowicz 2023a.
[15] Smart home. Smart cities. Smart world. Development of the Internet of Things (IoT), 2020, as cited in: Yurkiewicz, Dziemianowicz, 2023a.
[16] Yurkiewicz, Dziemianowicz 2023a based on Eurostat data for 2021.
[17] Jurkiewicz, Dziemianowicz 2023a based on Eurostat data.
[18] *Artificial intelligence in Poland – competences of AI experts*, 2020 as cited in: Yurkevich, Dziemianowicz 2023a.

GROWING IMPORTANCE OF BIOTECHNOLOGY

Biotechnology is currently a widely discussed topic due to its dynamic development and multidimensional links with other processes and phenomena. It offers real opportunities to improve public health, develop agriculture (especially organic farming) and protect the environment and adapt to climate change more effectively. At the same time, this development carries risks related to e.g., accidental creation of dangerous pathogens, uncontrolled and unregulated work of biologists. Biotechnology can also be used for military purposes, which highlights the importance of ensuring an adequate level of security in this area. The significance of biotechnology and its position in public debate in recent years has been greatly enhanced by the global experience of the COVID-19 pandemic.

Poland is following global trends, but due to the relatively low level of innovation in its economy, Poland remains outside the group of leading countries. There are many indications that the changes taking place in the country will be in line with global ones, but their intensity and scale will be smaller. The importance of biotechnology in the Polish economy and its potential for further growth is also evidenced by the fact that it is one of the National Smart Specialisations.

Figure 5: Ranking of biotechnology innovation rankings



Source: own elaboration based on data from Global Biotechnology Innovation Rankings

Among the countries surveyed in terms of biotechnology innovation, Poland ranks 36th out of 54 countries. At the same time, Polish biotechnology companies are characterised by relatively high productivity and production intensity[19].

The dynamics of development of domestic biotechnology companies vary depending on the type of entity. Over the last decade, there has been a clear increase in expenditure on biotechnology in the private sector, while the value has remained at a similar level in public research institutions[20]. As a result, the differences between the sectors are becoming more pronounced every year.

Projected trend effects in Poland:

- An increase in average life expectancy and an improvement in the overall level of public health. Simultaneously, social polarisation related to unequal access to new technologies may intensify. Ethical dilemmas (already present) may also arise in relation to new medical practices.
- Dynamic development of economic entities operating in the field of biotechnology. It should be assumed that a prerequisite for this development will be high-quality back-up in the R&D sector, especially human resources. The agricultural sector will also develop as a result of the emergence of new solutions for agriculture and further increases in its productivity.

[19] Global Biotechnology Innovation Rankings, (n.d.), as cited in: Jurkiewicz, Dziemianowicz 2023a.
[20] Jurkiewicz, Dziemianowicz 2023a based on data from Statistics Poland (Local Data Bank).

- Development of biotechnology law. These changes will be necessary due to the need to ensure the safety of research and protect society from the possible negative use of biotechnology. Further development in this field will also strengthen the links between the scientific and private sectors.
- Increased effectiveness and efficiency of environmental protection, which will be possible thanks to new biotechnological solutions.
- New forms of land use and the addition of new functions, e.g. in the form of urban agriculture, as well as the improvement of land used in its current form, including through the revitalisation of parts of agricultural and green areas.

GROWING IMPORTANCE OF CYBERSECURITY

The year-on-year increase in people's activity in the virtual world and the impact of technological development on all areas of life, including education, health and transport safety, mean that ensuring cybersecurity is becoming an important issue from the perspective of the functioning of societies.

In Poland, within just two years, the number of incidents increased by nearly 180% in 2020, reaching over 10,000[21]. In 2021, this number increased by another 182% compared to 2020. The number of cybercrimes recorded by the police since 2016 has increased by over 56% and amounted to nearly 55,000 in 2020[22]. The number of cybercrime reports increased by almost 178% in 2022 compared to 2021. The situation varies on a global and European scale. Poland ranks 22nd among the 108 countries included in the international study and is among the countries with a relatively high level of cybersecurity[23]. On a European scale, the countries in the eastern and south-eastern parts of the continent are in the worst situation. The number of incidents also varies by sector. In Poland in 2020, the highest number of reports came from the media sector[24].

Technological development also has many negative effects (including digital exclusion), which is why developing the digital skills of society is an important aspect of technological progress.

Projected trend effects in Poland:

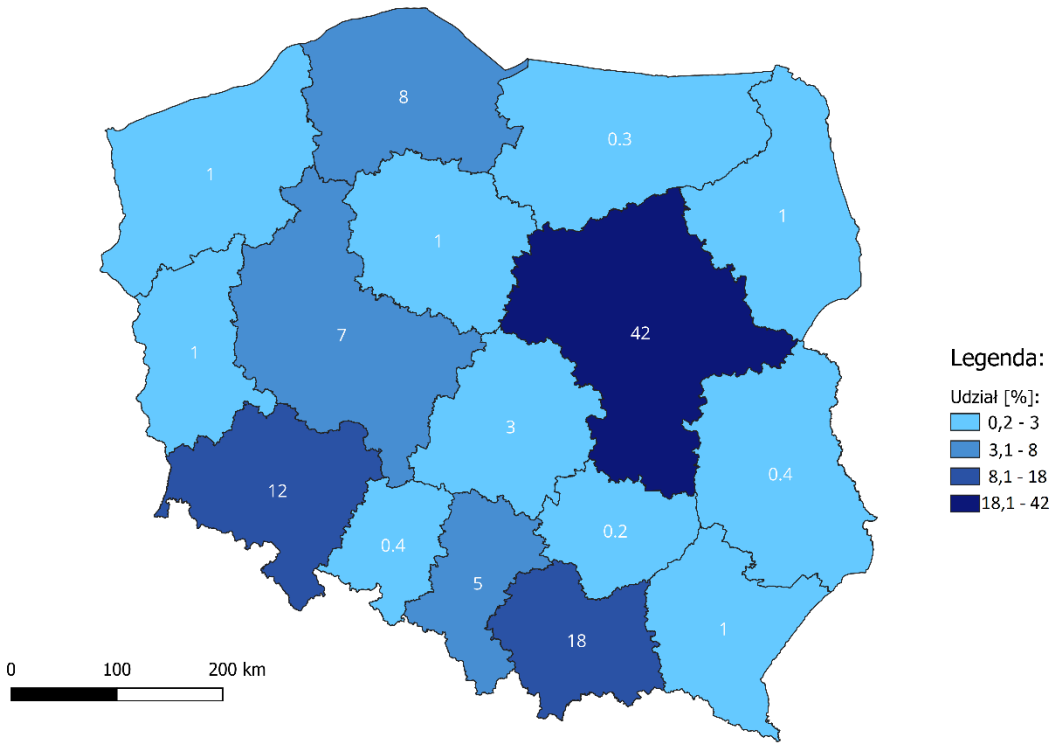
- A possible decline in public trust in ICT, which may lead to increased social unrest and tensions. At the same time, public awareness of cyber threats will increase, although it can be assumed that this increase will be uneven and may lead to deeper social polarisation. Multidimensional cyberattacks may cut off or limit public access to public services.
- In economic terms, the most significant factor will be a further increase in the number of ICT incidents. The private sector is likely to raise its expenditure on cybersecurity, which will increase the operating costs of businesses and may have an impact on prices. But at the same time, this expenditure will stimulate the development of the ICT sector, which may translate into its further dynamic growth.
- The public sector will also increase investments in the cybersecurity of its institutions. At the same time, these issues will find their place in the education system and will lead to a redefinition of military security and the search for new ways to ensure it.
- There may be threats to the environment associated with new types of hybrid attacks, such as the release of substances hazardous to human, animal and plant health and life into the environment (e.g., from scientific laboratories).
- From a spatial point of view, the regions most vulnerable to cyberattacks and their effects will be those where strategic and modern infrastructure (e.g., transmission network components) and facilities (e.g., communication hubs) are located.

Regional diversity of the megatrend:

To illustrate regional diversity in the area of the Technological Acceleration megatrend, two indicators were used: the distribution of AI specialists in individual regions and the percentage of people using e-government services.

[21] *Computer Emergency Response Team* .
[22] Kucharczyk 2021 as cited in: Jurkiewicz, Dziemianowicz 2023a.
[23] *Cybersecurity Exposure Index* (CEI) 2020, 2020, as cited in: Jurkiewicz, Dziemianowicz 2023a.
[24] Over 10,000 cybersecurity incidents in 2020, 2021 as cited in: Jurkiewicz, Dziemianowicz 2023a.

Map 4: Distribution of AI specialists across regions in 2021

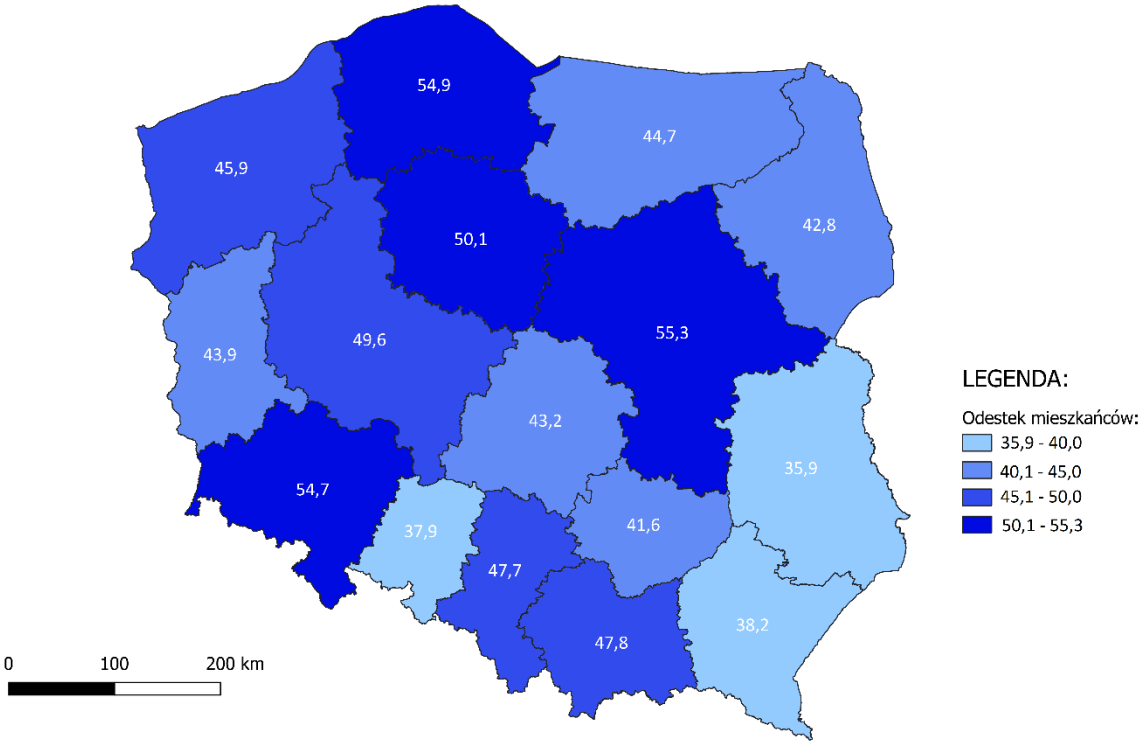


Source: own elaboration based on data from the State of Polish AI report by the Digital Poland Foundation.

LEGENDA	KEY
Udział [%]	Share (%)

There are significant differences in the distribution of AI specialists across individual voivodships. In most of the voivodships, their percentage is very low – 10 out of 16 regions account for between 0.2% and 3% of all national specialists in this field. The remaining regions are characterised by a few times, and sometimes more than a dozen times, higher values of this indicator (from 8% of specialists in the Pomorskie (Pomerania) Voivodship to 42% in the Mazowieckie (Mazovia) Voivodship). The largest concentrations of national AI specialists can be found in regions where the largest urban centres are located (Warszawa, Kraków, Gdańsk, Wrocław, Katowice, Poznań).

Map 5: Residents using the internet to interact with public administration.



Source: own elaboration based on data from GUS Domain Knowledge Base

LEGENDA	KEY
Odsetek mieszkańców:	Percentage of residents:

The percentage of residents using the internet to interact with public administration is much less varied. It ranges from 78% in the Świętokrzyskie (Holy Cross) Voivodship to 91.8% in the Mazowieckie (Mazovia) Voivodship). Despite the differences, this percentage can be considered high in all regions.

MEGATREND: THE GROWTH OF GLOBAL SOCIAL PROBLEMS

This megatrend consists of many diverse and interrelated phenomena. On the one hand, we are seeing an increase in the world's population, while on the other hand, the populations of Europe and Poland are declining, and demographic forecasts indicate a further decline in this area. In addition, there is the phenomenon of ageing societies and the associated demographic gap, which have a significant impact on the economic models of individual countries (e.g., expenditure on healthcare and long-term care, and changes in pension systems). Furthermore, the projected increase in life expectancy, together with new technologies and biotechnologies, is contributing to the exacerbation of this phenomenon.

Parallel to this megatrend, there has been an intensification of migration processes (climate change, armed conflicts, poverty and hunger), as well as an increase in social inequality affecting various social groups. Another segment of the megatrend is the development of new primary and secondary education, which will be shaped by various global trends (e.g., technological), the expectations of parents and students, and the needs of a rapidly changing labour market (including the emergence of previously non-existent professions).

Trends contributing to the megatrend:

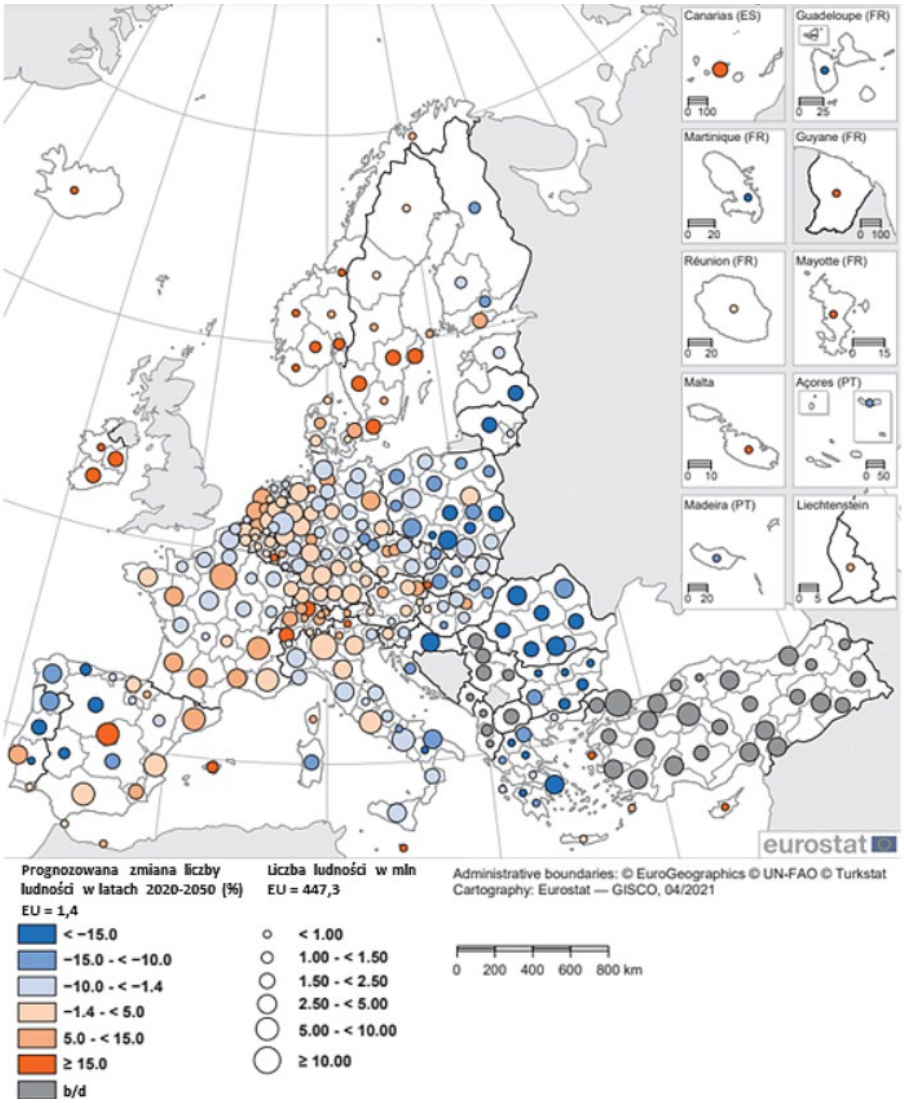
- Demographic uncertainty;
- An increasingly nomadic world;
- Growing social inequality;
- Developing demand for new forms and fields of learning.

DEMOGRAPHIC UNCERTAINTY

The world's population is steadily growing. Over the last decade, it has increased by more than 800 million people. Demographic forecasts indicate that this upward trend will continue. By 2050, the population is expected to reach nearly 9.7 billion. African countries will see the largest increase. In other parts of the globe, however, a decline will be observed. The highest one will occur in most countries of Central, Southern and South-Eastern Europe. Poland ranks close to the group of 20 countries with the highest decline in the index (in 403rd place)[25].

[25] Jurkiewicz, Dziemianowicz 2023c based on World Bank databases.

Map 6: Population in 2020 and projected population change between 2020 and 2050



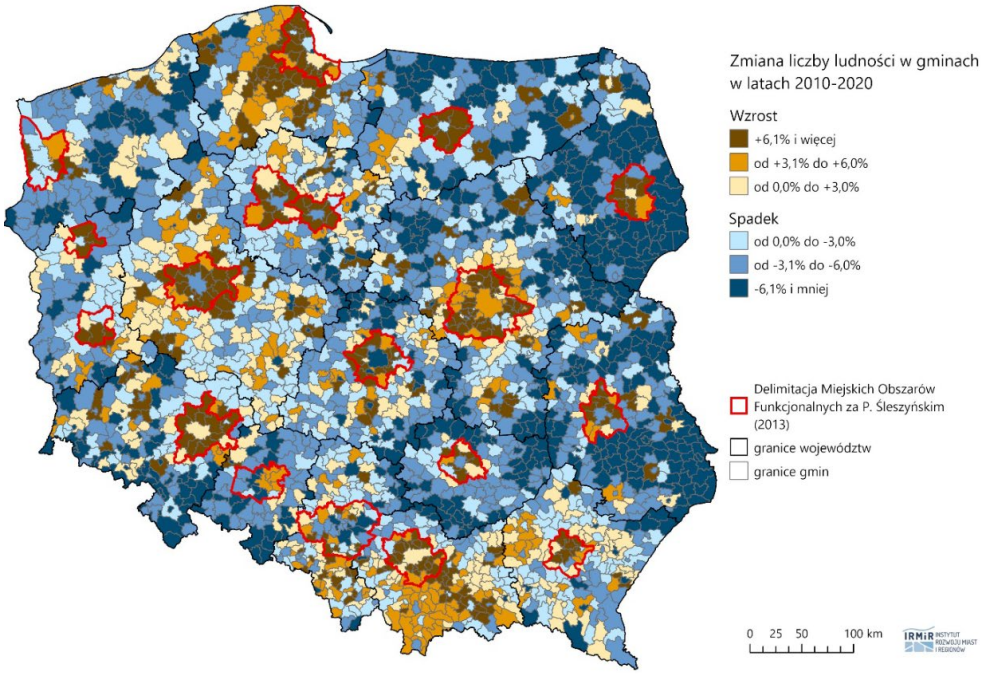
Source: Eurostat regional yearbook 2021, as cited in Sykała et al. 2023

Prognozowana zmiana liczby ludności w latach 2020-2050	Projected population change between 2020 and 2050
Liczba ludności w mln	Population in millions
b/d	no data

An analysis of data from World Population Prospects 2019 published by the UN and Statistics Poland (GUS) shows that a decline in population is projected across Europe between 2020 and 2050. However, regional population trends vary significantly. In Western and Northern Europe, there is a significant proportion of regions where the population will grow (mainly as a result of migration). The largest decline will occur in Central and Eastern European countries, including Poland (all regions except for the Warsaw metropolitan area).

According to data from Statistics Poland (GUS) and Eurostat, Poland is currently on the early stage of a fairly dynamic process of depopulation. Between 2010 and 2020, the population of Poland decreased by 264,900 (-0.7%). This trend is also confirmed by data from subsequent years – between 2010 and 2023, the population of Poland decreased by 2.3%. The decline in the country's population will continue and intensify in the coming years, as indicated by even the most optimistic demographic forecasts. The most pessimistic forecasts by GUS estimate the population of Poland in 2060 at around 26.7 million (a decline of over 40%), while according to the UN, this figure will reach 30.7 million by 2050 (a decline of nearly 20% over the next 30 years). Poland is projected to be one of the fastest depopulating countries in the European Union.

Map 7: Change in the number of inhabitants in Poland at the municipal level in 2010–2020.



Source: IRMiR study based on data from Statistics Poland (GUS).

Zmiana liczby ludności w gminach w latach 2010-2020	Population change in municipalities between 2010 and 2020
Wzrost	Increase
+6,1% i więcej	+6.1% and above
Od +3,1% do + 6,0%	From +3.1% to + 6.0%
od 0,0% do +3,0%	from 0.0% to +3.0%
Spadek	Decrease
od 0,0% do -3,0%	from 0.0% to -3.0%
Od -3,1% do - 6,0%	From -3.1% to - 6.0%
-6,1% i mniej	-6.1% and less
Delimitacja Miejskich Obszarów Funkcjonalnych za P. Śleszyńskim (2013)	Delimitation of Functional Urban Areas according to P. Śleszyński (2013)
Granice województw	Voivodship boundaries
Granice gmin	Municipal boundaries

As regards the ageing of the population, in 2050 nearly one in three Polish citizens will be at least 65 years old. Poland will be one of the oldest countries demographically, not only in Europe but also worldwide (6th place in Europe and 13th place in the world in terms of the percentage of the population aged 65 and over[26]). The most advanced process of population ageing is observed in depopulated areas, which are also characterised by low fertility rates.

Progressive ageing is also associated with a steady increase in health risks for an increasing number of people. Maintaining the current level of health security will be more costly and will require more medical staff and investment. The health risks described in the Global Burden of Disease analyses[27] may become more acute, particularly lifestyle-related diseases (e.g., cardiovascular disease, diabetes, rheumatic and musculoskeletal diseases, mental illness). Long-term challenges include growing demand for services, lack of incentives for innovation, widening disparities in overall health and well-being, and unequal access to advanced therapies. According to numerous empirical studies, factors influencing the health and healthy life expectancy of the Polish population also include

[26] Sykała et al. 2023.

[27] Available at: https://www.healthdata.org/research-analysis/gbd [accessed on 20 December 2024].

widening socio-economic inequalities, food contamination, antibiotic resistance, global warming and environmental pollution, and potential supply chain disruptions causing unforeseen restrictions on access to medicines.

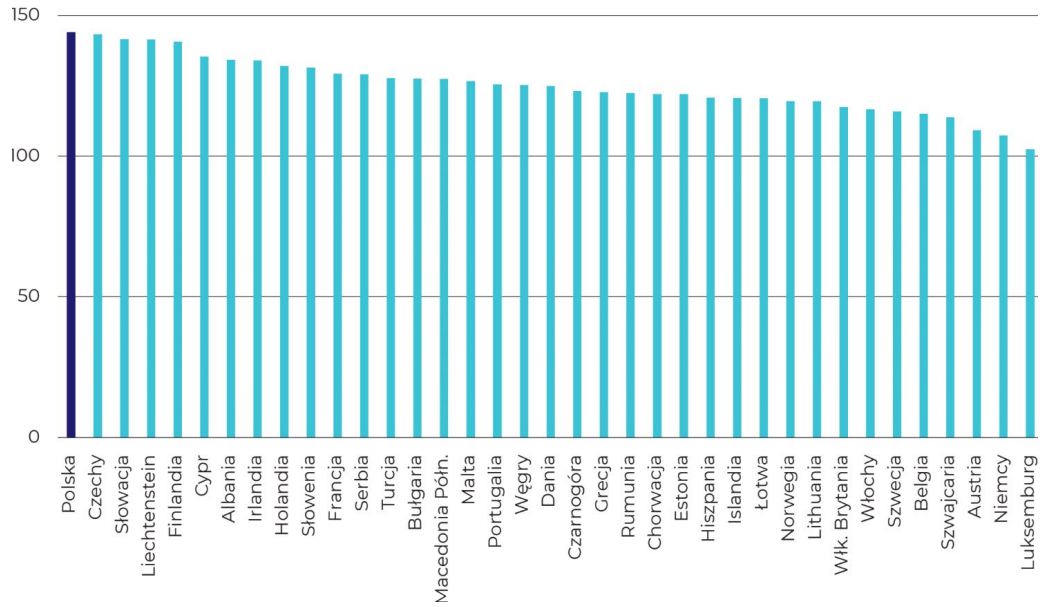
Alongside the ageing of the population, we are seeing a simultaneous increase in life expectancy. Life expectancy in Europe is the highest in the northern, western and southern countries of the region. In Poland, in 2019, life expectancy was below 78 years in more than half of the regions. The results achieved are similar to those of neighbouring countries in Central and Eastern Europe[28].

With the growing share of the ageing population and increased life expectancy in most EU countries, there has been a decline in the fertility rate (compared to 2010)[29]. In Central and Eastern Europe and Northern Europe (Latvia, Lithuania), the rate has increased. In Poland, the fertility rate fell from 1.41 in 2010 to 1.26 in 2022. A decline in the rate is also evident in the Scandinavian countries and in Western and Southern Europe. When analysing the average fertility rate over a number of years (2010-2022), it should be noted that Poland, despite visible positive changes, still has a low level in relation to other European countries (the ratio is 1.26, while the average for the analysed European countries is 1.46). It is worth noting that in the last decade, the fertility rate in Poland has remained consistently below the level guaranteeing simple generational replacement (at least 2.1). By 2060, a slight increase in its value to 1.49 is projected[30].

This situation will have an impact on the total dependency ratio. The highest values of this ratio are seen in Northern and Western Europe, and the lowest in Central and Eastern Europe. All EU countries have seen an increase in the dependency ratio compared to 2010. Poland has achieved the highest result among EU countries in this respect. Poland will therefore be one of the oldest countries demographically, not only in Europe but also worldwide. This means that there will be a decline in the number of people of working age and a shortage of human resources in selected sectors.

Figure 6: Total dependency ratio in 2020

[change 2010=100]



Source: own elaboration based on Eurostat data

Projected trend effects in Poland:

- In social terms, there is a demand for increased care for people in need of support (the elderly, sick, disabled) and adaptation of spaces to their needs, with a simultaneous increase in the share of costs related to providing care in household budgets. In addition, with the growing number of elderly people, there may be changes in family structures, with more and more people having to balance childcare with caring for elderly parents (sandwich generation). As a result of population ageing, the number of younger family members who could perform caregiving functions may decrease, which may further increase pressure on care institutions.

[28] Cohesion in Europe towards 2050, Eighth report on economic, social and territorial cohesion, 2022, as cited in: Sykała et al. 2023.
[29] Sykała et al. 2023.
[30] Ibid.

- In economic terms, particular attention will need to be paid to the issue of longer working lives (the growing number of working pensioners) and increasing pressure on labour productivity. We can therefore expect to see the development of a labour market for older people, migrants, robots and AI. Changes in work organisation, management, continuous improvement and professional development, flexible response to changes, labour market needs, etc. must also be taken into account. In addition, it will be necessary to develop the health and services market for older people. Another economic aspect will be the growing demand for senior-friendly infrastructure related to the care of people in need of support, as well as for new technologies in the field of health and care. In addition, the issue of staff shortages, and in particular the decline in the number of young people, may lead to a decline in economic growth and innovation potential. The effects of depopulation will also force us to consider changes in technological needs, modifications to the labour market and reduced demand for certain services and products.
- In environmental terms, one of the most important effects is the increasing anthropogenic pressure, primarily due to the continuing trend of growth in the production of goods and unsustainable consumption. This mainly concerns greenhouse gas emissions, the consumption of natural resources, increased air, water and soil pollution, and an increase in industrial and municipal waste. As a result, we will continue to see a worsening of global environmental problems, changes in terrestrial and aquatic ecosystems, and a decline in biodiversity.
- In spatial terms, the most important effects are the drain of human resources from peripheral areas (the influx of people to metropolitan areas and stagnating or depopulating non-metropolitan areas). In addition, another phenomenon that needs to be noted is the systematic depopulation of some cities (increasing demographic decline and progressive de-urbanisation of some urban regions, e.g. reduced demand for housing in city centres, which may result in their degradation and a growing number of vacant properties). This is followed by the costs of maintaining unused infrastructure and, at the same time, uncontrolled suburbanisation. In addition, the increase in the number of elderly people generates a greater demand for medical services, which will create pressure to increase medical staff, develop health infrastructure, including hospitals, long-term care centres and telemedicine systems, and consistently apply the principle of integrating health issues into all other policies (health in all policies). Demographic changes will also have an impact on the shape of the education network. Some schools in smaller towns may be closed due to a lack of pupils, which will require systemic solutions such as hybrid classes, changing the function of schools, transforming them into local education centres offering education not only for children but also for adults and senior citizens.
- In institutional terms, the most important effects include the need to adapt institutions (including tools for anticipating, monitoring and responding effectively to change) and public policies to the new conditions associated with changes in the population structure. This involves reforming the public finance system and changing the structure of expenditure in the sectors of education, healthcare and pensions. In addition, in the face of growing care needs, non-governmental organisations may play an increasingly important role in the provision of social services, including care for the elderly.

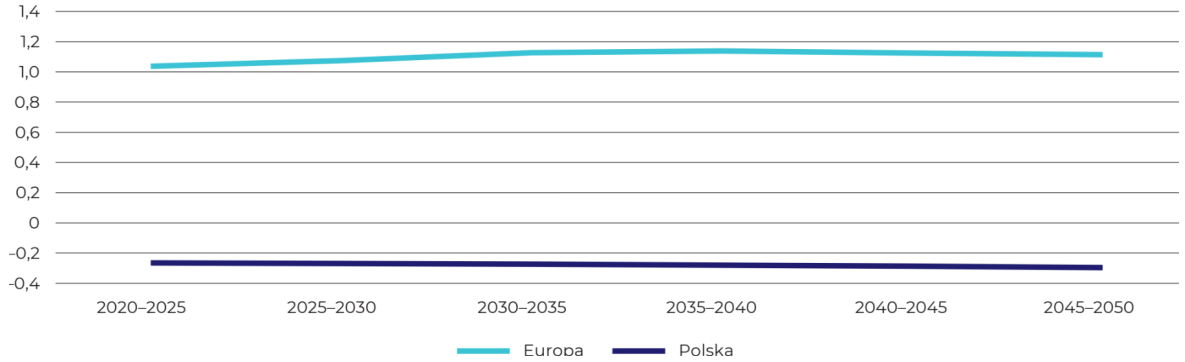
AN INCREASINGLY NOMADIC WORLD

By 2050, 4% of the world's population will live outside their country of origin[31]. On a global scale, due to progressive climate change and the resulting natural disasters, increased migration is predicted not only within regions, but also between them[32]. Half of the countries with the highest migration balance are located in Asia. This group also includes three European countries (Switzerland, Luxembourg and Cyprus). The group of countries with the lowest index values consists of a collection of countries and island states from various regions of the world. Poland ranks in the middle of the table (106th place). According to demographic forecasts, the level of net migration in the EU will remain stable and positive over the next 25 years[33].

Regarding Poland, according to UN data, forecasts for net migration per 1,000 inhabitants in 2020–2050 do not show significant fluctuations. But – based on current trends – it's estimated that net migration in Europe will be positive throughout the forecast period, while in Poland it will be negative[34].

[31] Nosarzewski et al. 2019, as cited in: Jurkiewicz, Dziemianowicz 2023c.
[32] Mao et al. 2019, as cited in: Jurkiewicz, Dziemianowicz 2023c.
[33] Yurkiewicz, Dziemianowicz 2023c.
[34] Sykała et al. 2023.

Figure 7: Projected net migration per 1,000 inhabitants in Poland and Europe in 2020–2050.



Source: own elaboration. based on UN Population Prospects data

Europa	Europe
Polska	Poland

Meanwhile, Russia's invasion of Ukraine has triggered a huge wave of war refugees to Poland, highlighting the need to prepare for other, slowly rising waves of migration (climate and economic).

Based on forecasts by Statistics Poland (GUS) and Eurostat, a significant proportion of Ukrainian citizens currently covered by temporary protection in connection with the war in Ukraine and who are also residents in Poland will return to their country, reflecting a negative migration balance. Their gradual return to their country is expected to take place mainly between 2024 and 2034. In addition, it is assumed that approximately 37.5% of citizens from that country will remain in Poland permanently. War refugees from Ukraine, but also political refugees from Belarus or the Russian Federation who will remain permanently in Poland, may have a positive impact on the demographic situation in the country.

Projected trend effects in Poland:

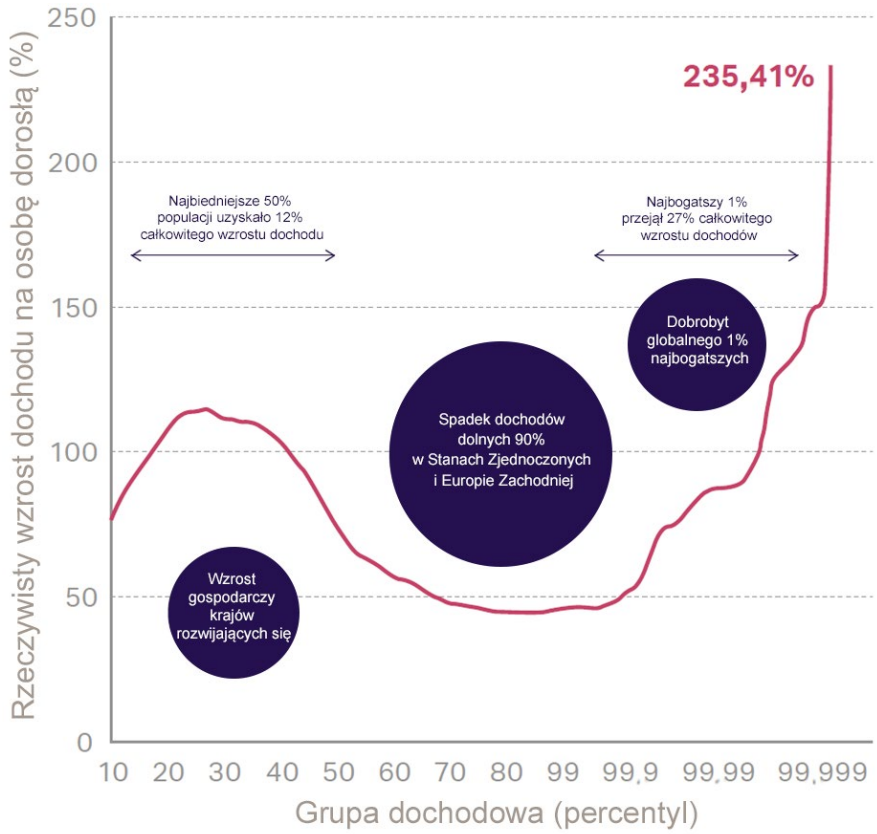
- In social terms, it is important to note the increase in social diversity and multiculturalism, as well as the need to prepare Polish society for these changes.
- In economic terms, particular attention will need to be paid to the issue of growing demand for specialists in professions that are in short supply on the labour market.
- In spatial terms, the most important effects are an increase in internal and external migration and the expansion of metropolitan areas.
- In institutional terms, the most important effects include the need to adapt institutions (including tools for anticipating, monitoring and responding effectively to changes) and public policies to the new conditions related to migration. Changes in the public finance system are important, including changes in the structure of expenditure in the sectors of education, healthcare and migrant integration. The development of international relations in the areas of migration, refugees, climate change and environmental degradation will also be an important aspect.

GROWING SOCIAL INEQUALITY

The primary measure of social inequality is the variation in residents' incomes. The largest income gaps between the top 10% earners and the bottom half of the population are seen in the Middle East and North Africa, Sub-Saharan Africa, Latin America, and South and South-East Asia. Europe continues to be the region with the lowest levels of disparity between these two income groups[35].

[35] Nosarzewski et al. 2022, as cited in: Jurkiewicz, Dziemianowicz 2023c.

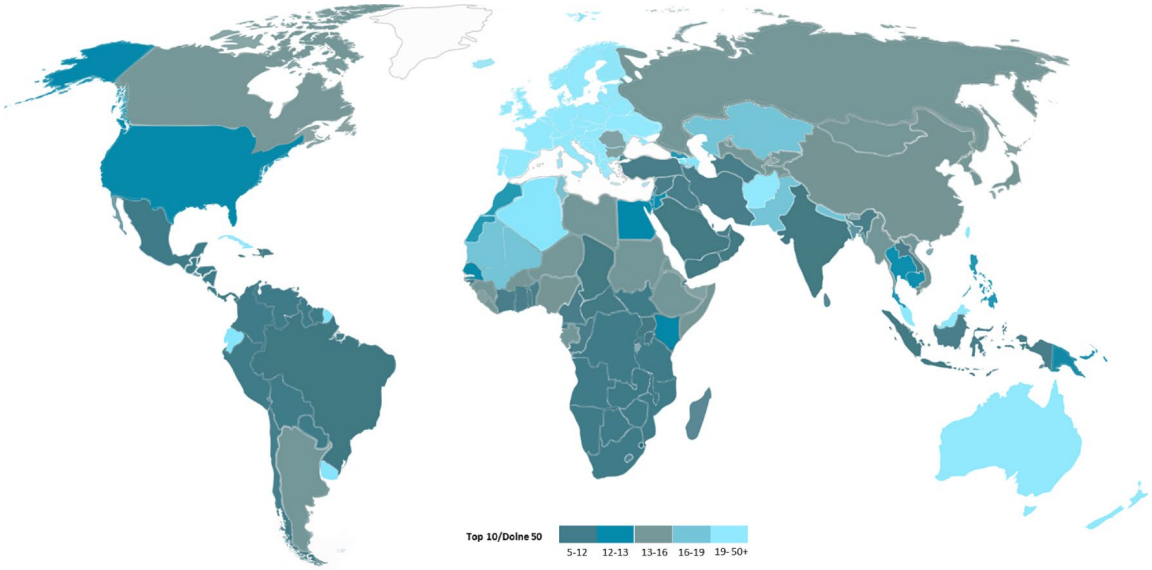
Figure 8: Growth in global inequality between 1980 and 2016



Source: Vision 2050: Time to Transform, 2020

Rzeczywisty wzrost dochodu na osobę dorosłą (%)	Real income growth per adult (%)
Najbiedniejsze 50% populacji uzyskało 12% całkowitego wzrostu dochodu	The poorest 50% of the population gained 12% of total income growth
Najbogatszy 1% przejął 27% całkowitego wzrostu dochodów	The richest 1% captured 27% of total income growth
Wzrost gospodarczy krajów rozwijających się	Economic growth in developing countries
Spadek dochodów dolnych 90% w Stanach Zjednoczonych i Europie Zachodniej	Decline in income for the bottom 90% in the United States and Western Europe
Dobrobyt globalnego 1% najbogatszych	Prosperity of the global top 1%
Grupa dochodowa (percentyl)	Income group (percentile)

Map 8: Income gap between the top 10% of earners and the bottom 50% of earners



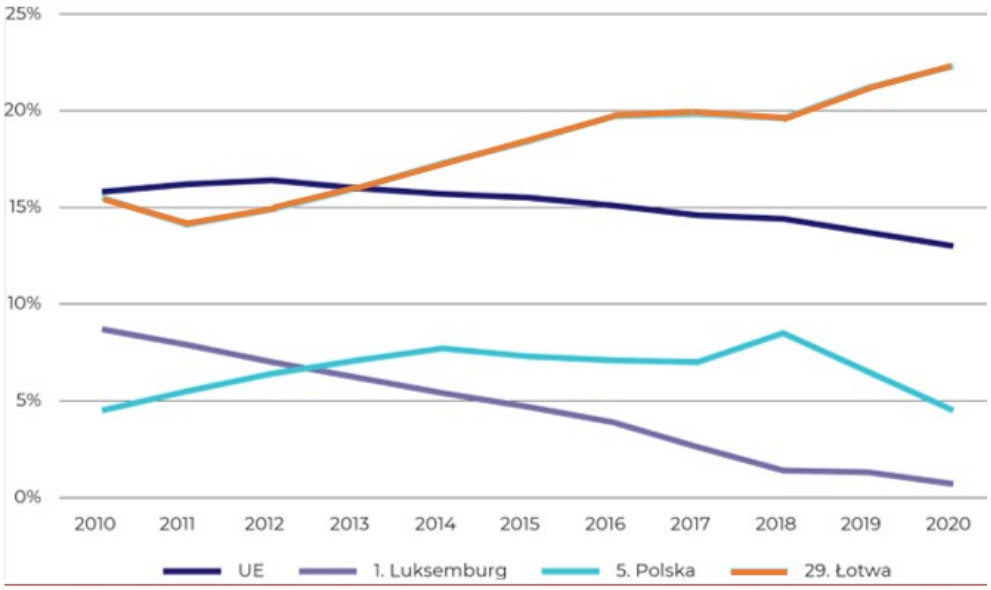
Source: Nosarzewski et al. 2022, as cited in: Jurkiewicz, Dziemianowicz 2023c.

In addition to differences in residents' incomes, two other issues contribute to the polarisation of society: gender parity and the importance of the middle class. Gender inequality manifests itself in many ways: discrimination, exclusion, income inequality, and others. The greatest progress towards gender equality has been achieved in Western Europe, North America, Latin America and the Caribbean, Eastern Europe and Central Asia[36]. It is estimated that, given current trends, it will take more than 130 years to achieve gender parity on a global scale. Forecasts show that the middle class, considered the foundation of properly functioning democracies and economic growth, will face many challenges and threats. Currently, the stability of this social group is no longer so certain[37].

When it comes to the national dimension of growing social inequality, the main cause is the increasing gap between the incomes of the highest and lowest earners. Based on the difference between the average salary and the median income, it can be concluded that in Poland, as both values increase, the gap continues to widen (in absolute terms). In 2022, among EU countries, the lowest income inequalities, as expressed by the Gini index, were in Slovakia, Slovenia and the Czech Republic, and the highest in Bulgaria, Lithuania and Latvia. Poland ranks 23rd on the list. In this context, it is also worth noting the issue of the pay gap[38]. In Poland, the wage gap is relatively low, but subject to significant fluctuations. It did not change significantly between 2010 and 2020. Starting at less than 5%, it increased by 4 pp. until 2018 and then fell below 5% again. In 2022, it was 7.8% again. This is still significantly better than the EU average. Nineteen of the 29 European countries included in the ranking had a double-digit indicator, with Estonia performing the worst, where the gender gap was over 21% in 2022. Luxembourg leads the ranking with a score close to zero, followed by Romania, Slovenia and Italy. Poland is in 5th place[39].

[36] Global Gender Gap Report 2021. Insight report, 2021, as cited in: Jurkiewicz, Dziemianowicz 2023c.
[37] Under Pressure: The Squeezed Middle Class. Overview and Main Findings, 2019, as cited in: Jurkiewicz, Dziemianowicz 2023c.
[38] The wage gap is an indicator of the difference between the hourly wages of men and women as a percentage of men's wages.
[39] Sykała et al. 2023.

Figure 9: Wage gap in Europe



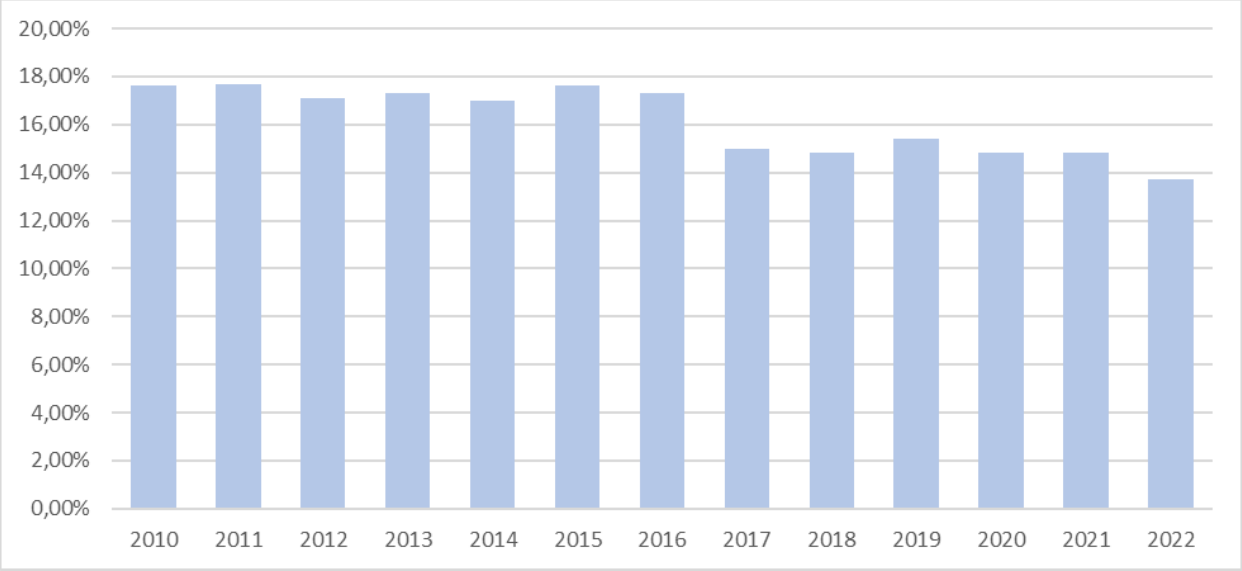
Source: own elaboration based on Eurostat data

In addition, there is a large number of people in short-term employment or without social security. Another factor contributing to inequality is the increase in household expenditure relative to income. On the other hand, there is a deterioration in the living conditions of the poorest and most disadvantaged groups and unequal access to good quality education services. One more important factor exacerbating inequality is the already visible automation and robotisation of production processes[40].

The poverty rate after social transfers, i.e. the share of people in households whose income (including social transfers) is less than 60% of the national median equivalent disposable income, was 13.7% in Poland in 2022. This means that it has fallen by almost 4 percentage points since 2010. At the same time, social benefits are increasing. The situation changed significantly between 2012 and 2020. On the one hand, the number of people receiving social assistance benefits fell by over 40% (approx. 800,000). However, during the same period, the total amount spent on family benefits increased significantly, rising by almost 40%. The number of pensioners also increased by almost 300,000 (3%) compared to 2012. Thus, policies to support the elderly and families are becoming more important than social support for people in disadvantaged situations[41].

[40] Conclusions from own elaborations based on data from Statistics Poland (GUS) and Eurostat.
[41] Sykała et al. 2023.

Figure 10: Poverty rate after social transfers in Poland.



Source: own elaboration based on data from the National Reporting Platform (SDG Platform).

Projected trend effects in Poland:

- In social terms, the following should be noted above all: growing inequalities in access to work, housing, consumer goods, resources (energy, water), educational services, health services and, as a result, an increased risk of poverty: income, energy and housing. Another consequence is the risk of marginalisation of people from disadvantaged groups, including in particular people with disabilities and their families, as well as senior citizens. One more important aspect is the risk of deterioration in physical and mental health (an increase in the number of people with addiction problems, an increase in the incidence of lifestyle diseases). Further consequences may include an increase in hate speech in society, growing social discontent and the risk of radicalisation, rising risk of social protests, and reduced support for democracy.
- In economic terms, due to weakened social cohesion and the risk of increased and poorly designed redistribution, the potential consequences include an increased risk of economic destabilisation/slowing economic growth. In the longer perspective, economic uncertainty is likely to increase, along with limited access to credit and business opportunities for disadvantaged sections of the population. Another important aspect is the decline in aggregate demand and the development of social economy entities.
- In environmental terms, it is important to note the increase in anthropogenic pressure resulting from social inequalities, i.e. the potential deterioration of the environment due to the increased risk of illegal waste disposal (e.g., dumping waste in forests) and the increased risk of illegal waste incineration, the increased risk of illegal tree felling for firewood, the continued use of so-called smoke-belching stoves and growing energy poverty.
- In spatial terms, it is necessary to point out the increase in territorial inequalities, e.g. inequalities in access to new jobs due to their concentration in the most economically developed areas with high-quality human capital. As a result, an increase in internal and external migration movements can be expected, as well as an increase in areas subject to peripheralisation and, as a further consequence, an increase in income disparities between local government units (LGUs). A parallel phenomenon may be the increase in areas of poverty and developmental backwardness, reinforced by transport exclusion, with the simultaneous creation of enclaves of wealth.
- In institutional terms, the first consequences will be an increasing need to adapt the tax, social benefits and education (including adult learning) systems. The second step will be attempts to find modern and effective solutions within the framework of housing policies targeted at people in need of support. Another important aspect will be the increased demand for healthcare for children and young people, including psychological and psychiatric care.
- Furthermore, in the absence of an adequate response from public policies, a decline in trust in institutions and the world of politics as well as in citizen-citizen, entrepreneur-entrepreneur and citizen-entrepreneur-state relations should be expected, accompanied by an increase in expectations for greater activity on the part of non-governmental organisations.

DEVELOPING DEMAND FOR NEW FORMS AND FIELDS OF LEARNING

When analysing the megatrend of growing global social problems, particular attention should be paid to the issue of education in the broad sense, including non-formal and informal adult learning. Basic indicators of educational attainment[42] have improved significantly over the last 20 years in the EU and OECD. In the EU, the percentage of adults with low educational attainment has been reduced by more than half, and in Poland by more than three times, clearly exceeding the EU average, even though the country started from a very low level. Currently, Poland is one of the EU leaders in this area[43]. This progress is more evident among younger people[44]. Such a significant improvement in education is not accompanied by comparable progress in the actual skills of adults (according to the OECD/PIAAC survey), especially new key skills, which include digital skills (according to the European Information Society Survey). The latter results indicate that more than half of adults in Poland do not have at least basic digital skills, which puts the country almost at the bottom of the EU countries[45].

In 2021, more than one-third (363) of the world's top 1,000 universities were located in European countries, with 184 ranked in the top 500 and 36 in the top 100. Compared to 2010, there has been a noticeable decline in the number of universities in the Top 500 ranking and a slight increase in the Top 100 group. The countries with the highest number of universities in the ranking are the United States and China (200 and 180 respectively in 2021). In the US, as in Europe, there has been an overall decline in the number of universities in the Top 500 ranking compared to 2010, while in China there has been a significant increase (84th place in the 2021 Top 500 ranking, previously 34th in the 2010 ranking)[46].

It is important to note that success at school or university is no longer as important and is not seen as the only factor determining how well pupils and students are prepared for the future and the changing job market. Attention is drawn to the need for changes in the way knowledge is delivered, including in education programmes, which will allow key competences to be developed from an early age. Numerous studies have attempted to identify the processes and trends that are important for adequately preparing children and young people for the dynamically changing conditions of the surrounding world (especially the digital one).

Progress in education will be strongly linked to the implementation of technology and biotechnology, and the 2050 outlook suggests that forms and effects of learning will be strongly linked to Artificial Intelligence. In social terms, the trends described above may result in fierce competition between societies, whose advantages will depend on their level of development and digital advancement. In addition, it will be important to be able to function skilfully in the virtual world, to which a significant part of the economy will also move[47].

There are many accumulated problems in the education and higher education system in Poland. For example, public debate emphasises that formal education is not adapted to the needs of pupils or students and to technological progress, curricula are focused on accumulating encyclopaedic knowledge rather than developing the ability to

[42] In the education policy promoted by the OECD and the EU, two issues relating to education are priorities: (1) reducing low educational attainment (at most primary/lower secondary) among adults aged 25-64; (2) promoting higher education among adults up to the age of 35 (although better results in this area depend mainly on the promotion of shorter forms of higher education – bachelor's degrees and so-called short cycles). This approach is particularly evident in the EU's education development objectives agreed within the framework of European cooperation in the field of education and training.

[43] In the EU, this percentage decreased from 34.1% (2002) to 20.2% (2023), and in Poland from 19.1% to 5.7% (Eurostat, online access code: edat_lfse_03).

[44] The percentage of adults aged 25-64 with higher education increased in the EU from 18.8% to 35.1%, and in Poland from 12.5% to 37.9%. A greater increase in this respect can be seen among younger adults (aged 30-34) – in the EU from 22.5% to 43.9%, and in Poland from 14.4% to 49.2%.

[45] In 2023, 55.7% of people aged 16-74 did not have such skills (44.7% in the EU), with the largest gap between people in Poland and their peers in the EU in this regard being seen among adults aged 45-74 (Eurostat, online access code: isoc_sk_dskl_i21]. The lack of full comparability of data on education for the period presented is due to numerous methodological changes and changes in the basis for generalising the results of surveys conducted during this period.

[46] Jurkiewicz, Dziemianowicz 2023c based on data from The Academic Ranking of World Universities.

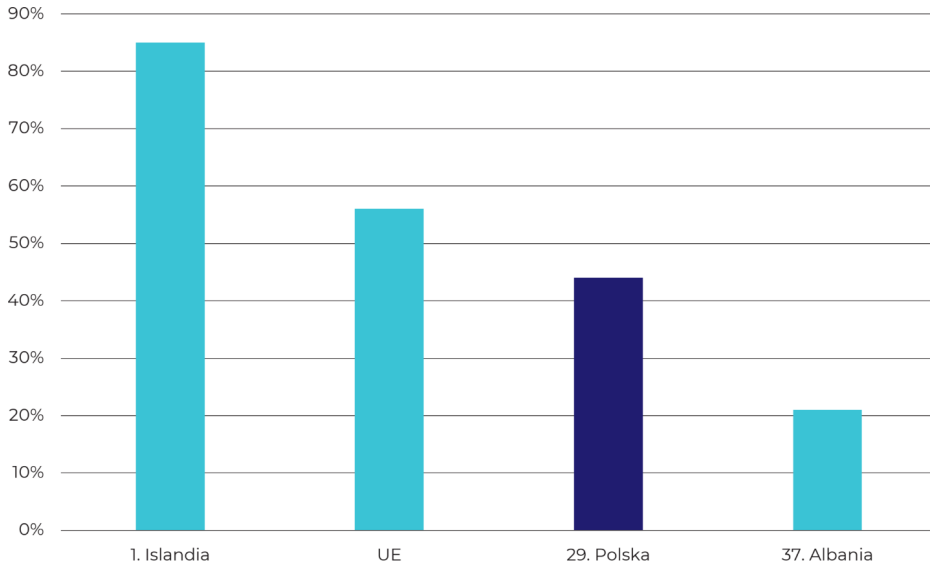
[47] Furthermore, the Analysis of the demand for competences in the economy and on the labour market (https://archiwum.ncbr.gov.pl/fileadmin/Ewaluacja/POWER/RK_Analiza_kompetencji_final.pdf) indicates that: 'In the future, the labour market and employers' competence needs will be increasingly influenced by three megatrends, namely: (1) globalisation, (2) technological progress, (3) demographic changes. In this context, the following competence groups are expected to become more important for most specialist positions: (1) transferable to other professional roles, e.g. digital, transdisciplinary, (2) learning, (3) human-machine/computer collaboration skills, (4) competencies complementary to machine capabilities, e.g. interpersonal, intercultural, social intelligence, cognitive, enabling the handling of non-codifiable tasks (complex problem solving, critical thinking, deductive thinking, cognitive load management), creativity (generating and understanding new ideas and concepts), unconventional and adaptive thinking, written expression skills, (5) technology skills (in professions not traditionally associated with this area), (6) data utilisation (in design, decision-making), (7) high-level specialist competences in middle and high-level professions, (8) highly specialised competences at the intersection of several fields (interdisciplinary).

search for it independently and think critically, the system for improving teachers' professional qualifications is weak, salaries are low, and the teacher remuneration system is inadequate[48].

Aspects such as the regionally differentiated decline in fertility, which exacerbates inequalities in access to high-quality education, and the growing demand for new skills, or in other words, the growing demand for so-called multidisciplinary people with hard (technological) and soft (social and emotional) skills, and the lack of coordinated systemic changes regarding cooperation between government, businesses and educational institutions, should also be added to this.

Education will increasingly benefit from technological progress. This will also apply to adult learning. Currently, the most popular measure of a society's adaptation to digital transformation is the prevalence of digital skills among its citizens. In Europe, the Netherlands has the highest score on this indicator, with 83% of citizens having basic or advanced digital skills. Western and northern countries are in a better position, while countries in the south of the continent are at the opposite end of the spectrum. In Poland, digital skills are not widely spread among the population. They are possessed by 44% of citizens, which is 12 percentage points less than the European Union average[49].

Figure 11: People with at least basic digital skills in 2023.



Source: own elaboration based on Eurostat data

Shortcomings in the education system's response to changing conditions and the skills required on the labour market may result in an increase in skills gaps, i.e. a growing shortage of essential skills. Skills gaps may vary depending on the age and stage of education of individuals. The results of a survey[50] conducted among students, pupils, lecturers and teachers show a varied picture of this phenomenon. The competence gap analysis – as the difference between the predicted importance of a given competence in the future and its current assessment – showed that both university and secondary school students indicate coping with stress and working under time pressure as the greatest challenges. In second place, they indicate specialist or professional knowledge. The following were also highly rated: organising own work, solving complex problems, and resilience to crisis and change. This means that people with the most recent educational experience feel that they lack functional and cognitive competences. For teachers and lecturers, the competence gaps were much greater and mainly included solving complex problems, critical and logical thinking. The particularly low scores of teachers indicate that this is a group that is aware of the mismatch between their skills and changing needs, and at the same time bears the greatest responsibility for shaping children from an early age.

[48] Recognised international studies of the competences of pupils and young adults (PISA, PIAAC and IEA - International Association for the Evaluation of Educational Achievement) indicate that their learning outcomes do not differ from the OECD and EU average, and in some areas clearly exceed it. As one example, see the results of the International Civic and Citizenship Education Study (IEA/ICCS 2022) at https://www.ibe.edu.pl/pl/wydarzenia/2251-iccs-2022-results-of-the-latest-edition-of-the-international-civic-competence-study-announced-2.

[49] Sykała et al. 2023, based on Eurostat data.

[50] Sykała et al. 2023.

Projected trend effects in Poland:

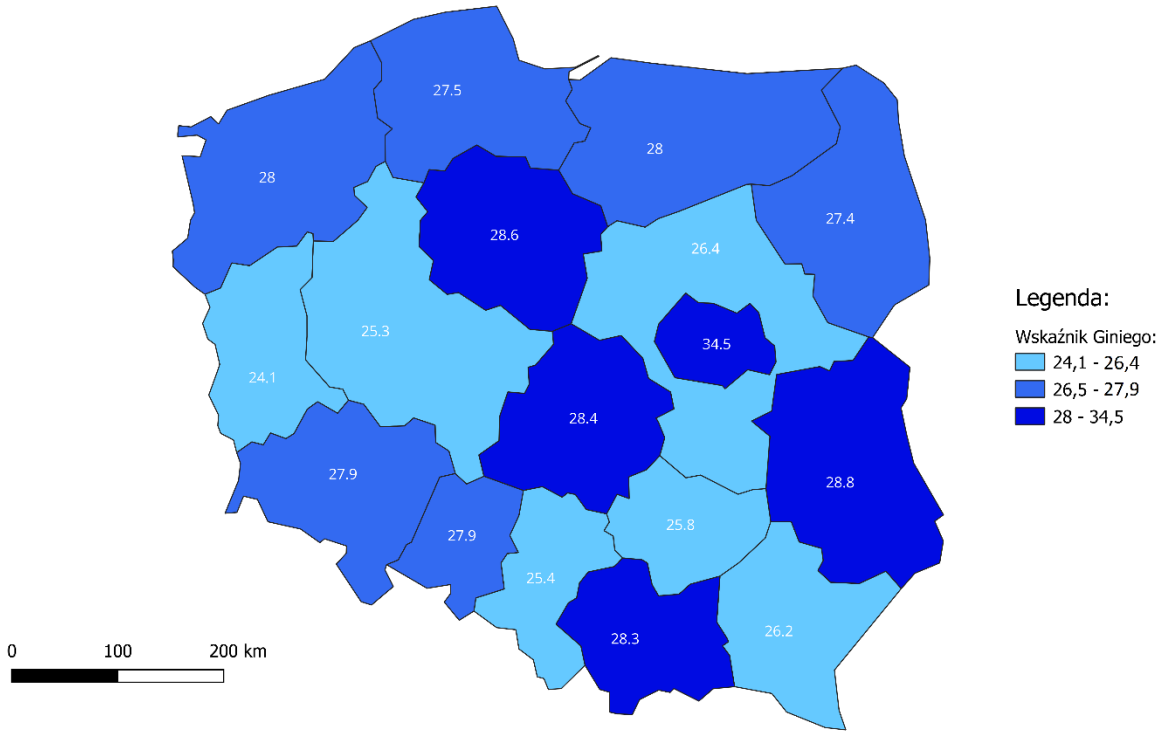
- In social terms, it is important to point out the limited public confidence in primary and secondary education and, as a consequence, social polarisation in the sphere of education, i.e. the outflow of some children and teachers from public to private education and an increase in demand for extracurricular, paid forms of acquiring knowledge and skills. As a result, we can expect education to play a minor role in the future, a greater number of pupils with skills that are not suited to the current and projected labour market, and a low level of preparation of pupils and students for careers in the world of new technologies and new professions. In addition, it must be said that, apart from the mismatch between the education of young people and the changing labour market (which often results in the NEET[51] phenomenon), the deteriorating situation of people aged 50+ should also be considered. In the longer term, there may be a weakening link between income and education. In addition, the social status of teachers is expected to continue to decline, with teachers retraining for other professions and a shortage of staff (particularly in certain fields).
- In economic terms, the consequences can be summarised primarily as a shortage of personnel for the economy of the future and a decline in the competitiveness of the economy due to the low quality of human and social capital. In addition, market entities can be expected to take over educational functions, the unit costs of employee training will increase, and the business demand for R&D&I activities will not be met. At the same time, we may see the development of new professions that are ahead of the education system and the development of technologies that replace humans, including in education.
- In environmental terms, the consequence will be a lack of development of environmental awareness and an increase in environmental costs due to spatially uneven access to good quality education.
- Among the consequences in spatial terms, we can expect territorially differentiated accessibility and quality of educational services. A particular problem may be the reduced availability of high-quality education in peripheral and problem areas. This may lead to depopulation of areas with low availability of educational services and, at the same time, a concentration of high-quality staff in metropolitan areas. In addition, investment in ICT infrastructure for education and training is likely to be concentrated mainly in metropolitan centres and cities. Another consequence may be an increase in transport from places of residence to educational institutions in metropolitan areas.
- In institutional terms, the consequences of underestimating the importance of education as the foundation for the country's development include growing social expectations and the need to adapt the primary, secondary, higher education and adult learning systems to the needs of the rapidly changing labour market, the world of new technologies and new (as yet unknown) professions. This will require radical organisational and legal changes throughout the education system. At the same time, it will be important to avoid the trap of a never-ending process of reform and a steady increase in dissatisfaction among teachers and parents, as well as increased tensions in relations between entities from the education system.

Regional variations in megatrends:

Social issues are characterised by a high degree of complexity and multidimensional interconnections. Therefore, three indicators have been selected to illustrate them – one relating to income inequality and two relating to education and training.

[51] The acronym NEET, which stands for Not in Education, Employment, or Training, is used to describe people who are currently not in education, employment or training and are not participating in any training or vocational programme.

Map 9: Income inequality in Poland in 2019.

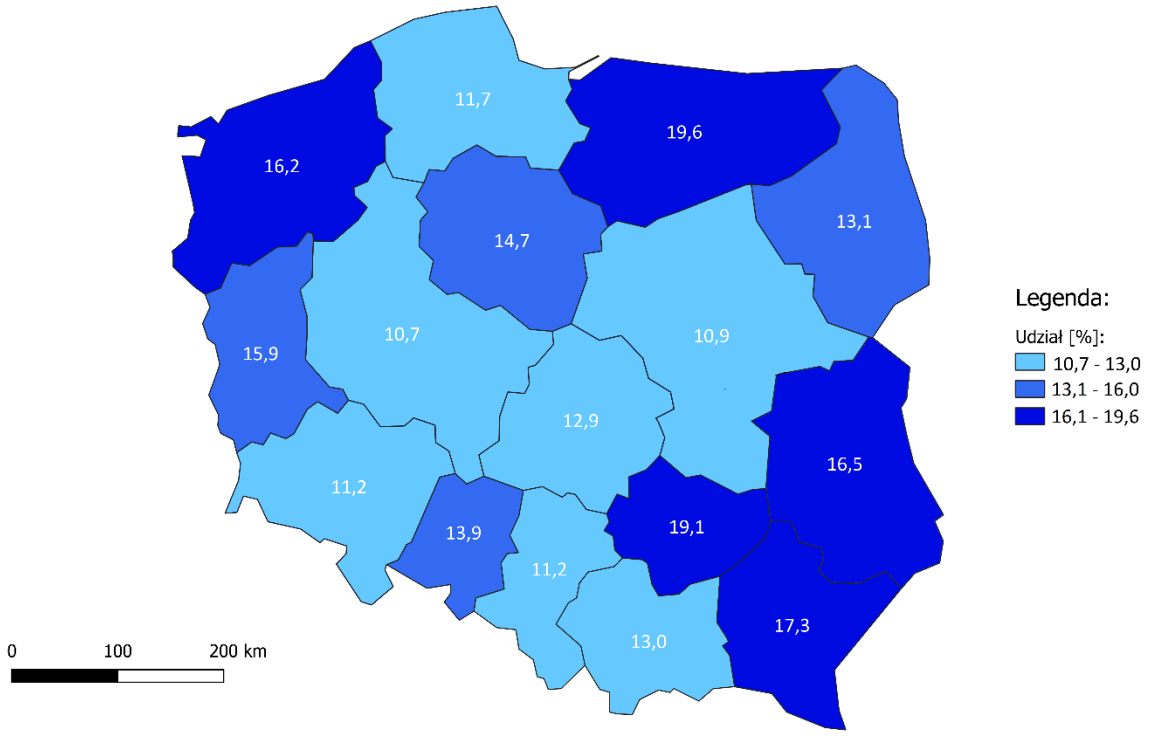


Source: own elaboration based on Eurostat data

Legenda	Key
Wskaźnik Giniego	Gini index

In terms of income inequality, Poland is a relatively homogeneous country. The classic indicator used to observe and present this phenomenon is the Gini index. It takes values from 0 to 1 (however, as in this case, it is often presented as a percentage, i.e. in the range from 1 to 100), where the higher the value, the greater the level of income inequality. In 2019, its value in Polish regions ranged from 24.1 to 34.5, with only one region (the Warsaw capital region) exceeding 30. The average value of this index for the European Union in 2019 was 30.2.

Map 10: Percentage of young people not in employment, education or training in Poland in 2019.



Source: own elaboration based on Eurostat data

Legenda	Key
Udział [%]	Share (%)

The situation is more varied for the NEET indicator. This indicator shows the percentage of young people (aged 15–29) who are not in employment, education or training. The worst situation in this respect is observed in two regions of northern Poland (part of the former Recovered Territories) – warmińsko-mazurskie (Warmia-Masuria) and zachodnipomorskie (West Pomerania), as well as two voivodships of south-eastern Poland (both part of the Eastern Poland macroregion) – Świętokrzyskie (Holy Cross) and Podkarpackie (Lower Carpathia). The most favourable situation in this respect is noted in regions where large urban centres are located: Małopolskie (Lesser Poland), Śląskie (Silesia), Wielkopolskie (Greater Poland) and Mazowieckie (Masovia).

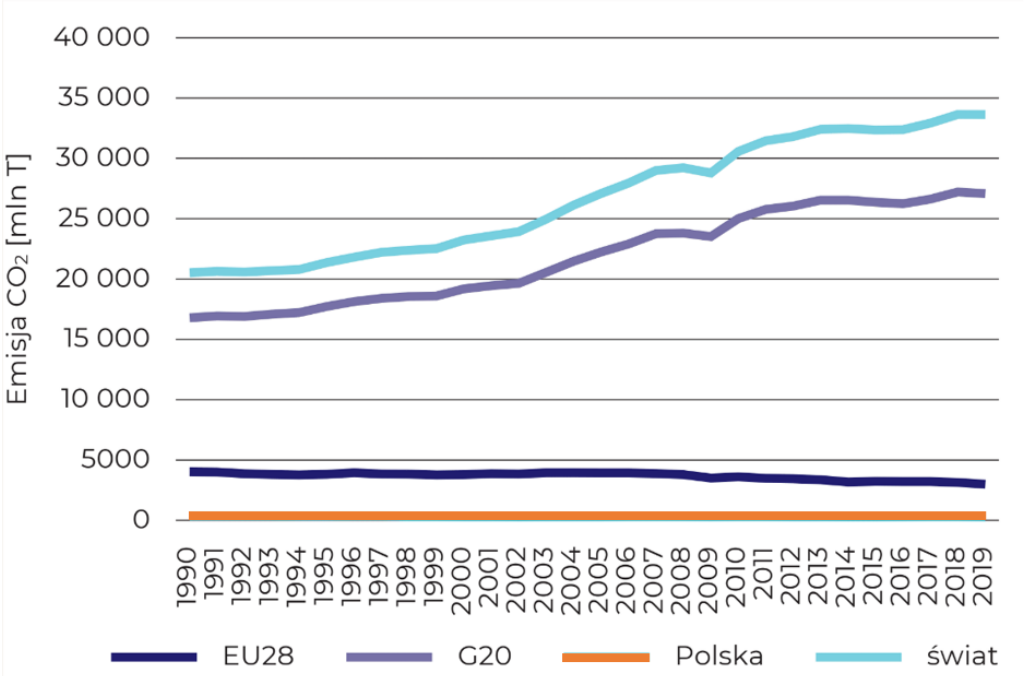
A similar indicator, but for an older age group (25-64 years), is the percentage of adults participating in education and training. In this case, the situation is fairly uniform across the country, except for the high percentage of adults participating in education in regions where large urban centres are located (as in the case of the NEET indicator described above): pomorskie (Pomerania), the Warsaw metropolitan area, małopolskie (Lesser Poland) and dolnośląskie (Lower Silesia). In addition to these, the kujawsko-pomorskie (Kuyavia-Pomerania) and lubelskie (Lublin) voivodships also stand out with high values for this indicator.

MEGATREND: INCREASING PACE OF ENVIRONMENTAL AND CLIMATE CHANGE

This megatrend characterises changes in the environment that have the most serious consequences for humans, relating to climate change, environmental degradation, the use of natural resources and the decline in biodiversity. Observed anthropogenic climate change is intensifying, and research indicates that the effects of it will continue to increase, even if all greenhouse gas emissions from human activity are reduced[52]. Each of the last four decades has been warmer than the previous one. In the last one, the average temperature on Earth was 1.09°C higher than that observed in the pre-industrial period (1850-1900)[53]. The rise in temperature is leading to the melting of glaciers and permafrost and a rise in sea levels – between 1901 and 2018, the observed increase was 20 cm, and the rate of this increase is accelerating (in 2006 – 1.3 mm/year, later in subsequent years – 3.7 mm/year)[54]. The main cause of climate change is the global increase in greenhouse gas (GHG) emissions into the atmosphere. Emissions are increasing on all continents, but primarily in the G20 countries, which account for approximately 82% of emissions. GHG emissions in Europe and Poland per capita are higher than the G20 average[55].

The concentration of greenhouse gases in the atmosphere is steadily increasing – since 1750, it means the beginning of the industrial era, the concentration of carbon dioxide in the air has increased by 47%, methane by 156% and nitrous oxide by 23%[56]. This growth is primarily caused by the burning of fossil fuels in various sectors, deforestation, intensive agriculture and the drainage of peatlands. Drainage of peatlands, which cover about 3% of the Earth's surface and accumulate globally up to twice as much carbon as forests (which cover 30% of the Earth's surface), accounts for about 4% of global CO2 emissions[57].

Figure 12: Changes in carbon dioxide emissions between 1990 and 2019.



Source: own elaboration based on Eurostat data.

EU28	EU28
G20	G20
Polska	Poland
świat	World

[52] IPCC 2018, IPCC 2021.
[53] IPCC 2021.
[54] IPCC 2021.
[55] OECD data.
[56] IPCC 2021.
[57] Convention on Wetlands 2021.

Air pollutant emissions and concentrations have increased in many areas around the world. In Europe, there is a general downward trend in emissions of fine particulate matter (PM2.5), but despite the measures taken, the persistently poor air quality in many regions continues to have measurable negative effects on human health.

Global demographic growth is leading to increased demand for food, and thus to intensive use of land, soil and water, contributing to their degradation, the loss of valuable landscapes and a decline in biodiversity[58]. As a result of efforts to increase soil productivity, the use of artificial fertilisers is steadily increasing worldwide, contributing to soil pollution and water eutrophication. Intensive land use has a negative impact on biodiversity, which is responsible, for example, for the circulation of carbon, water and nutrients in terrestrial ecosystems. Soil loss and the loss of its natural functions also occur as a result of urbanisation. The transformation of soil cover contributes to the intensification of climate change – the degradation of peat soils, including the drainage of peatlands, increases greenhouse gas emissions and contributes to a reduction in their absorption capacity.

Surface and underground waters are polluted by inadequately treated sewage, especially in underdeveloped regions where industry is also developed. Globally, approximately 80% of industrial and municipal sewage is not treated[59]. Only about 70% of the global population has access to drinking water of adequate quality. Human activity has also led to the degradation of a significant proportion of wetlands and river floodplains.

Over the past 50 years, global raw material mining has tripled, with growth accelerating since 2000[60]. In the EU, raw material extraction declined between 2000 and 2020, but the physical trade balance for primary raw materials indicates that the EU economy is highly dependent on primary raw materials sourced from other countries, in particular critical raw materials that are essential for the development of innovative technologies, including low-carbon technologies. A similar trend is observed for other high-income countries

The amount of waste generated worldwide, including municipal waste, is constantly growing – only a few countries have managed to decouple waste generation from economic growth. Forecasts predict a further increase in the amount of municipal waste generated by 2050. The way waste is managed affects the environment, human health and well-being. On a global scale, waste generation and waste management processes contribute to climate change (mainly through greenhouse gas emissions resulting from inadequate waste collection and uncontrolled waste disposal and incineration)[61] and are one of the largest sources of ocean pollution. At the same time, the negative effects of improper waste management are felt disproportionately by the world's poorest inhabitants. The fastest growing waste stream is waste electrical and electronic equipment, most of which ends up in mixed waste and, in middle- and low-income countries, is illegally landfilled or recovered. The management of plastic waste and its littering of the marine environment is also a particular problem.

Biodiversity forms the basis of ecosystem services, which are essential for human well-being. Global research indicates alarming downward trends in biodiversity at all levels (ecosystem, species and genetic) in all regions of the world. The downward trend, also observed in ecosystem services for humans, is expected to continue until 2050 and beyond, primarily as a result of the negative impacts of direct factors such as changes in land, sea and ocean use, overexploitation of natural resources, climate change, soil, water and air pollution, and the invasion of alien species.

Trends contributing to the megatrend:

- Progressive transformation of the Earth's climate system;
- Increasing degradation of the natural environment – atmospheric air, water, land surface and soil;
- Decline in biodiversity;
- Unsustainable use of raw materials and waste management.

[58] IPCC 2019.

[59] *Valuing water: Facts and figures*... 2021.

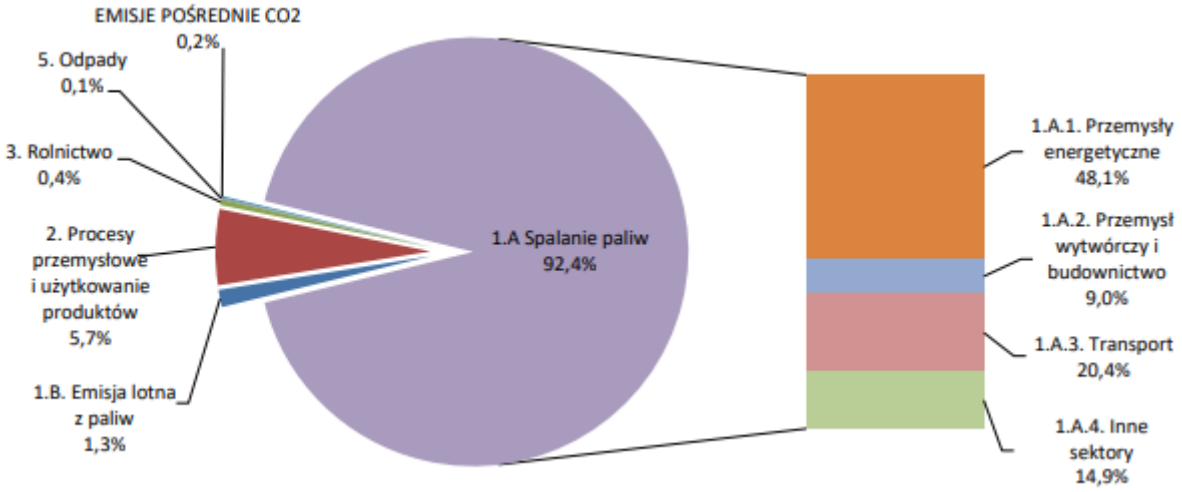
[60] Oberle et al. 2019.

[61] World Bank: Kaza, Silpa; Yao, Lisa C.; Bhada-Tata, Perinaz; Van Woerden, Frank. 2018. What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050. Urban Development. © Washington, DC: World Bank. http://hdl.handle.net/10986/30317 Licence: CC BY 3.0 IGO.

PROGRESSIVE TRANSFORMATION OF THE EARTH'S CLIMATE SYSTEM

Between 1990 and 2019, Poland emitted 7.7% of greenhouse gases among 32 European countries. The reduction in GHG emissions in Poland between 1990 and 2020 was 21% and was at the EU average, but the potential for reduction remains much greater. Although there is a noticeable downward trend in the share of CO_2 emissions (one of the main greenhouse gases) in global emissions in Europe, including Poland, per capita emissions are higher than the global average. According to the National Inventory Report 2023 Inventory of greenhouse gas emissions and removals in Poland for 1988-2021, the main source of CO2 emissions in 2020 was fuel combustion, accounting for 92.4% of total emissions. Within this category, the energy industry accounted for 48.1%, manufacturing and construction for 9.0%, and transport for 20.4%. Industrial processes and product use accounted for 5.7% of total CO2 emissions in 2021 (Figure 13). The highest increase in emissions in recent years was in the transport sector – by 80% between 1990 and 2019.

Figure 13: Carbon dioxide emissions[62] in Poland in 2021 by source category.



Source: National Inventory Report 2023 Inventory of greenhouse gas emissions and removals in Poland for 1988-2021, Ministry of Climate and Environment.

EMISJE POŚREDNIE CO2	INDIRECT CO2 EMISSIONS
Odpady	Waste
Rolnictwo	Agriculture
Procesy przemysłowe i użytkowanie produktów	Industrial processes and product use
Emisja lotna z paliw	Fugitive emissions from fuels
Spalanie paliw	Combustion of fuels
Przemysły energetyczne	Energy industry
Przemysł wytwórczy i budownictwo	Manufacturing and construction
Transport	Transport
Inne sektory	Other sectors

The increase in GHG concentrations in the atmosphere intensifies the greenhouse effect. Many indicators included in climate simulations show significant changes in the climate system and their effects on regional and local climates. Since 1951, the average annual air temperature in Poland has increased by 0.29°C/10 years. In urban areas, the rate of temperature increase is significantly higher due to changes in land use[63]. There is also a change in the structure of precipitation. It is less frequent, but sometimes more intense.

Global warming contributes to changes in the frequency and intensity of extreme weather events in Poland. Sometimes these phenomena, although not extreme in a statistical sense, lead to extreme consequences for life,

[62] not including the balance of net emissions and carbon sequestration.

[63] IMGW-PIB 2021.

health, the environment and infrastructure. Losses caused by extreme phenomena in Poland over the last two decades amounted to approximately PLN 115 billion in constant prices (an average of approximately PLN 6 billion per year)[64]. In Poland, the most common causes of climate change-related losses are water surpluses or deficits, which have a measurable impact on agriculture. Extreme events can also cause death. Violent thermal conditions (heat waves and cold spells) pose a particular threat to human health[65].

Climate change has a negative impact on natural resources used for economic purposes. In this respect, agricultural and tourist regions are particularly vulnerable to climate change[66]. Wielkopolska (Greater Poland), Ziemia Lubuska (Lubusz Region), Mazowsze (Mazovia) and Lubelszczyzna (Lublin Region) are threatened by the effects of drought on agriculture. Areas sensitive to climate change include the Baltic coast, due to sea level rise (according to various forecasts, from 0.6 to 1.1 m in the 21st century) and changes in wave patterns. Regions that benefit from tourism thanks to their natural resources, but which are also threatened by the effects of climate change, include mountain areas (winter tourism in the Beskids and Sudetes), the coast and lake districts (water tourism) and municipalities with areas of natural value (sightseeing tourism in protected areas).

Observed and projected effects of climate change, and thus their costs, with an increase in GHG emissions intensifying the greenhouse effect, may significantly reduce the positive aspects of economic change.

Projected trend effects in Poland:

- The effects of climate change will be seen in Poland in all areas. The strongest impact is expected in the social sphere. The threat to human health and safety will increase as a result of extreme weather events, including heat waves, which will be particularly noticeable in urban areas. At the same time, the severe social and economic effects of climate change will raise public environmental awareness and force gradual changes in lifestyle.
- In economic terms, extreme events (droughts, torrential rains, late frosts, snowless winters, strong winds) will cause a decline in food security. There will be a progressive loss of economically exploited natural resources and fluctuations in agricultural product prices. The economic consequences of this trend will be, on the one hand, infrastructure losses as a result of extreme weather events and, on the other hand, increased expenditure on adaptation to climate change. The need to mitigate climate change and adapt to its effects will entail an increase in the share of alternative fuels in the national energy mix (climate change may also affect energy production, especially for weather- and water-dependent sources), innovation and new research into the consequences of climate change, which will also result in a gradual improvement in air quality (see trend *Increasing degradation of the natural environment – atmospheric air, water, land surface and soil*).
- In spatial terms, the increase in the frequency and duration of hydrological droughts will cause a further decline in soil fertility and the drying up of wetlands; at the same time, torrential rainfall will cause localised flooding with some areas periodically unusable due to it. In the long term, the rise in the level of the Baltic Sea will accelerate coastal erosion and may also threaten the displacement of certain coastal areas, including urban ones.
- In environmental terms, a further decline in biodiversity (see trend Decline in biodiversity) and loss of ecosystem services are expected, as well as changes in the range of species. Pressure on ecosystems will increase due to suburbanisation, and the consequences of the urban heat island effect will grow in agglomerations. Greater use of spatial planning solutions allowing for better adaptation to climate change is expected.
- In institutional terms, the processes described will require deeper cooperation both at the international level and between local governments and sectors, as well as the formation of coalitions to solve specific problems.

INCREASING DEGRADATION OF THE NATURAL ENVIRONMENT – ATMOSPHERIC AIR, WATER, LAND SURFACE AND SOIL

The main sources of atmospheric pollution are emissions from the combustion of fossil fuels and biomass for heating purposes. According to data from the National Environmental Pollution Reduction Programme, in 2021, the energy sector was responsible for 94% of fine particulate matter (PM2.5) emissions in Poland, industrial processes for 3.1%,

[64] Siwiec E. (ed). 2022.
[65] Hajto et al. 2023b based on EM-DAT data.
[66] Institute of Environmental Protection – National Research Institute (IEP-NRI) 2013.

agriculture for 1.1% and waste for 1.6%. These emissions cause nearly 40,000 premature deaths annually[67]. The health risks associated with fine particulate matter in Poland are unevenly distributed, with higher risks occurring in densely populated and industrial areas and in small towns where near-ground emissions predominate.

Land use and observed changes in land management puts significant pressure on soils. Many soils are losing their productivity due to the intensification of agriculture for food production (in Poland, there has been an increase in the number of large-scale farms), as well as due to the conversion of agricultural land for development and infrastructure (the need for settlement – suburbanisation, expansion of transport networks, tourist infrastructure, industrial activity). These activities result in soil pollution, as well as increased soil sealing, compaction, erosion, salinisation, acidification and carbon loss.

Poland is one of the countries with the lowest water resources in Europe. Over the last 20 years, the amount of water used has decreased by approximately 20%. Slightly over 70% of the water consumed is used by industry, 10% by agriculture (including for the irrigation of agricultural and forest land and for filling and replenishing ponds), and less than 20% is used for domestic and economic purposes[68]. Wastewater is being treated more and more effectively – the pollutant load in wastewater after treatment is gradually decreasing. However, the use of nitrogen, phosphorus and potassium fertilisers per hectare of agricultural land is increasing[69]. Their excessive use causes eutrophication of surface waters.

Projected trend effects in Poland:

- In social terms, the expected effect of the trend will be increased migration flows to Europe as a result of increased threats to human health, growing social inequalities and social tensions related to access to good-quality natural resources (including water and soil).
- In economic terms, there will be more difficult conditions for doing business and changes in food production and supply chains. Environmental degradation may also lead to increased healthcare costs.
- In spatial terms, further occupation of previously undeveloped areas can be expected as a result of the search for land suitable for settlement.
- Among the institutional effects, an increased need for scientific research in the field of environmental protection and the search for ways to achieve closer international cooperation in environmental policy should be mentioned.

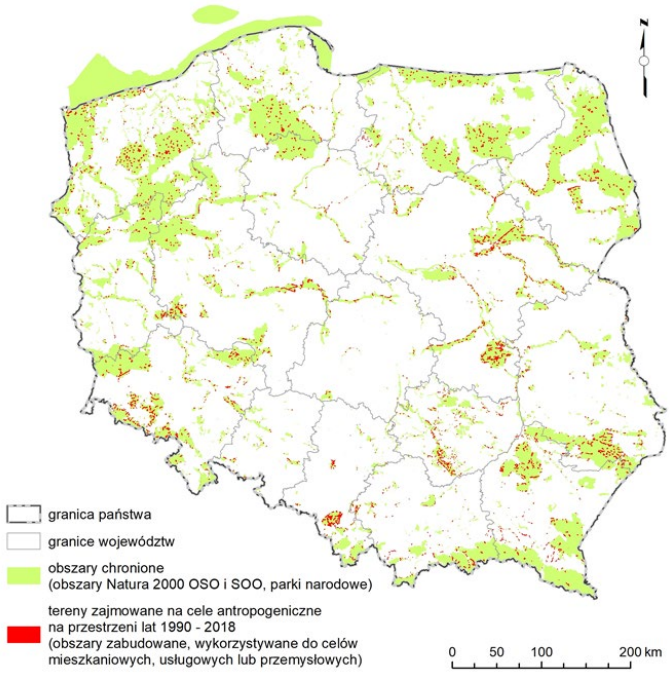
DECLINE IN BIODIVERSITY

Human activity has already led to the degradation of ecosystems and species habitats on the European continent[70]. In Poland, the most important factors directly affecting biodiversity are, in the case of terrestrial ecosystems, changes in land use leading to habitat and landscape fragmentation, habitat and species destruction, climate change and the spread of alien species. For aquatic ecosystems, the threatening factors are climate change, eutrophication and chemical pollution, disruption of watercourse continuity through the construction of damming devices, river regulation and transformation of their banks, and disruption of hydrology in catchment areas[71].

Particularly adverse effects on the richness or uniqueness of global, European and Polish biodiversity result from changes in the use and exploitation of areas of high natural value, including those already highly endangered. In Poland, changes in land use for anthropogenic purposes between 1990 and 2018 affected approximately 1% of the area of sites protected under the European Natura 2000 Ecological Network and national parks.

[67] Based on EMEP data.
[68] Based on FAO data.
[69] Based on Statistics Poland data.
[70] EEA, 2019.
[71] *Conservation Programme...* 2015; Pasztaleniec et al. 2021.

Map 11: Land occupied by buildings in Natura 2000 sites and national parks in Poland in 1990–2018.



Source: Hajto et al. 2023a.

Ganica państwa	State border
Granice województw	Voivodship borders
Obszary chronione (obszary Natura 2000 OSO i SOO, parki narodowe)	Protected areas (Natura 2000 SPA and SAC sites, national parks)
Tereny zajmowane na cele antropogeniczne na przestrzeni lat 1990-2018 (obszary zabudowane, wykorzystywane do celów mieszkaniowych, usługowych lub przemysłowych)	Areas occupied for anthropogenic purposes between 1990 and 2018 (built-up areas used for residential, service or industrial purposes)

The conservation status of species and natural habitats is deteriorating. A conservation status assessment carried out in 2013–2018 showed that only about 20% of habitat types were in a favourable state of protection, about 43% are in an unfavourable state, while habitats in a poor state account for about 35%[72]. In light of the results of environmental monitoring in Poland, the alarming results concerning the conservation status of water-related habitats deserve special attention. This also applies to species – in Poland, more than half of fish species are threatened with extinction due to habitat fragmentation and water pollution. Due to eutrophication and its secondary effects, the ecological status of 55% of river water bodies and 36% of lakes is below good, meaning that these waters do not meet environmental objectives. For transitional and coastal waters, all water bodies in this category are in poor ecological condition due to eutrophication and the associated poor condition of phytoplankton[73].

Factors threatening native biodiversity include invasions of alien species and climate change. In addition to contributing to the extinction of native species, alien species can completely alter the structure of valuable habitats and even the functioning of entire ecosystems.

The unprecedented rate of climate change poses a significant threat to biodiversity in Poland. The ongoing drought has had a particularly severe impact on nature – aquatic and water-dependent species and ecosystems, including natural peat deposits, are at risk of gradual disappearance or shifting ranges[74]. Drought also affects forests – currently, forests cover approximately 30.9% of Poland's land area, including land related to forestry[75]. The forest area in Poland is similar to the average forest cover worldwide (30.6%) and in Europe (32.2%)[76]. In the last six years,

[72] Cieśla et al. 2021.
[73] State Water Holding Polish Waters 2021.
[74] Kotowski 2018.
[75]Statistics Poland. Local Data Bank 2022.
[76] FAO, UNEP 2020.

the area of forests damaged by drought amounted to over 300,000 ha. 45% of agricultural and forest areas are at risk of drought[77].

Biodiversity is a fundamental characteristic of the natural environment, determining the variety of ecosystems, species of organisms and their genes. The more diverse the natural environment is, the more stable and resilient it is to change taking place. The decline in biodiversity and ecosystem services affects human security and the economy, among other things by reducing the ability to meet basic human needs, not only such as clean air, water and food, but also leisure and recreation.

Projected trend effects in Poland:

- In social terms, if the trends described are not be reversed, they will imply, among other things, a gradual loss of basic natural services on which societies depend, as well as threaten human health and well-being.
- In economic terms, current trends threaten agricultural production in particular, and thus food security. The collapse of food and health systems and disruptions in supply chains endanger the foundations of the economy. In environmental terms, the loss of biodiversity, if not stopped, poses a serious risk to life on Earth. There is also a danger of reduced competitiveness in tourism and recreation.

UNSUSTAINABLE USE OF RAW MATERIALS AND WASTE MANAGEMENT

The increase in raw material extraction observed worldwide is also taking place in Europe and Poland. Most EU countries have achieved relative or even complete decoupling of economic growth from environmental pressure, but considering the data on the physical trade balance of primary raw materials and the material footprint, which is more than thirteen times higher in high-income countries than in low-income countries, it can be assumed that this decoupling is largely the result of energy- and material-intensive production being moved to developing countries. A further increase in raw material extraction is projected until 2060[78].

The available resources of most minerals in Poland, as in other European countries, have been significantly reduced in recent years due to the extraction of easily accessible resources, the high costs of obtaining more difficult-to-access ones, and conflicts between deposits and other elements of the environment or land use. On the other hand, efforts to manage resources rationally have led to a reduction in demand and consumption of raw materials. The Polish economy is still based on energy from conventional sources, although the share of primary energy from renewable sources is steadily increasing and reached 21.3% in 2021 (the EU result for the same year was 40.8%). The shift to renewable energy sources will reduce coal consumption in the energy sector, but it should be remembered that it will also change the demand for other raw materials used in the creation of RES.

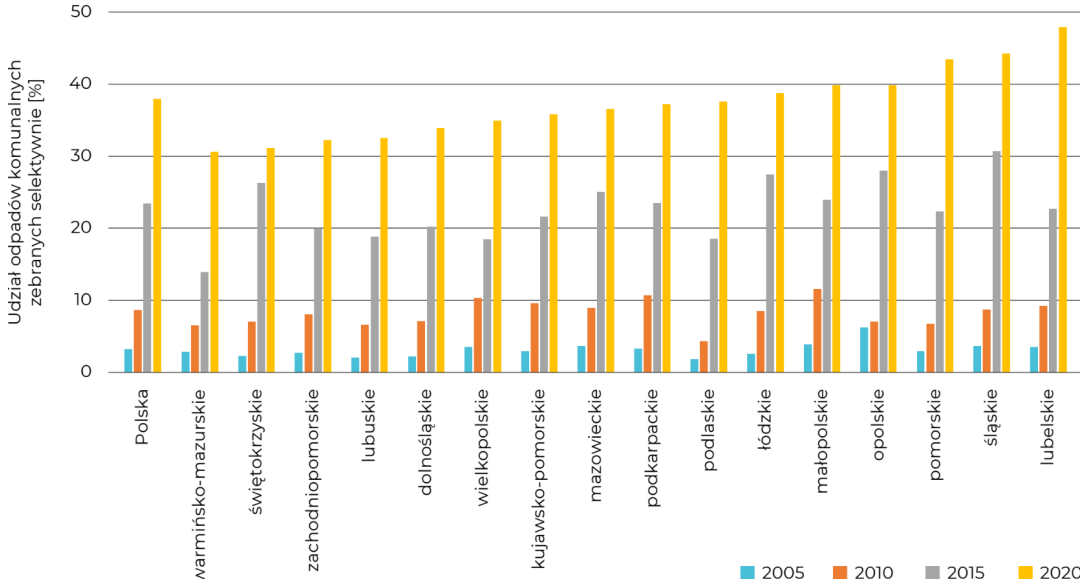
In Poland, as in the rest of the world, the problem of waste generation and management is growing. The largest group is industrial waste, which amounted to an average of 125 million tonnes per year until 2016 and an average of 113 million tonnes per year between 2017 and 2020. Between 1996 and 2022, its production decreased from 124 million to 115 million tonnes per year. This waste comes mainly from mining and extraction (more than half of the total waste), industrial processing, and electricity generation and supply[79]. The largest amount of industrial waste is generated in Lower Silesia and Silesia (a total of 55% of national production), and the least in Lubusz (0.6%). The amount of industrial waste generated, excluding mineral waste (which accounts for approximately 70% of all waste in Poland), grew by an average of 1.4% per year in Poland between 2004 and 2018. At the same time, since 2016, the method of waste management has remained virtually unchanged. The shares of recovery and disposal remain stable at around 48% for industrial waste and around 71% and 29% for waste excluding mineral waste, respectively.

Municipal waste in Poland accounts for approximately 10% of all waste generated. Between 2005 and 2020, the amount of municipal waste collected and disposed of increased from 9.4 million to 13.1 million tonnes. In 2022, the average amount of waste generated per capita per year was 355 kg (the highest per capita waste generation rate, amounting to 422 kg, was recorded in 2022 in the Dolnośląskie (Lower Silesia) Voivodship, and the lowest in the Podkarpackie (Lower Carpathia) Voivodship, where 243 kg of municipal waste was generated per capita per year)[80]. On a national scale, it has been possible to partially decouple GDP growth from waste production – GDP is growing

[77] State Forests 2020.
[78] IRP 2019, OECD.
[79] Based on Statistics Poland data.
[80] Ibid.

faster than the amount of waste generated. The forecast predicts a further increase in municipal waste to over 15 million tonnes in 2040[81].

Figure 14: Share of municipal waste collected selectively in total municipal waste collected.



Source: own elaboration based on data from the Local Data Bank of Statistics Poland (GUS).

Between 2005 and 2020, the amount of waste collected and sorted separately increased significantly from 3.2% to 37.9% (the lowest values were recorded in the Warmińsko-Mazurskie (Warmian-Masurian) Voivodship, and the highest in the Lublin Voivodship). Broken down into groups, these are biodegradable waste (42 kg/person), glass and bulky waste (19 kg/person), mixed packaging (14 kg/person), paper and cardboard, and plastics (13 kg/person each). Since 2005, there has been a significant decrease in the amount of municipal waste sent to landfill – from 70% to 40% in 2020, with the EU average in 2020 being 23%. The increase in waste sent for recycling rose from 6% to 39% (EU average 48%) and waste sent for thermal conversion with energy recovery from 0% to 20% (EU average 27%)[82]. Plastic packaging waste remains a major problem, which has direct financial implications for Poland[83]. A more effective fight to reduce it is crucial for Poland's financial interests. As a result of rising waste management costs, the burden on waste producers in terms of collection and management fees is increasing. Over the last decade, there has been a significant increase in municipal waste collection fees, and analyses show that municipalities are finding it increasingly difficult to manage their municipal waste management budgets.

Despite establishing a hierarchy of waste management methods, in which disposal is the least desirable method of waste management, a large proportion of waste from economic activity is still sent to landfill. The amount of industrial waste accumulated so far in landfills (heaps, sediment ponds) in Poland is almost 1.8 billion tonnes, of which 46% is waste from mining and extraction[84]. The number of facilities where mining waste is stored is gradually decreasing, and there is growing interest among producers and holders of mining waste in technologies that enable recovery or safe disposal, as well as a shift to a business model based on the principles of the circular economy[85]. The number of active municipal waste landfills is also steadily decreasing, and at the end of 2022, there were 259 landfills accepting municipal waste, covering a total area of 1,600 ha.

Recycled raw materials and materials are becoming increasingly important in the materials economy, but the circular economy indicator, which measures the share of materials from processed waste in the total consumption of raw

[81] Institute of Environmental Protection-National Research Institute (IEP-NRI) 2021.
[82] Poland makes contributions to the EU budget, among other things, from its own resources based on non-recycled plastic packaging waste. In 2023, Poland contributed to the EU budget due to its own resources.

[83] Poland's membership contribution to the European Union is partly dependent on the weight of non-recycled plastic packaging waste. In 2023, the membership contribution amounted to EUR 532 million, which represented 7.4% of contributions to the EU budget from the plastic resource; in 2021, we contributed EUR 372 million, which represented 6.4% of contributions.

[84] Data on waste previously landfilled (accumulated) refer to the amount of waste deposited on the premises of the plants as a result of landfilling in the reporting year and in previous years.
[85] E.g., the MINE.THE.GAP project, https://h2020-minethegap.eu/.

materials and materials, has remained stable at around 10% in Poland since 2016 (compared to the EU average of 12.8% in 2020)[86].

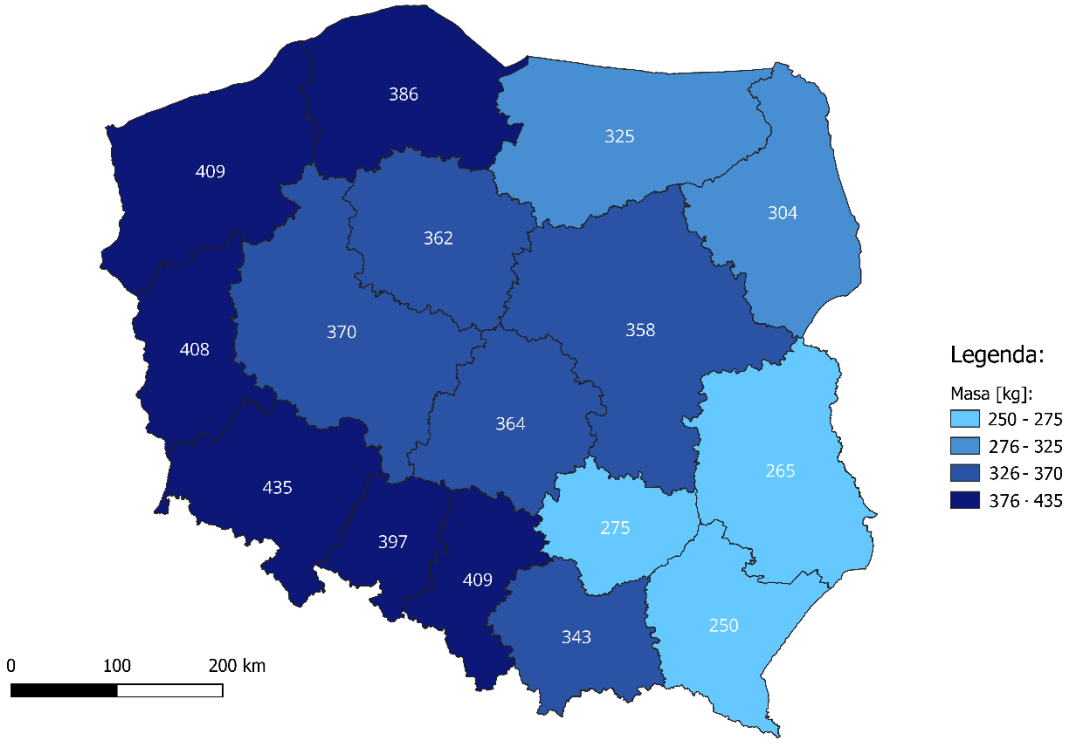
Projected trend effects in Poland:

- The strong and varied effects of this trend will be felt in the economic sphere: production costs (including for electronics) will rise due to more difficult access to raw materials and the need to import them; waste management costs will increase, local governments will face problems related to financing waste management, and the grey market for waste management will develop.
- In environmental terms, this will primarily result in greater pressure on the environment as a result of illegal waste disposal, due to the rising costs of waste collection from residents and the increasing burden of waste on the environment, including the penetration of microplastics into soil, water and food.
- In spatial terms, the effects of this trend may become apparent in the form of an increase in the area of land designated for waste storage and the occupation of new areas for illegal waste disposal sites. On the other hand, it is predicted that post-mining and post-storage areas requiring reclamation and redevelopment will be released.
- In terms of institutional impacts, we can highlight the growing importance of the circular economy, including the intensification of research and development in this area, as well as cooperation between local government units and other partners in the field of waste management.

Regional variations in megatrends:

In the case of the megatrend *Increased pace of environmental change*, two indicators illustrating the impact of human activity on the natural environment were selected to illustrate the variations.

Map 12: Mass of municipal waste generated per capita in Poland in 2019.



Source: own elaboration based on data from the Local Data Bank of Statistics Poland (GUS)

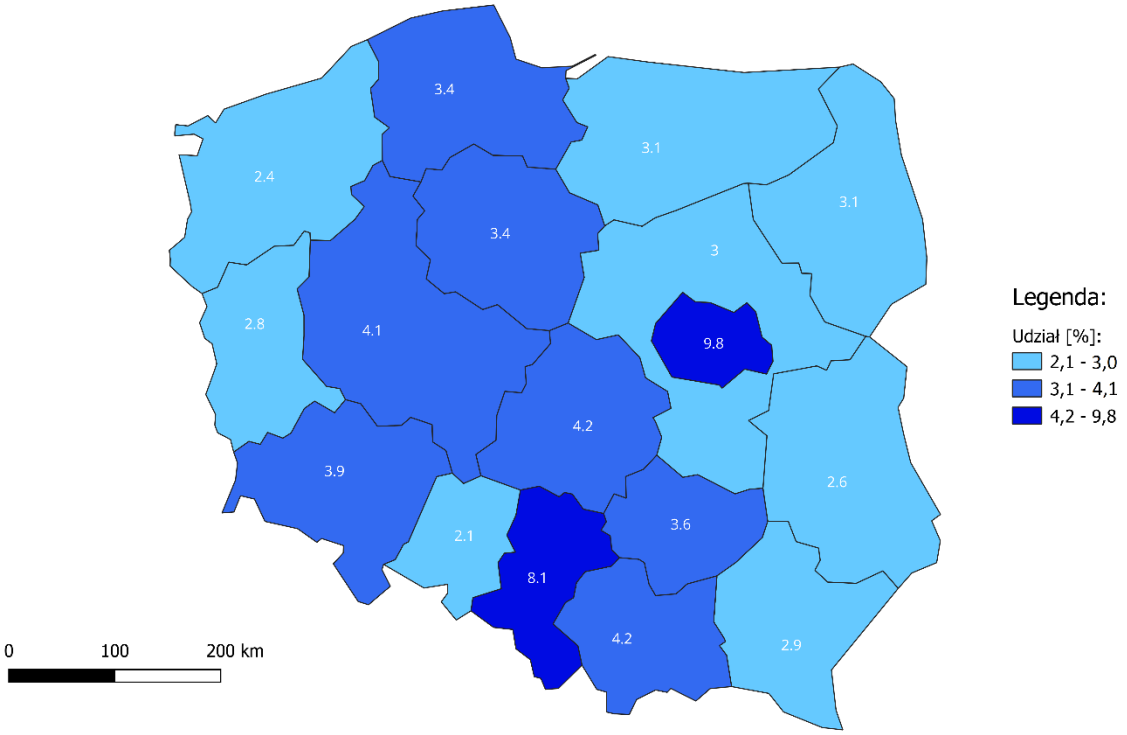
Legenda	Key
Masa [kg]	Mass [kg]

The first is the mass of municipal waste generated per capita. In this case, there are clear regional differences. The lowest amount of waste generated is characteristic for the voivodships of Eastern Poland (especially the southern

[86] Based on Eurostat data.

ones), and the highest for the regions located along the border with Germany and the Czech Republic (from West Pomeranian to Silesian) and the Pomeranian Voivodship. The voivodships in the central part of the country and the Małopolskie (Little Poland) Voivodship have values intermediate between these two groups of regions.

Map 13: Share of artificial surfaces in total surface area in 2021.



Source: own elaboration based on Statistics Poland Local Data Bank data

Legenda	Key
Udział [%]	Share (%)

The second indicator reflecting anthropogenic pressure on the natural environment is the share of artificial surfaces in the total area of the region. In this case, the situation is fairly uniform in most regions – in 15 out of 17 statistical regions, the share of artificial surfaces ranges from 2.1% (Opole Voivodship) to 4.2% (Małopolskie Voivodship). Two regions stand out in this respect, where the largest urban agglomerations in the country are located – the Silesian Voivodship and the Warsaw metropolitan area.

Land use is constantly changing. Current lifestyles and socio-economic trends determine how land is managed. Agriculture, forestry and urban development have the greatest impact on land use patterns and changes.

The number of urban dwellers is steadily increasing. The urban population has almost doubled over the last 30 years. Since 2007, the urban population has outnumbered the rural population, and the disparity between cities and rural areas in this respect is increasing. In 2020, nearly 4.5 billion people (approx. 57%) lived in cities worldwide. It is estimated that by 2050 this figure will reach 6.8 billion, i.e. approximately 68% of the world's population.

North America is the most urbanised (approx. 83% in 2022), while Africa is the least urbanised (approx. 43.5% in 2020). At that time, approx. 75% of the population in Europe lived in cities. The highest urbanisation rate is observed in highly developed countries, including city-states and island countries, e.g. Bermuda, Monaco, San Marino, Vatican City – 100% each, Qatar – 99.3%, Belgium – 98.2%, Israel – 92.8%, Japan – 92%, Argentina – 92.3%. The lowest rates are found in African and Asian countries – Papua New Guinea (13.6%), Burundi (14.4%), Niger (16.9%), Sri Lanka (19%). Following the rate of population growth in less developed countries, much faster urban development and urban population growth can be observed. Between 2015 and 2020, the annual urban population growth in these countries accounted for 94% of the total one[87].

The number and role of megacities (cities with a population of over 10 million) is growing worldwide. There are currently 33 such cities, most of them in Asia and Latin America, mainly in developing countries. The largest in terms of population (in 2022) are Tokyo (34.4 million), Delhi (32.9 million), Shanghai (29.2 million), Dhaka (23.3 million) and Mexico City, Cairo and São Paulo (approx. 22 million each). More than 11% of the urban population lives in megacities (2018). According to the UN (2018), by 2030 the number of megacities will increase to 43 and they will account for approximately 21% of the urban population.

Today, however, most of the world's urban population lives in cities with fewer than 1 million inhabitants (56.6% in 2022). In 2018, 2 billion people lived in urban settlements with fewer than 500,000 inhabitants, and approximately 400 million people in cities with between 500,000 and 1 million inhabitants.

Urbanisation around the world proceeds in different ways and at different rates. Particular differences can be seen between highly developed and poorly developed countries. In highly developed countries, where the rate of urbanisation has slowed, there has been an exodus of people from city centres to the suburbs. In less developed countries, the intense and rapid influx of people into cities often exceeds their capacity. As a result, poor neighbourhoods (slums, favelas) with very low standards of living are created, with makeshift buildings, no paved roads or sewage systems, and no access to fresh water.

Not all cities are growing and recording population increases. Armed conflicts, unfavourable natural conditions, migration and low birth rates are shaping regions (including their cities) that are experiencing depopulation. Between 2010 and 2021, 30 countries around the world, including Poland, recorded a decline in population. The largest population declines (over 10%) were recorded in Syria, Puerto Rico, Lithuania, and Bosnia and Herzegovina. The phenomenon of depopulation is expected to intensify. According to the UN report *World Population Prospects 2022*, by 2050, the problem will affect 61 countries. Currently, cities in Asia and Europe are losing population, and to a lesser extent, North America. Depopulation is affecting cities in Japan, Poland, Russia, as well as the capitals of countries such as Romania, Sri Lanka, Latvia and Armenia. It is predicted that all of these centres will lose more than 2 million inhabitants by 2030, or more than 2% of their population.

The growing world population, increasing urbanisation and the development of non-agricultural sectors are resulting in more and more land being taken up for development and infrastructure (the need for settlement, in particular the development of urban agglomerations, the expansion of transport networks and tourist infrastructure, and industrial activity). Agricultural and natural areas, including floodplains and wetlands, are being taken over for settlement. e.g. in the United States, between 2000 and 2025, it is estimated that approximately 7.6 million hectares of land will be lost, including 2.8 million hectares of agricultural land and 2.8 million hectares of ecologically sensitive land, to residential development[88]. Similar trends are occurring in Europe – between 2000 and 2018, 1.25 million hectares of open land were converted into built-up areas. The area of sealed land is growing, which greatly limits

[87] *World Cities Report 2022: Envisaging the Future of Cities*, 2022.
[88] Stelmaszewska N., 2020.

water storage, food production, and the area and continuity of habitats for various species. This leads to landscape fragmentation and a reduction in biodiversity. The process is often uncontrolled, contrary to the principles of sustainable development, and the resulting urban spaces are dysfunctional and unfriendly to life.

The world's forest area is steadily decreasing – between 2001 and 2023, forest cover decreased by 12%, which corresponds to a loss of 488 million hectares[89]. Forests are disappearing mainly due to logging for new agricultural land, primarily for palm oil and soybean plantations. Most forests are being cleared in South-East Asia (Indonesia and Malaysia), North America (the south-eastern United States and Canada) and tropical areas. Forests are also being cut down in Europe, albeit on a smaller scale. The scale of deforestation in Europe is on the rise. The highest number of trees are being cut down in Estonia, Portugal, Spain and Poland.

The area of grassland is also decreasing, as it is mainly being converted into farmland or forests.

The growing demand for food leads to increasing use of soil. New areas are systematically acquired and occupied for arable land. At the same time, desertification is occurring. Approximately 50,000 km² of soil is lost annually. In highly developed countries, there is a phenomenon of agricultural land abandonment. This mainly affects peripheral areas, from which the younger generation migrates to cities in search of better economic prospects. As a result, the area of arable land in the world is showing a slight upward trend, especially in developing countries, e.g. between 1981 and 2018, the percentage of such land increased from 6% to 8.7% in Latin America and from 5.6% to 9% in sub-Saharan Africa. In many highly developed countries, the opposite trend is observed due to investment pressure and the decline of agriculture in favour of services. During the same period, the area of arable land decreased by 4.1% in the European Union and by 1.7% in Japan[90].

Marshes are the fastest disappearing ecosystems – 1.6% of marshes are lost annually. Peat bogs are drained, among other things, for agricultural land or exploited for energy, agricultural and horticultural purposes. Today, peatlands in Indonesia and Malaysia are being drained most intensively worldwide. In Europe, most peat bogs were drained in the 20th century (98% in Germany and 94% in the Netherlands). Awareness of the importance of wetlands in the context of climate change is growing. The world's largest restoration project is underway in Indonesia. In Europe, such activities are being carried out in Germany, the Netherlands and Belarus.

Trends contributing to the megatrend:

- Growth of strong cities and urban functional areas;
- Transformations in rural areas;
- Changes in land use.

GROWTH OF STRONG CITIES AND URBAN FUNCTIONAL AREAS

Globally and in Europe, the percentage of the population living in cities is steadily increasing, although the rate of this process has slowed down in the 21st century. Domestic urbanisation trends differ from global and Western European trends. Since the beginning of the 20th century, the urbanisation rate in Poland has been steadily increasing, reaching its highest level in 1991 – 62%[91]. Since then, urbanisation processes in Poland have stabilised and slowed down since the mid-1990s. Similar trends can be observed in Central and Eastern European countries (e.g., Slovakia, the Czech Republic, Lithuania, Latvia). In 2021, 59.75%[92] of Poland's population lived in cities. Compared to other highly developed countries, where the average share of the urban population exceeds 80%, this is a low level. World Bank forecasts predict that after a temporary stagnation, urbanisation in Poland will continue and reach 70% in 2050.

There are no multi-million metropolises in Poland. Only Warsaw has a population exceeding one million. The next four cities – Kraków, Łódź, Wrocław and Poznań – have between 500,000 and 1 million inhabitants.

The urban population in Poland is unevenly distributed, despite the polycentric distribution of the settlement network. The largest concentrations are in Silesia, Greater Poland and Western Pomerania, where most Polish cities are located. Large cities such as Warsaw, Łódź, Kraków and the Tri-City also play an important role. The

[89] Global Forest Watch.
[90] World Bank.
[91] Own analysis based on Statistics Poland (GUS) data.
[92] Statistics Poland. Local Data Bank.

current layout of cities was shaped by historical circumstances (partitions) and natural conditions (natural resources, rivers, trade routes).

Over the last 30 years, there have been no significant changes in the overall urbanisation rate, but population growth in individual cities and the influx of people into functional urban areas represent a noticeable urbanisation trend. Residents are attracted to the largest agglomerations, primarily Warsaw, Poznań, Wrocław, Kraków and the Tri-City, and it is mainly the areas surrounding central cities that are being settled.

At the same time, there is an influx of people to large cities, but this is offset by the outflow of migrants from central cities to surrounding municipalities. This results in the depopulation of some cities, especially their centres (Poznań, Łódź, Lublin, Szczecin, Bydgoszcz, Toruń, Gdynia, Sopot) and an increase in the population of the municipalities surrounding these cities. Since 1989, there has been an increasing dispersion of development, especially in the vicinity of Warsaw, Łódź, the Tri-City and Kraków, but also around smaller cities such as Olsztyn, Jelenia Góra, Radom, Kielce and Zamość. Suburban areas attract residents from boththese cities and surrounding rural areas.

Projected trend effects in Poland:

- Cities, especially large ones, and their functional areas will drive the development of Poland and its regions. They will concentrate high-quality social capital. Cities will provide public and private services to their residents and to the population living in their surroundings. They will be places for gathering and exchanging knowledge, creating innovations and new technologies, and providing higher-order services.
- Further urban sprawl will have a negative impact on the space. Loose and irregular development will cause further changes in the functional and spatial structure of the areas around cities. These areas will lose their agricultural character – population density will increase, the share of agricultural land in the land structure will decrease, and urban-rural forms of settlement will function, which over time will take on an increasingly urban character. The cultural and architectural resources of suburban villages will be destroyed. Traditional architecture will be intertwined with and eventually replaced by suburban developments, i.e. multi-storey buildings, villas, holiday homes, roads, wholesalers, warehouses, etc. The suburban landscape will continue to deteriorate. At the same time, depopulated areas are likely to become increasingly marginalised. The strongest depopulation processes will continue to affect the Podlasie Lowlands, Roztocze, the Lublin region, the Opole region and the sparsely urbanised areas of the Łódź, Świętokrzyskie (Holy Cross) and Mazowieckie (Mazovia) Voivodships. These areas will record an increasingly lower intensity of development – there will be more and more abandoned buildings, followed by their reduction and a thinning of the settlement network.
- There will be further fragmentation and development of natural and open areas. The development of ecological corridors will disrupt the migration of species. The construction of air corridors will hamper efforts to improve air quality in cities. Buildings will continue to encroach on floodplains and areas of agricultural and natural value. There will be higher emissions of pollutants.
- In social terms, the population structure of big cities, urban functional areas and depopulating areas will be even more disrupted. Cities and urban functional areas will have more young people, with a predominance of women. Depopulating areas will see further ageing of the population. This also applies to peripheral areas. Excessive car use will have a negative impact on health, family and social life: a more sedentary lifestyle, stress associated with daily commuting, road accidents, environmental pollution, less time for interpersonal relationships. Underdeveloped local public transport and dependence on cars will contribute to transport and social exclusion, particularly of children and the elderly. The spread of development into the suburbs will result in the transfer of the urban lifestyle to these areas. The population that settles there will be closely linked to the city through employment and the use of public and private services. Looking at urbanisation more broadly as an urban way of life and the percentage of the population employed outside agriculture, the degree of urbanisation in Polandwill increase.
- In economic terms, the costs of managing and developing areas of dispersed development will continue to rise. Dispersed development will be a major barrier to the organisation of efficient public transport, technical infrastructure and access to public services. Underdeveloped public transport and the need to meet the basic needs of residents will reinforce dependence on private transport and daily commutes to the central city. Declining population density in depopulated areas (cities and peripheral areas) will also increase the costs of providing social and technical infrastructure. It will continue to be primarily the wealthy who give up living in the central city, while it will be mainly the working-age population who leave the peripheral areas, resulting in significantly lower income tax revenues for city budgets.

TRANSFORMATIONS IN RURAL AREAS

The population in rural areas around the world is slowly increasing. In 1990, these areas were inhabited by 3.02 billion people. By 2020, this number had increased to 3.44 billion. However, statistically, this has not corresponded with an increase in the global area of arable land, which fell from 37.1% of the total area in 1990 to 36.5% in 2020[93]. In Poland, between 1989 and 2022, the rural population increased from 14.6 million to 15.3 million (while the total population of the country decreased from 38.04 million to 37.9 million). The statistical increase in the rural population is mainly due to suburbanisation processes. Since 2000, there has been a positive balance of migration from cities to rural areas, which intensified significantly in 2020, mainly due to the COVID-19 pandemic, and in 2022. Most often, people aged 30-44 with children move to rural areas. The population growth mainly concerns areas surrounding cities. At the same time, there is a significant depopulation of peripheral rural areas, mainly along the north-eastern and eastern external border and in the Opole and Świętokrzyskie (Holy Cross) Voivodships.

Meanwhile, the number of farms in Poland is declining. According to the 2020 General Agricultural Census, their number decreased by 13% compared to 2010. Despite the fact that the remaining farms have increased their area, in general terms, the share of agricultural land in the total area of Poland has been steadily declining for years.

In Poland, there has been a systematic decline in the share of the agricultural and non-agricultural sectors in the local economy. Deagrarisation is not incompatible with the possibility of developing a modern agricultural economy in rural areas. In certain situations, it can contribute to the modernisation of agriculture, including the restructuring of the agrarian structure (especially at the regional level), the application of new technologies (leading to a reduction in labour demand through the introduction of agricultural machinery) and the implementation of innovative solutions. In another context, deagrarisation may also mean the withdrawal of farms from commercial production or even the complete abandonment of agricultural production[94]. In Poland, the data indicate the presence of both of these phenomena related to deagrarisation: in certain areas of the country, there is relatively dynamic development of the agricultural sector[95], while in others, there are signs of withdrawal from agricultural activity[96]. The structure of Polish agriculture is highly fragmented, with significant regional differences. Statistically, on a national scale, the median number of agricultural plots has increased slightly over the last 10 years (by 1.5% per 100 ha). However, the opposite trend, i.e. a decrease in the number of plots per 100 ha, interpreted as a process of concentration and reduction of land fragmentation, can be observed in eastern Poland – in the Lublin and Podlasie Voivodships and in the eastern part of the Mazowieckie (Mazovia) Voivodship.

The development of non-agricultural activities is also noticeable in Polish rural areas. Approximately 40% of the population lives in rural areas in Poland. Today, most of these residents earn their living from sources other than agriculture. In 2018, approximately 22% of the economically active population in rural areas worked in agriculture. However, the nature of this work varied greatly, ranging from sporadic, often seasonal work on farms to agriculture as the main or only source of income. It is estimated that approximately 10% of the rural population earns their living in this way.

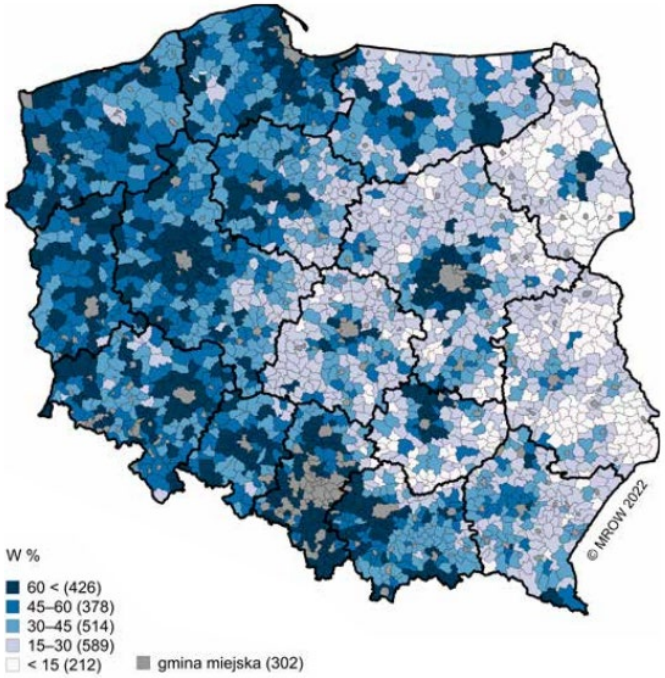
[93] World Bank data.

[94] Rosner and Stanny 2018.

[95] Sikorska et al. 2015.

[96] Jadczyszyn and Rosner 2013.

Map 14: Share of non-agricultural economic entities in the total number of economic entities in 2022.



Source: European Fund for the Development of Polish Rural Areas 2023.

Gmina miejska	Urban municipality

Transport accessibility in rural areas in Poland is gradually improving but remains very low. In 2019, the average travel time to the regional capital was 70 minutes, which is 10 minutes shorter than in 2010 and 2015. This improvement was the result of the intensive development of the expressway and motorway network, which increased in length from 1,316 to 4,027 km between 2010 and 2019[97]. Nevertheless, no improvement in transport accessibility was observed, or even a deterioration in areas remote from major transport hubs. On average, residents of rural or urban-rural municipalities had access to public transport in 83% of villages. This figure remained unchanged during the period analysed. However, more than 10,500 villages, or 25.8% of the total, still have no access to public transport.

Projected trend effects:

- Villages will become multifunctional areas with an increasingly smaller share of agricultural functions. Without sufficient technological advancement in agriculture, this may entail the risk of insufficient food supplies in the country and greater dependence on external suppliers.
- Development of new functions in rural areas.
- Improved transport links between local centres may contribute to a further increase in the number of rural residents (due to shorter commuting times and the growing functional attractiveness of these areas).
- Declining employment in the agricultural sector due to ongoing automation and socio-economic changes in the country.

CHANGES IN LAND USE

The Earth's surface is undergoing intensive transformation – the area of built-up land is growing, the area of forests is decreasing, new areas are being taken over for arable land (primarily at the expense of forests, marshes and grasslands), and the area of desert and semi-desert land is increasing. The trends observed in Europe and Poland only partially correspond to global trends – there is intensive development of the European continent, deforestation is occurring on a smaller scale, and the area of agricultural land is slowly but steadily decreasing.

The share of built-up and urbanised land in the country's total area has been steadily increasing from approx. 9% in 2003 to approx. 13% in 2020. The share of built-up and urbanised areas is rising in all voivodships. This process is

[97] Koziarski 2021, p. 228.

particularly intense in agricultural areas, especially those within the sphere of influence of cities. The change in the function of agricultural areas and their evolution towards multifunctional spaces has led to the intensive development of industrial, service, residential and transport facilities. Furthermore, Poland is still in the process of catching up in terms of infrastructure. The construction of strategic infrastructure investments is most often carried out in natural areas.

At the same time, villages located in peripheral areas are ageing, depopulating and disappearing. The decline in population in these areas is causing changes in the space and landscape. Abandoned buildings are falling into disrepair. Agricultural activity in these areas is vanishing – farmland is being abandoned.

The most urbanised province is Silesia, and the least urbanised is Kuyavia-Pomerania. Unfortunately, in many places in Poland, development is chaotic, contrary to development needs and demographic forecasts.

As in other European countries, the area of agricultural land is decreasing – between 2002 and 2020, it fell by 4.3%. This is due to urbanisation and the ageing of the agricultural population. The decline mainly concerns land located in the vicinity of cities, which is designated for construction projects, and poor-quality agricultural land, which is forested. The largest decline in agricultural land was recorded in the Mazowieckie (Mazovia) Voivodship, and the smallest in the Opole Voivodship. Nationwide, the area of all forms of agricultural land decreased, but the largest decrease was in arable land. Nevertheless, some voivodships recorded an increase in the area of certain types of agricultural land, e.g. arable land in the Opole Voivodship or orchards in the Mazowieckie, Łódź, Lublin and Świętokrzyskie (Holy Cross) Voivodships.

Forests cover approx. 30.9% of Poland's area and their number is steadily growing. Annually, approx. 40 million m^3 of wood is harvested in Poland (approx. 40 million trees are felled), and approx. 1,000 ha are afforested[98]. Although forest cover in Poland is increasing, from the point of view of the environment and the functioning of the entire ecosystem, it is not only the size of the area that is important, but also the age of the tree stand and the mass of its wood.

Trees are also an important element of the green infrastructure of cities and rural areas. In recent decades, frequent tree felling has been observed in cities and their functional areas. The number of trees in the agricultural landscape has also decreased – in fields, along roadsides, along drainage ditches and around water reservoirs. Between 2012 and 2020, the density of linear tree stands decreased by 9.3%, the number of linear tree stands decreased by 7.4%, and the number of individual trees decreased by 14.6%.

The area of marshes is shrinking – 85% of marshland in Poland has been drained or degraded. Marshes are being converted into fertile agricultural or forest land, areas for investment or peat mines.

Despite many negative trends, it is important to note that the EU is taking many measures to reverse or mitigate negative spatial trends. These include: No Net Land Take by 2050 – a European Commission initiative (from 2011) aimed at reducing the balance of new land take in the EU to zero by the middle of the 21st century, the Biodiversity Strategy for 2030 (2020) and the Regulation of the European Parliament and of the Council on the restoration of natural resources, the so-called *Nature Restoration Law* (2024), which aims to restore and protect ecosystems in the long term and mitigate the effects of climate change.

Projected trend effects in Poland:

- Spatial polarisation and related chaotic changes in land use will follow – investment pressure.
- More land will be taken up by strategic investments, including roads, railways, energy and leisure infrastructure.
- Cities will become heat islands. The average annual temperature in Warsaw in 2050 is expected to be 2.4^0C higher than today. Exposure to high temperatures will have a negative impact on human health: an increase in cardiovascular and respiratory diseases, stress, an increase in hospitalisations, and higher mortality.
- The function of rural areas will continue to change. Villages located in the vicinity of cities will become multifunctional units. There will be further development of buildings in these areas (residential, service, warehouse, production, including those related to renewable energy production). At the same time, rural development will decline and become sparser in peripheral areas.
- The forest cover of Poland will increase slightly. The species composition of forests and the age of trees will change. There will be a gradual shift away from monocultural forests towards a more natural composition.

[98] Forest Data Bank, Statistics Poland (GUS)

Intensive forest management will be carried out. The average age of forests will decrease – old trees will be cut down and replaced with young plantings.

- Open and monotonous agricultural areas with an increasingly smaller proportion of meadows and pastures, devoid of field trees and fragmentation of natural areas will contribute to greater exposure of these areas and their inhabitants to the effects of adverse climate change: extreme temperatures and drought, wind, heavy rainfall. Soils will be eroded, contributing to their desertification.
- The economic costs of climate change (mitigation and adaptation) will increase. Energy consumption for cooling and air purification will increase. Cities will incur high costs for measures to mitigate the urban heat island effect and adapt to climate change. Extreme weather events will hamper crops – harvests will be smaller, and food will be more expensive.
- Biodiversity will decline. Multifunctional and environmentally valuable areas such as wetlands, including peat bogs, and meadows will be lost. Many organisms will be deprived of their habitat. Ecosystems will become further fragmented, hindering the migration of animals and plants (see trend: *Increasing degradation of the natural environment –air, water, land surface and soil*).
- The water balance will deteriorate, increasing the risk of floods and droughts. Groundwater quality will decline – pollution with nitrogen, phosphorus and calcium compounds will increase. Soils will be susceptible to erosion and surface runoff. Sealed soils will hinder water retention and increase its costs.

MEGATREND: TRANSFORMATION OF THE GLOBAL ORDER

This megatrend takes into account processes related to the transformation of the global economic balance of power, primarily linked to the growing role of Asian countries on the international arena. It also includes a discussion on the future of democracy. The third element of the megatrend is the increase in international tensions, which, given the war in Ukraine, may affect Poland more directly than expected. The war in Ukraine and the sanctions imposed on Russia by most countries have triggered a process, already anticipated before the Russian aggression, of Russia seeking a new political power balance in favour of China. There is a consolidation of Western countries (grouped in NATO and the EU), and China may play a counterbalancing role at this point.

The transformation of the global order means a shift in the world situation towards the growing importance of Asia. Countries such as China, India and Indonesia have proven to be dynamically developing economic markets, which in the period 2009-2019, i.e. until the COVID-19 pandemic, accounted for over 80-85% of global growth. The economic and commercial centre of the world is shifting to Asia, where not only China but also Japan, South Korea, Southeast Asian countries and the so-called East Asian economic tigers, such as Singapore and Taiwan, are developing dynamically. These countries have achieved economic success based on models that are completely different from liberal democracy. A shift has also taken place in the institutional sphere – in addition to the group of the world's most developed countries, the G20 group was created, i.e. the G7 countries plus the above-mentioned emerging markets, and at the same time the BRICS group was formed, i.e. Brazil, Russia, India, China and South Africa. In addition, recent years have shown that China and other Asian countries posea challenge for the US and the EU not only in economic and trade terms, but also in terms of technology. China's economy is growing rapidly, followed closely by countries such as India, Indonesia and the ten countries of the Association of Southeast Asian Nations (ASEAN).

In the context of thinking about the year 2050, the bipolar development of the world is therefore important. On the one hand, there are the United States and the EU, and on the other, the Asia-Pacific region, where the economic, commercial and, increasingly, technological centre of gravity is shifting.

The state of democracy is changing. Changes in democratic systems, although difficult to grasp, are becoming increasingly visible. A study[99] conducted by Freedom House on the state of democracy in Central and Eastern Europe and Eurasia points to significant negative trends. A total of 29 countries were surveyed, with 24 showing a deterioration in the state of democracy.

It is worth noting that countries where the democratic system functions smoothly are also characterised by a high level of political stability, effective governance and civil liberties. Half of the countries with the highest level of political stability are located in Europe, and the index values have remained stable over the last decade. City-states and island states (though not necessarily democratic) also account for a large share of this group. Poland's political stability index has fallen significantly over the last decade. Poland ranks only 60th in the ranking[100].

The socio-political systems operating around the world, including democracy and its variants, are increasingly using technological progress and social engineering to control the behaviour of their citizens. For example, China 5.0 is becoming a symbol of achieving technological power over citizens in order to maintain and strengthen the position of those in power. The weaknesses of democracy, which is unable to effectively prevent various types of political, social and economic pathologies, are coming to light.

Trends contributing to the megatrend:

- Growing political importance of Asia;
- Weakening democratic mechanisms;
- Increasing international tensions, including new armed conflicts threatening to escalate.

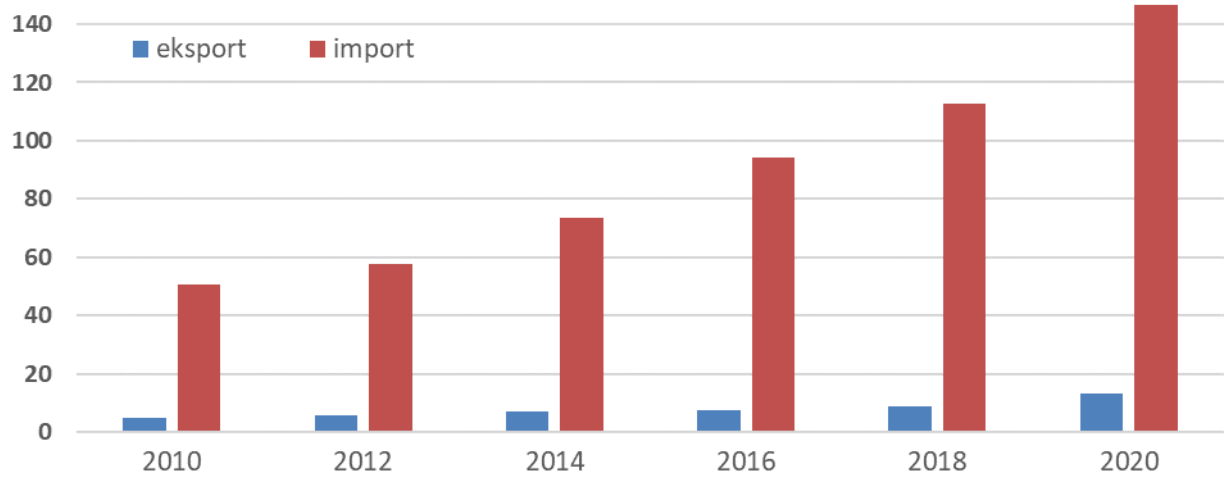
[99] Nations in transit. The Antidemocratic turn, 2021, Washington DC, Freedomhouse.

[100] World Bank, 2022.

GROWING POLITICAL IMPORTANCE OF ASIA

In the context of Polish-Chinese relations, Poland continues to act more as a member of the EU than as a separate economic and political entity. Nevertheless, it is important to note that China is Poland's second largest trading partner in imports (after Germany). In just six years (between 2015 and 2020), the value of imports from China increased by nearly 55%. China is not one of Poland's main export countries, but there is also a clear upward trend in this area, with an increase of 76%[101].

Figure 15: Trade between Poland and China [in PLN billion]



Source: own elaboration based on Eurostat data.

Eksport	Export
Import	Import

In the context of the war in Ukraine and Russia's noticeable rapprochement with China, it is and will remain particularly important for Poland to strengthen its position within NATO structures. In political terms, it will be essential to address questions about the sources of Poland's geopolitical security and the possibility of Poland playing a greater role in the economic sphere (in the context of the future economy).

Projected trend effects in Poland:

- In social terms, there may be further social polarisation regarding the importance of the EU and social activation around strategic choices that will be made in relation to the potential conflict between the so-called East and West.
- In environmental terms, Poland may see an improvement in environmental indicators as a result of restrictions on economic activity that does not comply with strict environmental protection requirements. At the same time, there is a risk that some of this activity will be transferred to countries with lower standards, which, from the perspective of global environmental responsibility, should be considered undesirable.
- In spatial terms, there will be a development of transcontinental transport links and the strengthening of Poland's position as part of transport routes of international importance.
- In institutional terms, there will be a development of policies aimed at enhancing Poland's strong economic competitiveness and strengthening the country's position within international structures.

WEAKENING DEMOCRATIC MECHANISMS

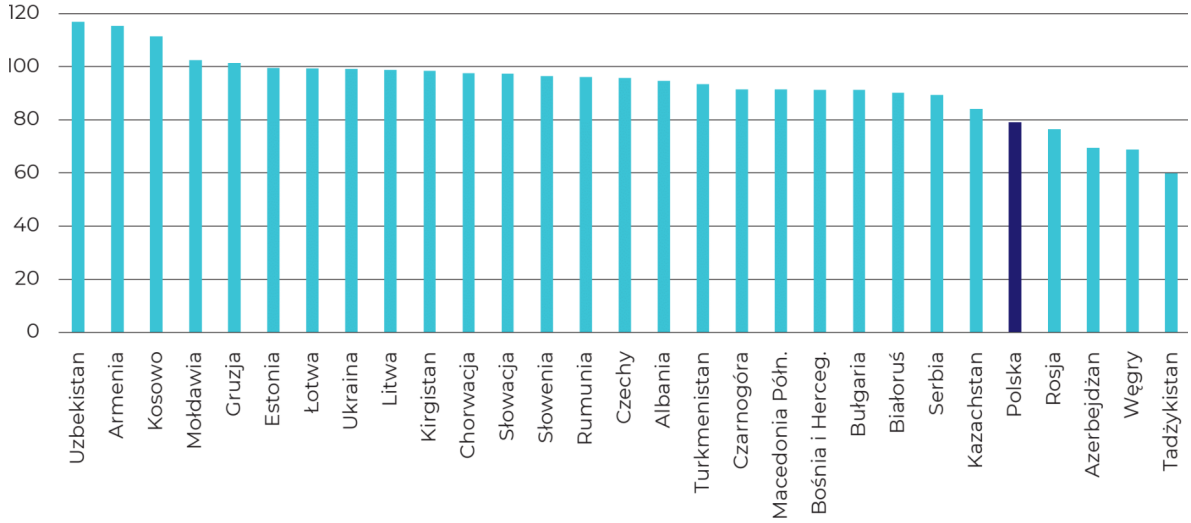
In line with identified global trends, strong democracies are found primarily in Northern and Western Europe. Less efficient systems operate in Central and Eastern Europe and South-Eastern Europe[102]. According to a study on the

[101] Yurkiewicz, Dziemianowicz 2023b based on SWAiD data.
[102] See *Global democracy…*, 2021 (available at: https://www.economist.com/graphic-detail/2021/02/02/global-democracy-has-a-very-bad-year) and Herre, Roser, 2013, *Democracy, Our World in Data* (available at: https://ourworldindata.org/democracy).

state of democracy conducted by Freedom House[103] in Central and Eastern European countries, Poland scores 4.6 on a 7-point democracy index. At the same time, it belongs to a group of countries that have experienced above-average negative changes between 2011 and 2021.

Figure 16: Democracy Index – change between 2011 and 2021

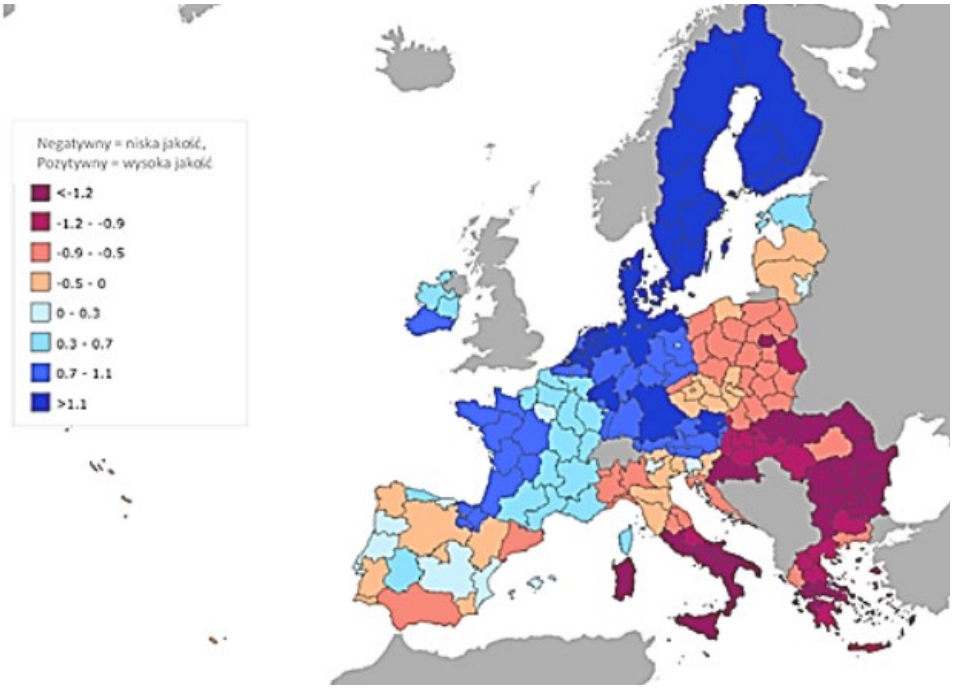
(2011 = 100)



Source: own elaboration based on Nations in transit data. The Antidemocratic turn 2021

The European Quality of Government Index, prepared by researchers from the Institute for Governance Quality at the University of Gothenburg, allows for the capture of governance aspects at the sub-national level. In 2021, Polish regions achieved negative values for this index, lower than those of Northern and Western Europe, but similar to those of neighbouring countries – the Czech Republic and Slovakia. Between 2010 and 2017, Poland stood out from the EU in terms of the number of regions that saw an improvement in this index. Between 2017 and 2021, a deterioration in governance quality was identified in numerous regions of the country.

Map 15: European Quality of Government Index (1)

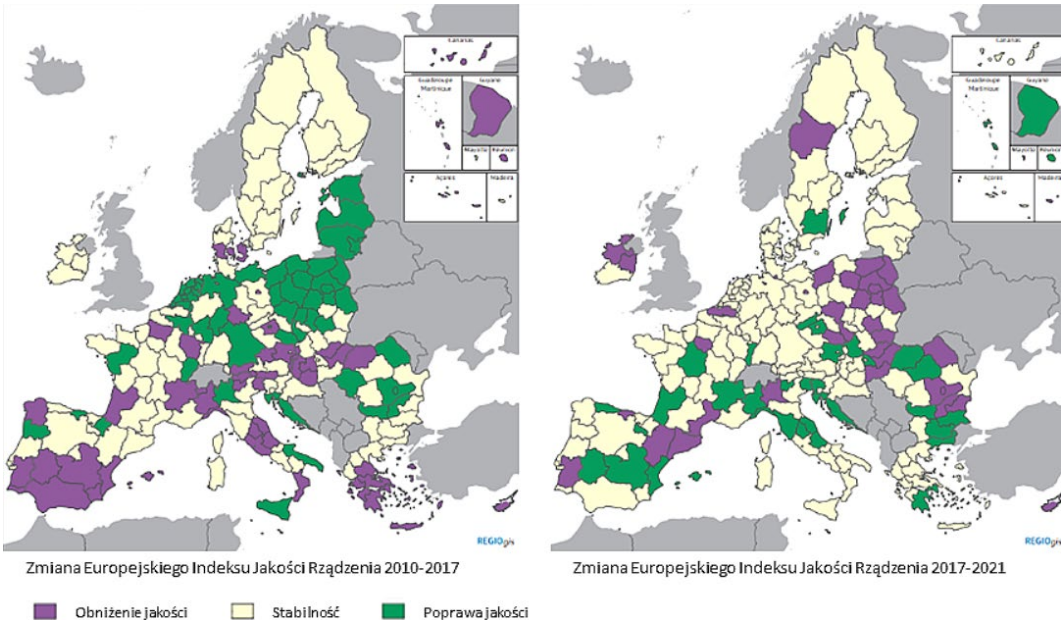


Source: Cohesion in Europe towards 2050… 2022, as cited in: Jurkiewicz, Dziemianowicz 2023b

Negatywny = niska jakość	Negative = low quality
Pozytywny = wysoka jakość	Positive = high quality

[103] Nations in transit. The Antidemocratic turn, 2021, Washington DC, Freedomhouse.

Map 16: European Quality of Government Index (2)



Source: Cohesion in Europe towards 2050… 2022, as cited in: Jurkiewicz, Dziemianowicz 2023b

Zmiana Europejskiego Indeksu Jakości Rządzenia 2010-2017	Change in the European Quality of Government Index 2010-2017
Obniżenie jakości	Decline in quality
Stabilność	Stability
Poprawa Jakości	Improvement in quality

The level of satisfaction with democracy in Poland in the years 1993-2018 remained below the scale. Since 2018, there has been a slight predominance of Poles satisfied with the Polish political system. In the period 1992-2020, there has been a gradual decline in support for undemocratic governments[104].

Democracy in Poland will be subjected to similar tests as in other European countries. The idea of a so-called secure state may lead to the use of technology to increase state control over citizens and restrict civil liberties, thereby limiting democracy as we understand it today. The continuing division between those who are satisfied and those who are dissatisfied with the functioning of democracy in Poland will lead to further polarisation of society[105].

Projected trend effects in Poland:

- In social terms, the continuing division between those satisfied and dissatisfied with the functioning of democracy in Poland will lead to further social polarisation, and the restriction of civil liberties in the name of a secure state will lead to a decline in trust in political authorities and in society in general. As a result, grassroots movements defending civil rights and related social protests will emerge.
- In economic terms, there will be the development of new technologies related to the idea of a so-called secure state and innovations in the field of social participation.
- The division between satisfied and dissatisfied people will have a territorial dimension, including between cities and rural areas, and may also have a strong sub-regional and local dimension.

[104] Poles about democracy, 2020, as cited in: Jurkiewicz, Dziemianowicz 2023b.
[105] Yurkevich, Dziemianowicz 2023b.

INCREASING INTERNATIONAL TENSIONS, INCLUDING NEW ARMED CONFLICTS THREATENING TO ESCALATE

According to the Global Peace Index, in 2025, seven of the ten most peaceful countries in the world are located in Europe. Poland ranks 36th[106]. The highest number of armed conflicts occur in the Middle East and Africa, and the status of the conflict in Ukraine identified in 2014 is described as deteriorating[107].

At the same time, Poland and other European countries were struggling with migration from Arab countries, which was taking place via the Belarusian route. The smuggling activity was aimed at weakening the position of Poland, Lithuania and Latvia – countries that criticise the Belarusian authorities – and, as a consequence, destabilising the entire EU.

Russia's aggression in Ukraine in 2022 has radically changed the perception of Europe, especially in Central and Eastern Europe. Nowadays, due to the lack of clear information about the scale and duration of the crisis, what further actions governments will take in response to Russia's aggression and the refugee crisis, and how the private sector and consumer behaviour will change, it is difficult to identify a single scenario and determine which changes will be long-term and which will be short-term. In the near future, we may see both the emergence of new challenges and the disappearance of the current effects of the conflict[108].

Poland's geopolitical position and Russia's ongoing aggression against Ukraine suggest that Poland's strategic interests in relation to potential threats are unlikely to change by 2050. The presently declared increase in public spending on Poland's defence may translate into a strengthening of the competitive position of Polish arms companies, but at the same time, there may be political abuse of the so-called national defence interests over the freedoms and rights of citizens[109].

Projected trend effects in Poland:

- In social terms, increased international tensions and conflicts may lead to growing animosity and enmity towards citizens of other countries (in conflict with Poland) and towards the growing number of political immigrants. As a consequence, social polarisation may occur due to different perceptions of the international situation and its consequences in the form of refugees.
- Social polarisation may follow traditional left-right political divisions or social stratification, depending on citizens' standard of living and, for example, fears of foreigners associated with job losses or access to public services. Social polarisation can be exacerbated by the information bubbles in which we operate in the virtual world.
- As a consequence of the struggle to defend democratic values, civil liberties, anarchist attitudes, etc., and, on the other hand, the growth of aggression and hostility towards foreigners, there may be an increase in social protests both on the streets and via social media.
- In economic terms, there may be a rise in the arms industry and the related research and development sector.
- An increase in international armed conflicts means environmental degradation, and defence activities may lead to a decline in the importance of environmental protection.
- In spatial terms, the consequence will be the development of infrastructure for military purposes and the weakening of border areas outside the EU. The prospect of Ukraine's accession to the EU may strengthen the border regions of eastern Poland.
- In institutional terms, there will be a strengthening of cooperation within international institutions and organisations, including primarily NATO and the EU, and an increase in public spending on security and defence.

[106] *Global Peace Index 2025. Identifying and measuring the factors that drive peace, 2025.*
[107] *Global Conflict Tracker*, 2025.
[108] Smit et al. 2022, as cited in: Jurkiewicz, Dziemianowicz 2023b.
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LIST OF MAPS AND FIGURES

Maps

Figures

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