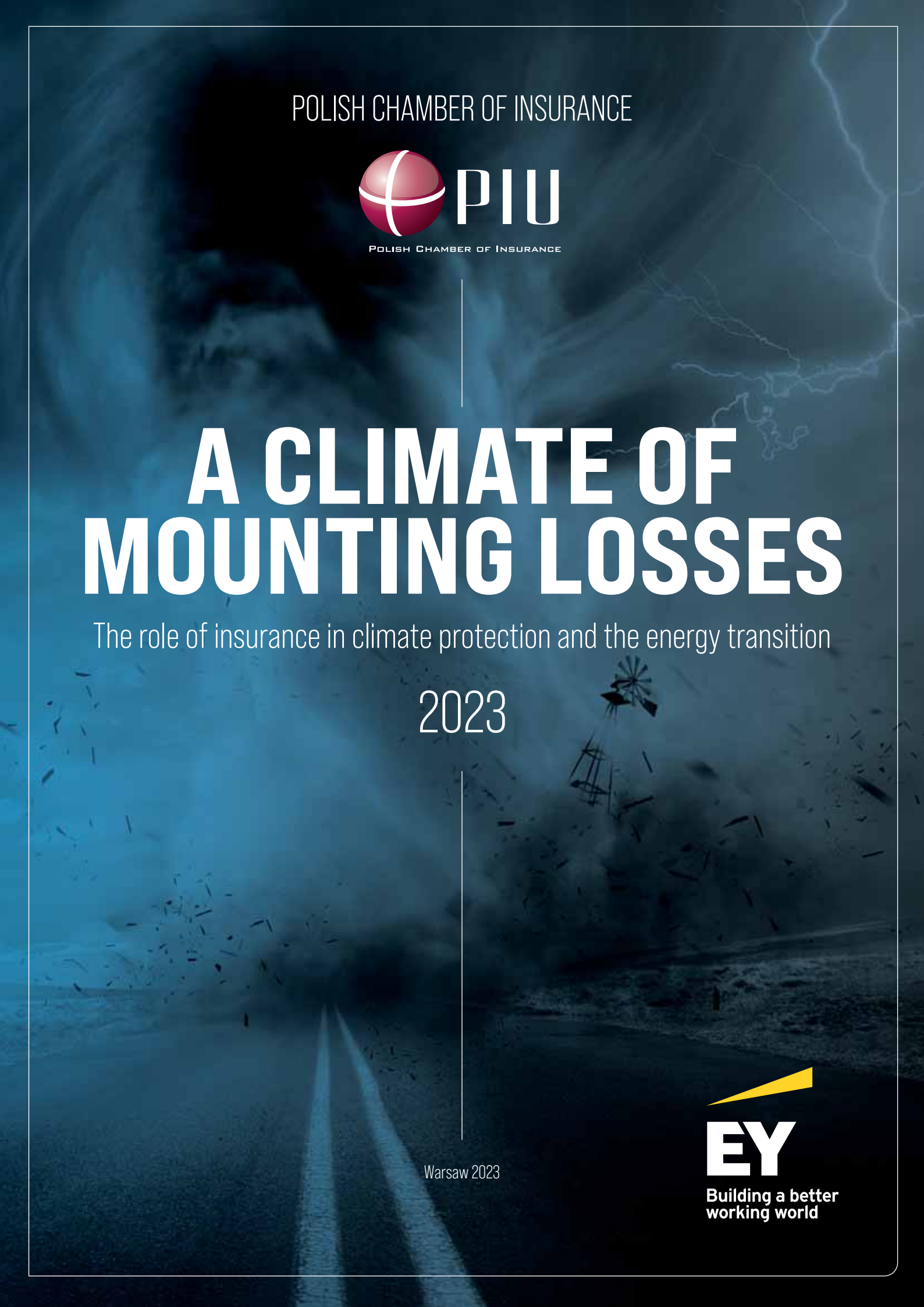


POLISH CHAMBER OF INSURANCE

PIU

Polish Chamber of Insurance

A CLIMATE OF MOUNTING LOSSES

The role of insurance in climate protection and the energy transition

2023

Warsaw 2023

EY

Building a better working world

CONTENTS

INTRODUCTION

Jan Grzegorz Prądzyński
President of the Board

Dear Readers,

In 2018, we predicted in the first climate change report that the costs of weather catastrophes and their intensity will increase. In less than 5 years that lie between the two publications, we are dealing with phenomena of tremendous proportions. There were fires in the western United States, waves of severe frost that moved far south across the globe, floods in Europe, China, Pakistan and Africa that caused huge damage. And after we completed the report edition and handed it over to the graphics studio, record-breaking heat was recorded in Spain, in South and South-East Asia, and the biggest flood in Italy in 100 years, as well as forest fires in Canada, which negatively affected air quality in a large area of North America. Recently, we have also seen that extremely high temperatures in summer not only pose a direct threat to human life and health, but also cause agricultural losses and forest fires. Last year's record-breaking heat waves in Western Europe showed that production losses due to water shortages combined with an increase in energy demand can lead to sharp price spikes on the energy exchanges and thus to turbulence on the financial markets.

Insurance is crucial for social and economic resilience to the impact of natural catastrophes. In countries where insurance is common, it is possible to quickly restore the property of individuals, businesses and public infrastructure and life returns to normal after a few months. Where insurance does not work, the effects of natural catastrophes linger for years, leading to economic decline in the affected areas and mass migration.

Climate protection is something we must all strive for. The Polish insurance market takes this challenge very seriously. Insurance and reinsurance companies invest considerable resources in environmental solutions. Insurance products that support green investments are also being developed. We carefully analyse current and proposed legislation related to ESG policies. In the report we have devoted a separate chapter to this topic. Poland, like other countries in the European Union, has committed to building a low-carbon economy by 2050. The transformation of the energy sector will be a long-term, gradual and complex process. During the activities, many technological barriers have to be overcome. In our opinion, this change will not be possible without the commitment of insurance and reinsurance companies. Their products ensure the financial security of investors, planners, contractors and later operators of new plants.

Changes in the energy sector also mean new challenges in the area of building security. In the report, we point out the risks associated with fire safety and the need to ensure adequate maintenance of the RES facilities already in operation. A separate issue will certainly be the establishment of a system of insuring nuclear risks. We hope that the report ***A climate of mounting losses. The role of insurance in climate protection and the energy transition*** will be an interesting source of knowledge for you and an inspiration for deeper discussions on the threats and challenges of climate change.

THE KEY POINTS OF THE REPORT

Between 2019 and 2021, natural catastrophes caused more than USD 600 billion in damage. The greatest damage was caused by the hurricane Ida in the USA (USD 65 billion) and the Bernd flood in Europe (USD 54 billion).

The most likely scenario is an increase in global temperature of 2 degrees Celsius by 2050. If this scenario occurs, extreme droughts will occur 2.4 times more frequently than in the pre-industrial era.

The negative effects of heat and drought on the economy could already be observed in 2022. Record temperatures were measured throughout Western Europe in the summer, and as high as 40 degrees Celsius in the British Isles. That meant records in electricity consumption. The heat was accompanied by a lack of precipitation, which caused the level of the rivers to drop to extremely low levels. Due to the lack of sufficient water, there were considerable restrictions on the generation of electricity in hydroelectric and nuclear power plants. This in turn contributed to a sharp rise in prices on the power exchanges.

Climate change will have a negative impact on Poland's economy. The relative decline in GDP will be 3% in a positive scenario in which the goals of the Paris Agreement would be achieved. GDP will fall by 10% if the temperature rise is as predicted in the pessimistic forecasts.

The drought is a serious threat to Poland. The reconstruction of water resources has been interrupted in recent years. Contrary to popular belief, it is the result of intense droughts in the 1980s and 1990s. A truly catastrophic scenario may occur if there is an overlap between the currently observed hydrological drought and the extreme meteorological droughts that have already occurred in the past.

The threat of extreme drought is associated with an increased likelihood of violent local events. Between 2016 and 2021, insurance companies reported 273 events to the OPFSA that they classified as catastrophic. Insurers paid out PLN 3.622 billion in claims. The greatest damage was caused by torrential rains, inundation events, storms, hail and hurricanes.

In Poland, the insurance of natural persons against the risks of natural catastrophes is relatively widespread. 71% of single-family homes are insured against a hurricane and 63% against the risk of flooding.

THE KEY POINTS OF THE REPORT

The construction of flood protection infrastructure is of great economic importance. The construction of a dry retention basin in Racibórz means that insured losses would be 19% and 11% lower for the floods of the same magintude as those in as in 1997 and 2010, respectively. Assuming that only 30-40% of the damage was insured at the time, one can estimate that thanks to this investment, damage with a total value of PLN 2-2.67 billion would have been avoided. These estimates refer only to direct damage.

Insurance companies play an important role in the green energy transition by offering insurance products that secure investments. Insurers also play a special role as institutional investors, directing financial flows to companies and for the implementation of projects that contribute to the fight against climate change.

The transformation of the energy sector is associated with many risks that may lead to disruptions in the implementation of investments, damage to property, environmental pollution or financial claims from individuals and entities affected by companies and institutions implementing projects in the energy sector. Companies and institutions that make investments benefit from property insurance, liability insurance, cyber insurance, insurance against loss of profits and collateral in the form of insurance bonds.

KEY FIGURES FOR NATURAL CATASTROPHES[1]

170

Number of natural catastrophes in 2021

USD 159 billion

The protection gap from natural catastrophes in 2021

7,368

Number of direct victims of natural catastrophes in 2021

39.3%

Average percentage of insured losses between, 1980–2021

EUR 487 billion

Losses suffered by all EU countries over the last 40 years due to climate change

EUR 16 billion

Losses due to climate change in Poland over the last 40 years

[1] Data on the impact of climate change on EU countries' losses: Economic losses from climate-related extremes in Europe (europa.eu). Data on worldwide losses due to natural catastrophes: Elaboration based on data from Swiss Re.

CHAPTER

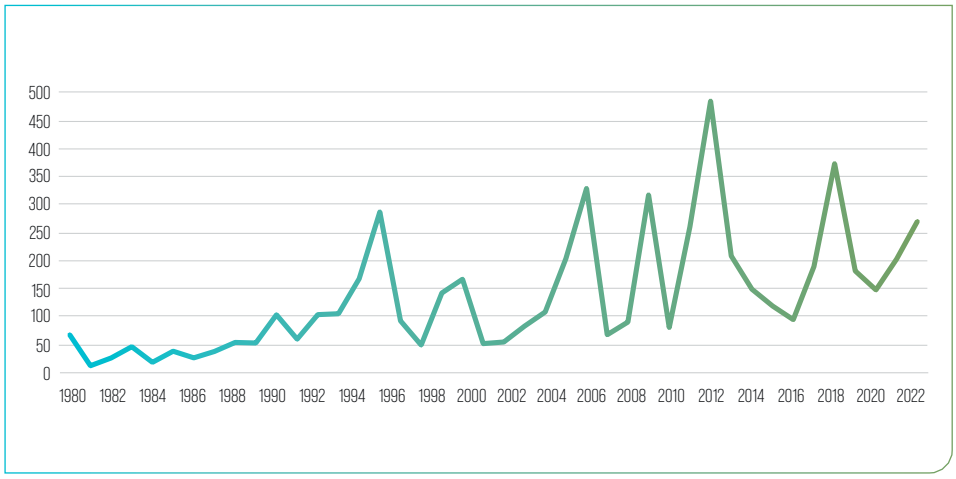
CLIMATE CHANGE AROUND THE WORLD

INTENSITY OF EXTREME EVENTS AND INCREASING LOSSES

OVER THE PAST 40 YEARS, THE NUMBER OF EXTREME EVENTS AROUND THE WORLD HAS INCREASED SIGNIFICANTLY.

In the years 1981-1990, an average of **79 natural catastrophes per year was recorded, and in the last decade the figure was as high as 186**. Financial losses related to the impact of extreme events have also increased significantly. **The annual mean for 1981-1990 is nearly USD 41 billion in losses.** In the last decade (2012–2021), this figure has increased almost fivefold – to more than USD 193 billion.

FIGURE 1.
LOSSES DUE TO NATURAL CATASTROPHES, 1980–2022 (USD BILLION)[2]



[2] Own study based on Swiss Re data.

IN THE LAST 40 YEARS, THE SHARE OF INSURED LOSSES IN TOTAL LOSSES CAUSED BY NATURAL CATASTROPHES AVERAGED 39.3%.

Despite the increasing number of natural catastrophes, the proportion of losses covered by insurance has remained at a similar level over the years, mainly due to increasing insurance penetration.

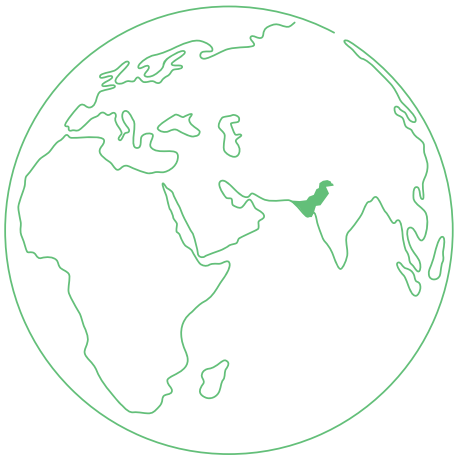
Lack of insurance leads to slower economic recovery in regions affected by natural disasters. This is especially true for developing, low-income countries.

EXAMPLES

In September 2022, **33 million** people were affected by the floods in Pakistan.

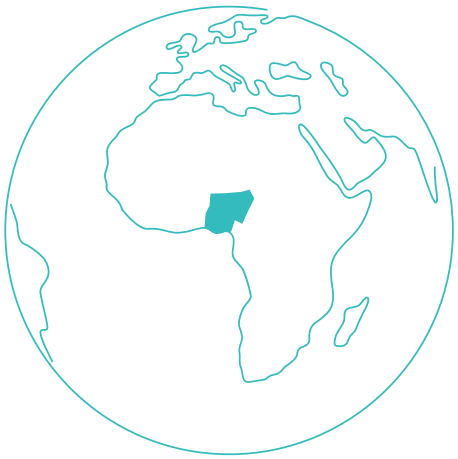
1,700 PEOPLE DIED AND 7.9 MILLION HAD TO BE RESETTLED,

of whom 600,000 are currently living in temporary relief camps. The vast majority of losses remain outside the insurance system.



In the aftermath of the October 2022 floods in Nigeria

1.3 MILLION PEOPLE HAVE BEEN RESETTLED.



In addition to the direct consequences in the form of fatalities and destruction, natural catastrophes also cause consequential damage such as famines, epidemics due to terrible hygienic conditions and political tensions. As a result, we can expect an intensification of climate-induced migration movements.

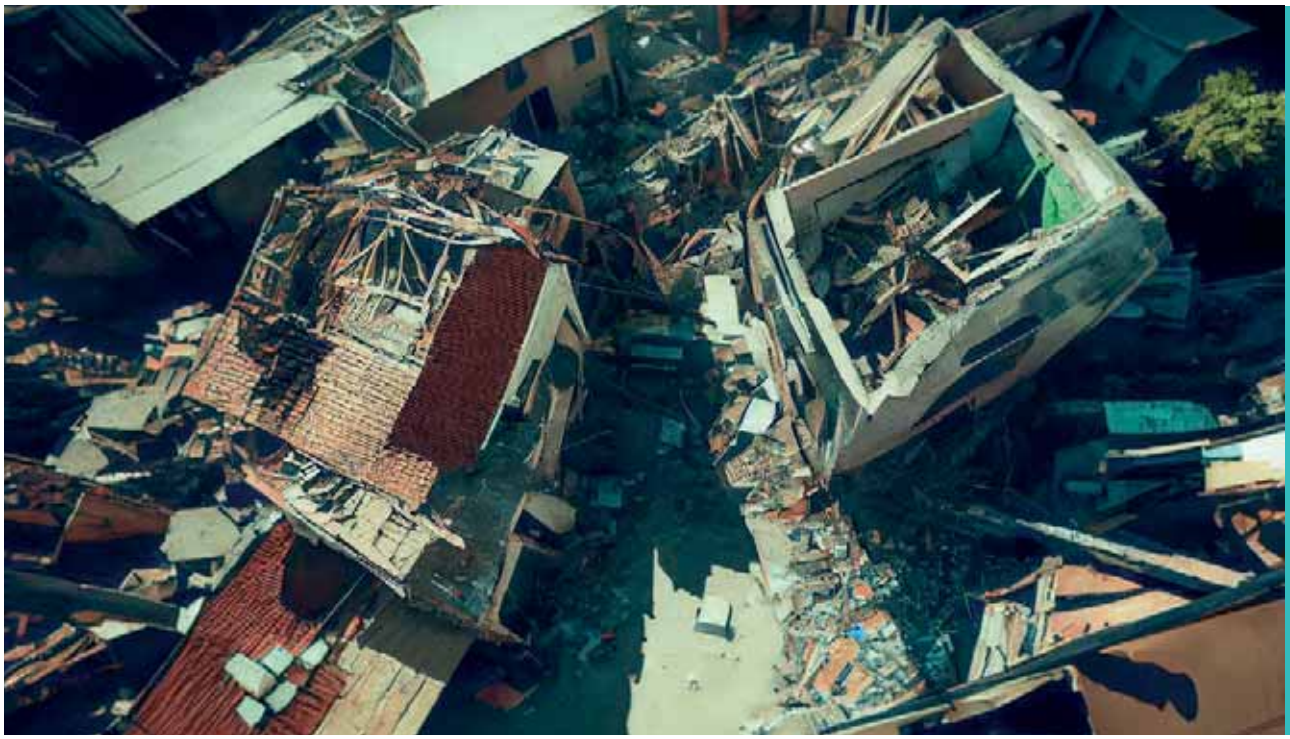


FIGURE 2
NATURAL CATASTROPHES AROUND THE WORLD, 2019–2021

	2019	2020	2021
number of events	204	190	170
total losses (USD billion)	147.3	202.6	270
insured losses (percentage of total losses)	38.8%	44.4%	41%
fatalities	8,419	5,820	7,368

Source: own study based on Swiss Re data

MAJOR CATASTROPHES CAUSED BY THE ELEMENTS, 2019–2022

OVER THE PAST THREE YEARS, NATURAL CATASTROPHES HAVE CAUSED MORE THAN **USD 600 BILLION IN DAMAGE**. THE GREATEST DAMAGE **WAS CAUSED BY THE HURRICANE IDA AND THE BERND FLOOD IN EUROPE**. GERMANY WAS PARTICULARLY AFFECTED, WITH INSURED LOSSES OF EUR 8.1 BILLION ACCORDING TO A GDV[3] REPORT. THE FLOODS IN CHINA ALSO HAD CATASTROPHIC CONSEQUENCES. 41% OF TOTAL LOSSES WERE INSURED.

The insurance gap became clearly visible during the floods in Germany. At that time, **more than 200,000 flood claims** were reported, including about 40,000 for damaged vehicles, 90,000 for damaged buildings and nearly 30,000 for damaged business property and business interruption[4]. **There, the percentage of insured losses was only 24%.** In Germany, after the flood, a debate began about compulsory household insurance against this risk. **Only 46% of households in 2021 were protected from flooding or heavy rainfall[5].** The German Insurance Association (GDV) has set up a special website[6] where residents can check historical damage in the areas where they live to encourage them to take extra precautions to protect their property[7].

Extreme temperatures were also the cause of much damage during the reporting period. Severe frost in Texas in February 2021[9] denied 5 million people access to electricity because infrastructure and transmission grids could not adapt to such temperatures[10]. The outages resulted in infrastructure with an installed capacity of about 46 gigawatts[11] being taken off the grid, which is roughly the amount that the whole of Poland had at that time.

[3] GDV Naturgefahren – report 2022, page 39.
[4] A year after floods in Germany a quarter of insurance claims still open (Reuters).
[5] Only 46 Percent of German Households Have Flood Insurance (FloodList).
[6] Naturgefahren-Check fürs Haus: Jetzt Risiko online ermitteln (dieversicherer.de).
[7] Insured flood losses in North Rhine-Westphalia and Rhineland-Palatinate in the range of 4 to 5 billion euros (gdv.de).
[9] Hurricanes, cold waves, tornadoes: Weather disasters in USA dominate natural disaster losses in 2021 (Munich Re).
[10] Texas House Panel Advances Bill Requiring Power Plants to Prep for Extreme Weather (insurancejournal.com).
[11] https://www.texasmonthly.com/news-politics/texas-blackout-preventable/

HUGE DAMAGE WAS ALSO CAUSED BY RECORD HEATWAVES, WHICH PARTICULARLY AFFECTED CALIFORNIA.

In December 2020, nearly 110,000 fires broke out in the state, damaging 10,500 buildings. The area burned was more than four times the size of that affected by the 2015-2019 fires. **Damage from wildfires in the United States amounted to around USD 16 billion in 2020, of which around 70% was insured**[12].

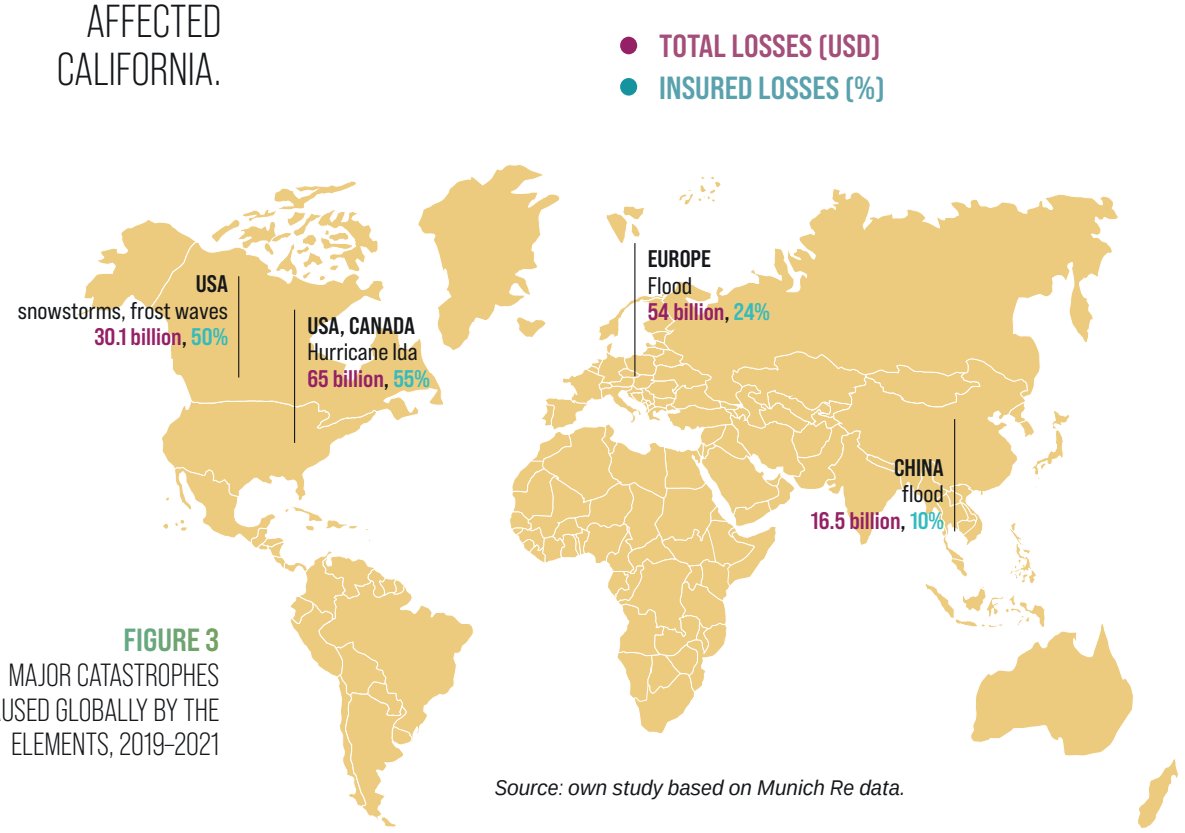


FIGURE 3
MAJOR CATASTROPHES CAUSED GLOBALLY BY THE ELEMENTS, 2019–2021

Source: own study based on Munich Re data.

However, the consequences of catastrophes are not only direct losses in the affected region (deaths, damaged infrastructure), but also disruptions in supply chains that affect society as a whole. The exemplary impact of the events on supply chains, shown below, was felt by a significant part of society.

FLOODING IN WESTERN EUROPE, JULY 2021

The infrastructure of the Vodafone mobile network was destroyed, resulting in one sixth of the transmitting stations being cut off from the network[13]. It took several days to repair the damage.

HURRICANE IDA, 2021

In the fuel market, the number of barrels of oil produced in the affected areas fell **by 16 million in the first 10 days after the** disaster (more than 90% of production was halted)[14].

HURRICANES IN EUROPE, 2022

Due to a power failure in Poland on 19 February 2022, **almost 600 passenger** trains were delayed and rail services were **suspended on 31** sections of railway lines[15].

FIRES IN AUSTRALIA, 2019-2020

More than 800 million animals died in the **fires. Some of them** were livestock – their deaths caused losses of EUR 2 billion to producers[16].

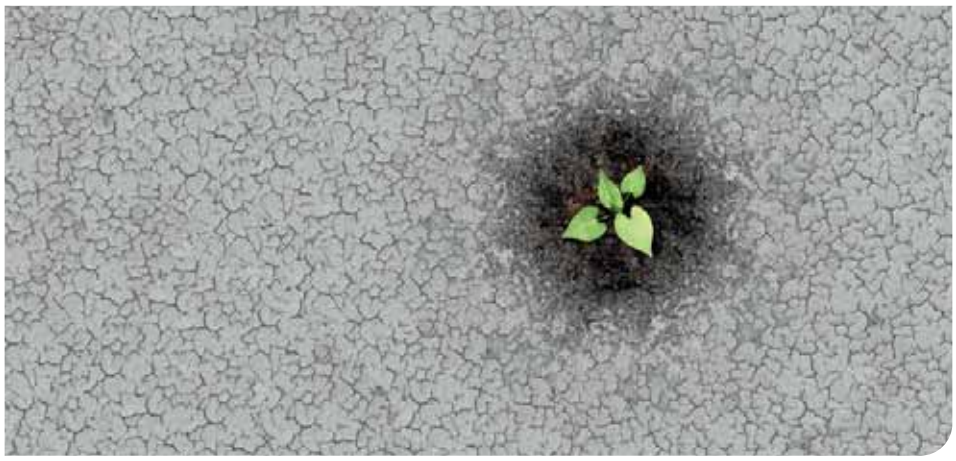
[12] Munich Re: Insured 2020 Natural Catastrophe Losses Hit $82 Billion on Hurricanes, Wildfires (ambest.com).
[13] https://businessinsider.com.pl/wiadomosci/niemcy-stracily-miliardy-w-powodzi-idzie-gospodarczakatastrofa/c9et1z1
[14] Hurricane Ida's damage tally could top $95 billion, making it 7th costliest hurricane since 2000 (cnbc.com).
[15] Niebezpieczny orkan Eunice przechodzi przez Polskę. Brak prądu i paraliż na kolei. Nowe dane (Polska The Times).
[16] Everstream Analytics Special Reports - Bushfires in Australia.

FORECASTS OF CLIMATE CHANGE AND ITS IMPACT ON INSURANCE

PROJECTED CLIMATE CHANGE FOR THE WORLD

1°C

that is how much the average global temperature will rise between 2020 and 2050.



Currently, the most likely scenario is an increase in global temperature of **2 degrees Celsius by 2050** compared to the pre-industrial era and an increase in global average temperature of 1 degree Celsius between 2020 and 2050. Among other things, this will lead to a rise in sea levels and record-breaking air temperatures, which are also dangerous for humans. The intensity of evaporation will also increase, leading to disruptions in water management[17]. **Agriculture will be particularly affected.** It is estimated that global maize and soybean yields could fall by about 5% in the second half of the twenty-first century[18].

ACCORDING TO EXPERTS, THE FREQUENCY AND INTENSITY OF SEVERAL TYPES OF EVENTS WILL INCREASE IN THE COMING YEARS.

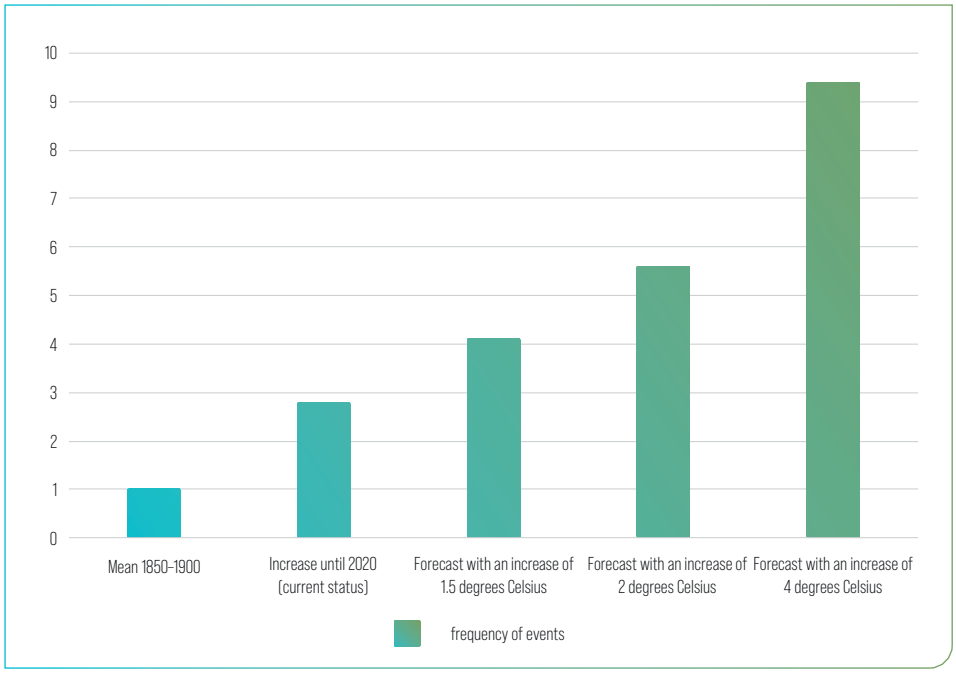
[17] IPCC Report, abbreviated version in Polish, Raport_IPCC_2021_11_04_TŁUMACZENIE_FINAL.pdf (pan.pl).
[18] How climate change affects soybean and corn farming globally — Quartz (qz.com).

EXTREME TEMPERATURES ON LAND

ONE OF THE GREATEST DANGERS ARE RISING TEMPERATURE AMPLITUDES.

Currently, heat waves are responsible for about 0.5 million deaths per year worldwide[19]. At the current rate of climate change, however, extreme heat periods will occur many times more frequently. The most likely scenario of temperature increase assumes that the frequency of their occurrence in 2050 will more than quadruple compared to pre-industrial times[20]. The intensity of such events will also increase. Temperatures during heat waves will be on average more than 1 degree Celsius higher than today.

FIGURE 4
INCREASE IN THE FREQUENCY OF EXTREME TEMPERATURES OCCURRING WITH A PROBABILITY ONCE EVERY 10 YEARS IN THE WORLD



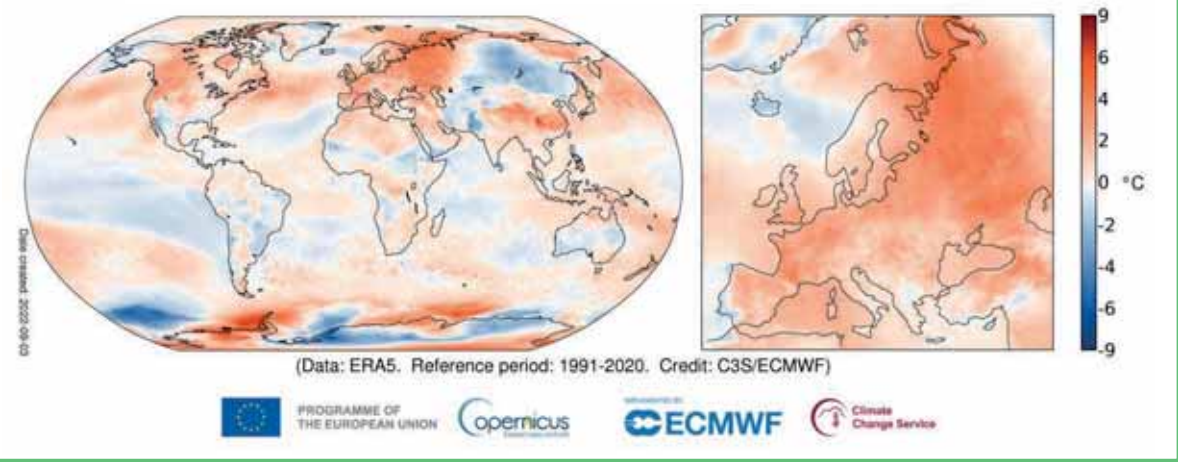
Source: own study based on IPCC data. The simulation results cover all terrestrial areas of the world.

The graph shows the frequency of extreme heat waves that occurred on average every 10 years in the years 1850–1900. At present, such events occur 2.8 times more frequently than they did then.

[19] Global, regional, and national burden of mortality associated with non-optimal ambient temperatures from 2000 to 2019: a three-stage modelling study (The Lancet Planetary Health).
[20] IPCC Report 6, abbreviated version in Polish, Raport_IPCC_2021_11_04_TŁUMACZENIE_FINAL.pdf (pan.pl).

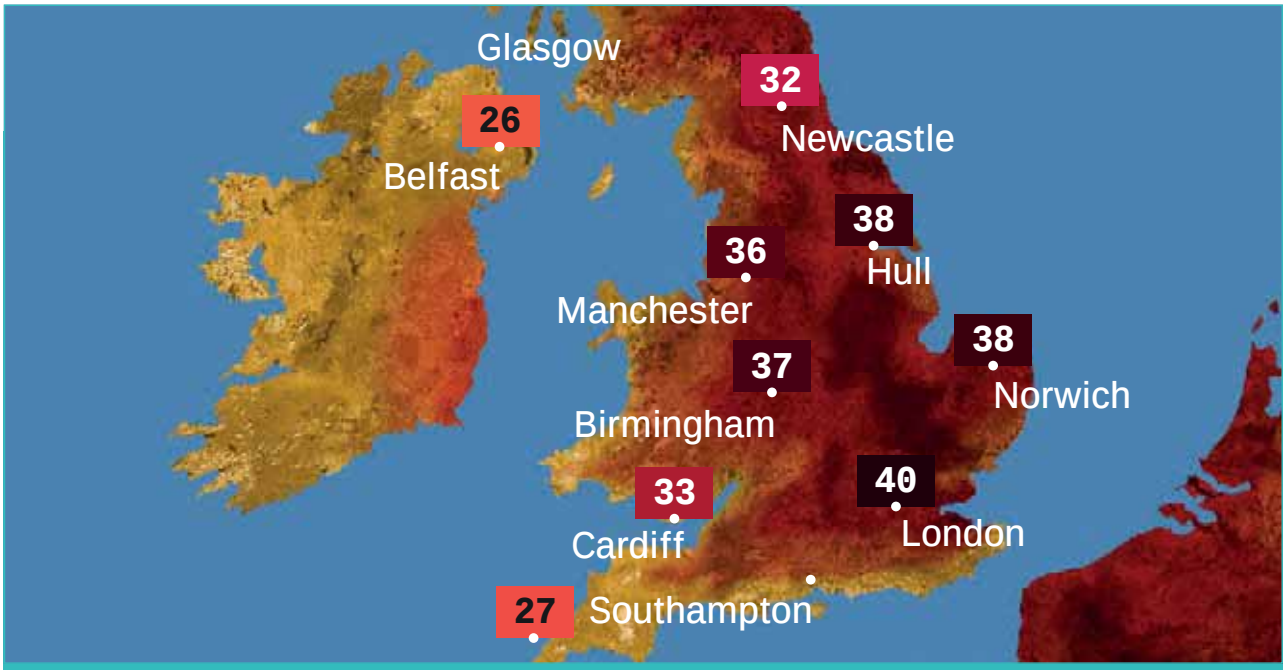
In the summer of 2022, extremely high temperatures were measured throughout Europe. Heat waves of 40 degrees Celsius were reported in the British Isles. The greatest deviations from the average occurred in northern Russia. Temperatures were also higher than average in northern Canada. This means that a considerable amount of heat has accumulated in the Arctic Ocean, **which affects the thickness of the ice sheet in this region**.

AREAS WITH ABNORMAL AIR TEMPERATURE



AREAS WITH AN AVERAGE TEMPERATURE IN AUGUST 2022 IN RELATION TO THE AVERAGE TEMPERATURE IN AUGUST IN THE PERIOD 1991–2020

Source: https://climate.copernicus.eu/copernicus-summer-2022-europes-hottest-record.



A WAVE OF HOT AIR STRETCHED FROM PORTUGAL TO THE BRITISH ISLES, WHERE RECORD TEMPERATURES WERE REGISTERED.

The graphic is based on https://news.un.org/en/story/2022/07/1122822.

HEAVY PRECIPITATION ON LAND

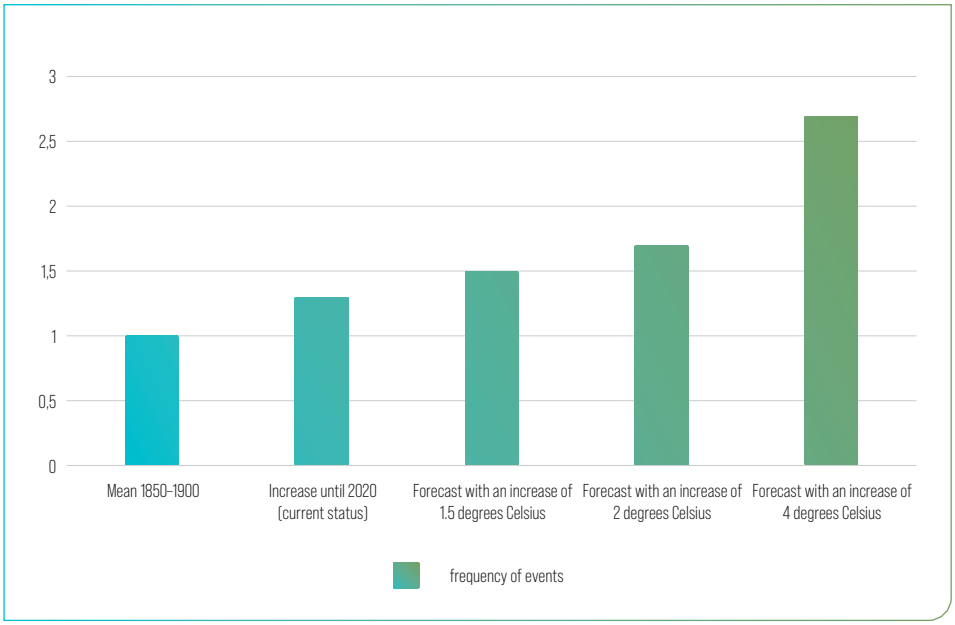
EXPERTS PREDICT AN INCREASE IN THE INTENSITY OF HEAVY PRECIPITATION.

One of the consequences of heavy rainfall can be the so-called flash flood. Flash floods are caused by heavy rainfall that the ground cannot absorb, so low-lying areas are flooded. Particularly great damage occurs in cities with a small amount of blue-green infrastructure. Preventing such events is one of the most important goals of climate change mitigation for city managers, which we discuss in more detail in Chapter Two.

EXAMPLES
LUDWIGSBURG, GERMANY, 20–30 JUNE 2022
198.7 LITRES FELL ON A SQUARE METRE

The Bernd low-pressure area was the cause of the rainfall in Cologne. In two **days, more than 160 litres of water fell on one square metre.** This led to violent floods and inundations that claimed 134 lives[21].

FIGURE 5
AN INCREASE IN THE FREQUENCY OF HEAVY PRECIPITATION EVENTS OCCURRING WITH A PROBABILITY OF ONCE IN 10 YEARS WORLDWIDE.



Source: own study based on IPCC data. The simulation results cover all terrestrial areas of the world.

The graph shows the frequency of precipitation that occurred on average every 10 years in the years 1850–1900. **At present, such events occur 1.3 times more frequently. In the most likely scenario of temperature increase by 2050 (2 degrees Celsius), sudden precipitation will occur 1.7 times more frequently than in pre-industrial times.**

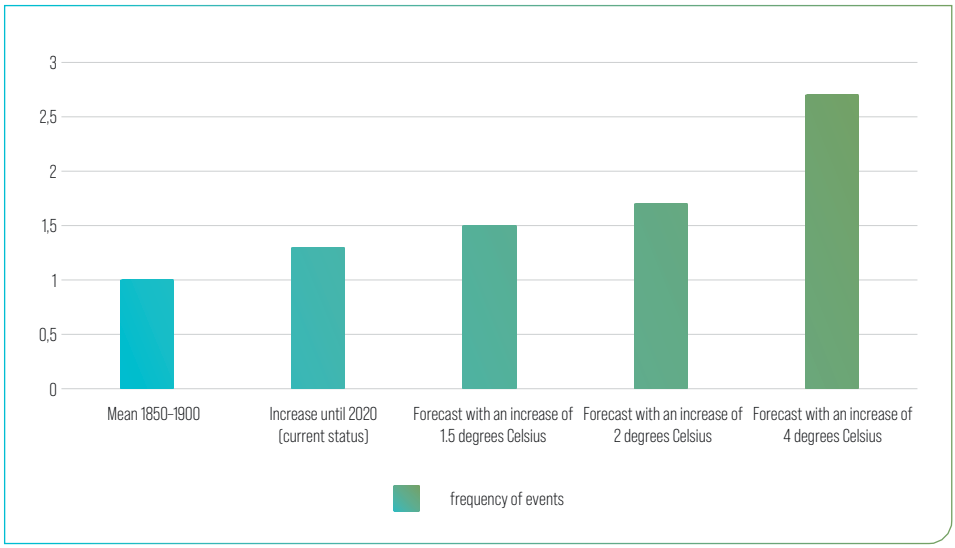
[21] GDV Naturgefahren - report 2022.

AGRICULTURAL AND ENVIRONMENTAL DROUGHTS

DUE TO WEATHER CHANGES, MANY REGIONS ARE EXPOSED TO PERIODS OF DROUGHT, THE EFFECTS OF WHICH ARE INCREASINGLY SERIOUS FOR THE INHABITANTS.

The frequency of environmental and agricultural droughts will increase. At the current rate of climate change, the frequency of droughts will increase by 1.4 times by 2050. Droughts are associated with severe consequences for agriculture, for example the 2019 drought in Poland reduced crop yields by about 20%.

FIGURE 6
WAN INCREASE IN THE FREQUENCY OF AGRICULTURAL DROUGHTS, WITH A PROBABILITY OF ONCE IN 10 YEARS, IN SELECTED REGIONS OF THE WORLD.



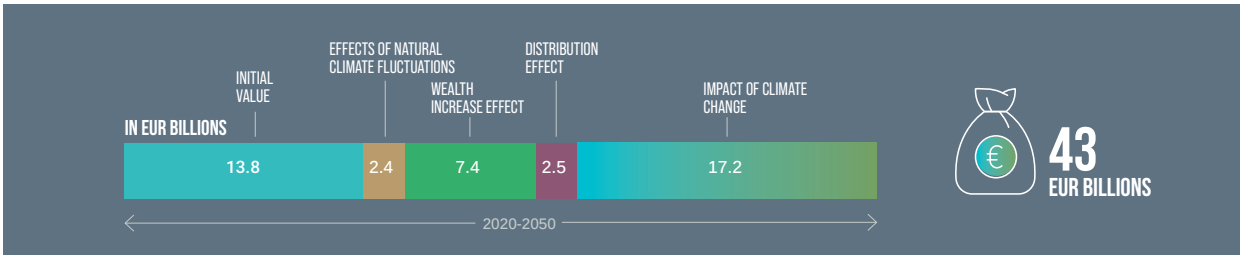
Source: own study based on IPCC data. The simulation included the drying regions listed in 6th IPCC Report. The simulation covered Western and Central Europe, among other areas.

The graph shows the frequency of droughts that occurred on average every 10 years in the years 1850–1900. At present, such events occur 1.7 times more frequently. **In the most likely scenario of temperature increase by 2050 (2 degrees Celsius), droughts of this type will occur 2.4 times more frequently than in pre-industrial times.**

Drought does not only mean agricultural losses. Hydrological drought leads to a drop in the water table, which changes the geological conditions of individual sites. As a result of the disappearance of groundwater layers, cavities are created. There is therefore a danger of landslides and collapses. This phenomenon occurs on a large scale in France.

French insurers estimate that the value of related losses will be three times higher in the 2020–2050 period than in the thirty-year period 1989–2019.

FRANCE – THE EXPECTED IMPACT OF DROUGHT RISK CONSIDERING VARIOUS FACTORS IN THE PERSPECTIVE OF THE YEAR 2050



the expected total value of damage by 2050 is

SLIGHTLY HIGHER THAN THREE TIMES THE AVERAGE

total value of damage over the last 31 years

5 DEPARTMENTS

Two-thirds of the growth of the loss/claims ratio occurred in five departments. The departments with the highest risk exposure are Haute Garonne (23%), Gironde (19%), Bouches-du-Rhone, Tarn-et-Garonne and Tarn (8%)

A SURVEY SHOWS THAT CLAIMS PAYMENTS

for damage caused by collapses and landslides due to the drought are increasing

IMPACT OF CLIMATE CHANGE

in the trend of an increase in the value of claims in excess of EUR 17 billion is the most important inflationary factor

Source: France Assureurs, Impact du changement climatique sur l'assurance na l'horizon 2050

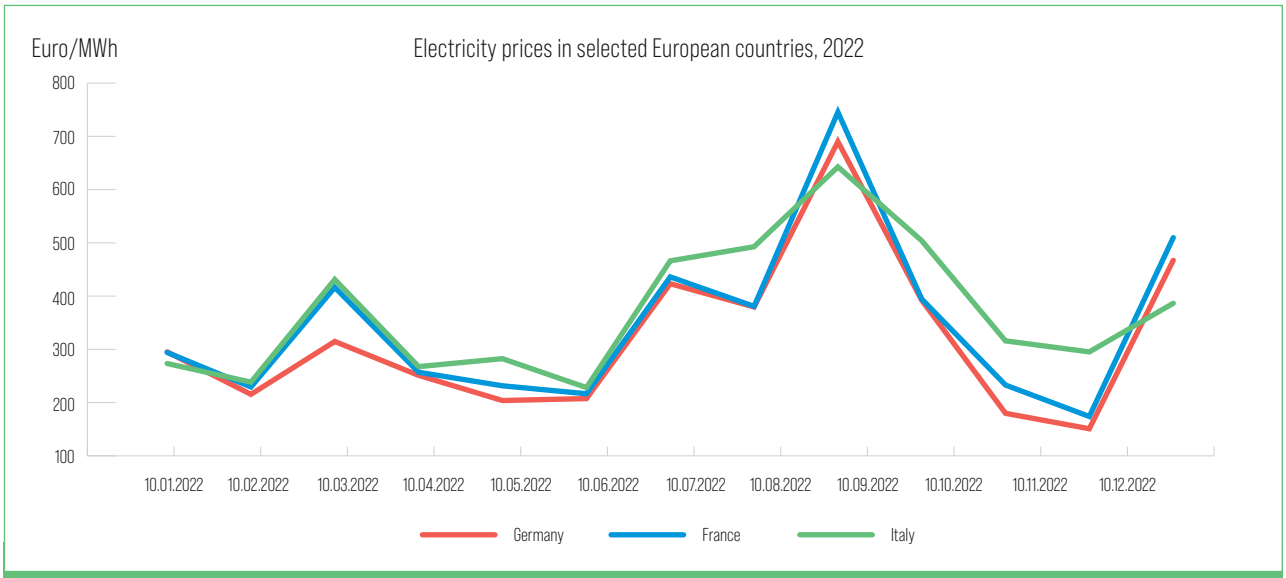
CHANGE IN PRODUCTION VOLUME (THW) IN EUROPE BY INDIVIDUAL ENERGY SECTORS IN THE PERIOD JANUARY–JULY 2022 COMPARED TO THE SAME PERIOD IN 2021 – THE INFLUENCE OF WEATHER FACTORS

Source: Rystad Energy

Custom graphics based on www.bbc.com/news/science-environment-62524551

Drought also means trouble for the energy sector. The low water level of rivers in 2022 has led to a significant reduction in electricity generation from hydro and nuclear power plants. Nuclear reactors require an enormous amount of water for cooling.

In Spain, hydropower production has decreased by 40% in 2022 compared to 2021[22]. In France, nuclear reactors were shut down because of the falling river level. The decline in electricity production in Western Europe has contributed to a sharp rise in electricity prices. The negative effects of the war in Ukraine have been mixed with adverse weather events[23].



OWN STUDY BASED ON ELECTRICITY PRICES EUROPE (EUENERGY.LIVE).

Regardless of the assumed climate change mitigation scenario, extreme events such as droughts, precipitation events or heat waves will become more frequent, leading to an increase in the number and value of associated damages. **In this situation, prevention is particularly important to reduce the social and economic risk of the negative impact of natural catastrophes. Above all, it is about the right spatial planning, about building standards, about the right technical condition of the building structures.**

[22] https://www.bbc.com/news/science-environment-62524551
[23] https://www.rfi.fr/en/france/20200825-drought-provokes-shutdown-nuclear-reactors-northeast-france-belgium-ardennes-chooz-meuse
[24] https://stooq.pl/n/?f=1507239

THE CONSEQUENCES OF NOT TAKING PROPER PREVENTIVE MEASURES

MACROECONOMIC MODELS DEVELOPED BY RESEARCHERS AT THE EUROPEAN CENTRAL BANK (ECB) AND THE EUROPEAN INSURANCE AND OCCUPATIONAL PENSIONS AUTHORITY (EIOPA) **SHOW THAT THE IMPACT OF EXTREME EVENTS COULD INCREASE SIGNIFICANTLY IF COUNTRIES DO NOT TAKE APPROPRIATE ACTION.**

FIGURE 7
EXPECTED ANNUAL INCREASE IN COSTS OF CATASTROPHIC EVENTS IN EUROPE (IN MILLION EUR) IF NO MEASURES ARE TAKEN TO ADAPT TO CLIMATE CHANGE[25]

	HISTORICAL MEAN (1981–2010)	2050 (rise by 1.5 degrees Celsius)	2100 (rise by 2 degrees Celsius)
HURRICANES	4,594	49%	148%
DROUGHT EVENTS	9,048	37%	248%
RIVER FLOODS	7,809	100%	324%
COASTAL FLOODS	1,400	679%	7800%
TOTAL	**22,851**	**100%**	**716%**

HURRICANES, FLOODS AND DROUGHTS ARE AMONG THE MOST IMPORTANT EVENTS.

Without adaptation measures, floods will be particularly dangerous, their frequency and intensity will increase significantly, and consequently flood-related damage will recur and be higher. **In particular, rising sea levels will dramatically increase the risk of coastal flooding (also known as storm surges), which can be the most costly for the European economy[26].** This is why adaptation measures that can minimise the impact of these events are so important.

89%

This is how much **the cost of flooding** can be reduced if we adapt to change

1.35 million

Number of people who may be exposed **to coastal flooding** every year

15 million

Number of people who may be affected by hurricane damage each year

[24] https://stooq.pl/n/?f=1507239
[25] Climate change, catastrophes and the macroeconomic benefits of insurance (europa.eu); JRC PESETA IV raport:: JRC PESETA IV (europa.eu).
[26] Climate change, catastrophes and the macroeconomic benefits of insurance (europa.eu).

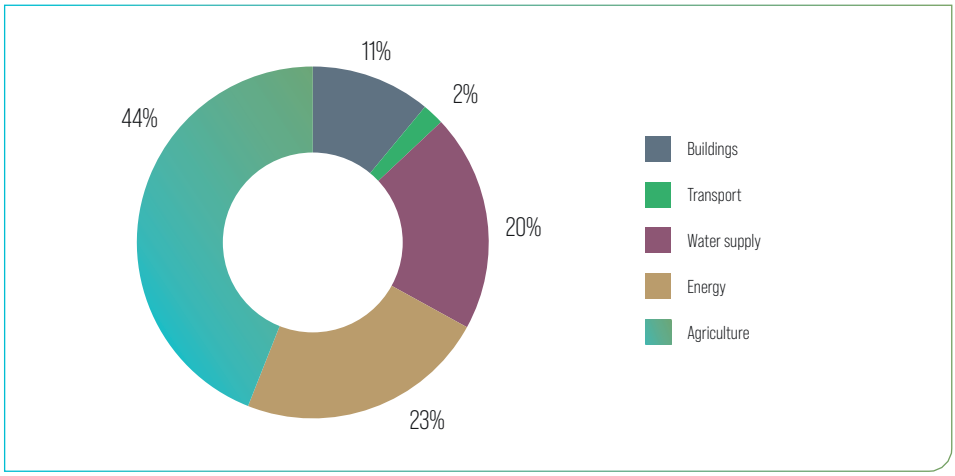
EXPERTS ESTIMATE IN THEIR FORECASTS THAT THE COSTS OF ADAPTING TO CHANGE, I.E. FOR THE CONSTRUCTION AND MAINTENANCE OF FLOOD PROTECTION FACILITIES, CAN BE REDUCED BY UP TO 89%.

The cost of potential catastrophes is notably many times higher than the cost of building protective structures. Furthermore, adapting coastal areas (especially raising dikes) can reduce the number of people exposed to death from flooding by 60%.

Violent storms and hurricanes are also a threat and cause damage of around EUR 5 billion annually in Europe alone. These phenomena are very difficult to model, which makes it difficult to determine their origin and effects. **Reports from research institutions close to the EU indicate that the thesis that climate change influences the frequency of storms and hurricanes is not currently supported by research.** In recent decades, however, there has been a marked increase in such events, and the development and implementation of building standards that strengthen hurricane resistance[27] could be the answer.

The agricultural and energy sectors will be particularly affected by droughts. For agriculture, the increased costs of irrigation, the provision of water for plants and animals, will be particularly acute. For the energy sector – the possibility of using water in the extraction of raw materials and in the cooling of reactors.

FIGURE 8
SHARE OF ECONOMIC SECTORS IN THE DAMAGE CAUSED BY DROUGHTS (PROJECTION FOR THE YEAR 2100)[28]



[27] pesetaiv_task_13_windstorms_final_report.pdf (europa.eu).
[28] JRC PESETA IV project – task 7. Global Warming and drought impacts in the EU pesetaiv_task_7_drought_final_report.pdf (europa.eu).

CLIMATE CHANGE AND GDP DECLINES FOR WORLD ECONOMIES

IN 2021, SWISS RE HAS DEVELOPED MODELS TO EXAMINE THE IMPACT OF CLIMATE CHANGE ON THE ECONOMIES OF 48 SELECTED COUNTRIES, WHICH TOGETHER ACCOUNT FOR 90% OF THE GLOBAL ECONOMY.

According to the models, these changes have a significant negative impact on the economy. Even in the most optimistic scenario, it is no longer possible to reduce this impact to zero. **However, depending on the pace of change, it is possible to limit the effects of global warming.** In the most optimistic scenario, the impact of changes oscillates around a few percent of GDP. Yet pessimistic scenarios show that the economies of some regions may shrink by as much as a quarter.

FIGURE 9
PROJECTED PERCENTAGE DECLINE IN GDP RELATIVE TO THE SCENARIO WITHOUT CLIMATE CHANGE – FORECAST FOR 2050[29]

Region	The Paris Agreement (rise below 2 degrees Celsius)	Rise by 2 degrees Celsius	Rise by 2.6 degrees Celsius	Rise by 3.2 degrees Celsius
WORLD	-4.2%	-11.0%	-13.9%	-18.1%
OECD	-3.1%	-7.6%	-8.1%	-10.6%
NORTH AMERICA	-3.1%	-6.9%	-7.4%	-9.5%
OUTH AMERICA	-4.1%	-10.8%	-13.0%	-17.0%
EUROPE	-2.8%	-7.7%	-8.0%	-10.5%
AFRICA AND THE MIDDLE EAST	-4.7%	-14.0%	-21.5%	-27.6%
ASIA	-5.5%	-14.9%	-20.4%	-26.5%
OCEANIA	-4.3%	-11.2%	-12.3%	-16.3%
POLAND	-3.0%	-7.9%	-7.9%	-10.6%

[29] A study based on a publication of Swiss RE Institute, swiss-re-institute-expertise-publication-economics-of-climate-change.pdf (swissre.com).

AFRICA AND ASIA ARE THE MOST ECONOMICALLY VULNERABLE REGIONS.

For the former continent, the dangers come primarily from water shortages and limited crop yields. By contrast, Asia is particularly vulnerable to floods and tsunamis.

ACCORDING TO A MODEL PREPARED BY SWISS RE, POLAND IS CURRENTLY THE LEAST RESILIENT TO RISKS ASSOCIATED WITH HEAVY RAINFALL. ONLY FEW COUNTRIES IN THE WORLD ARE RANKED LOWER IN THIS CATEGORY.

Climate change will result in a relative decline in Poland's GDP by 3% (in a Paris Agreement scenario) or even more than 10% if temperature rises are in line with pessimistic forecasts[30]. The models also took into account the adaptive capacity of the economies in question, the presence of institutions dealing with climate change, management of resources, and the economy of a given state (e.g. GDP per capita). According to them, the countries of North America and Europe have the greatest ability to adapt.

[30] Swiss RE Institute, The economics of climate change: no action not an option, swiss-re-institute-expertise-publication-economics-of-climate-change.pdf (swissre.com).

INSURANCE AS AN ECONOMIC STABILIZER

INSURANCE IS CRUCIAL IN MITIGATING THE IMPACT OF FUTURE DISASTERS CAUSED BY CLIMATE CHANGE.

Financially securing the affected enterprises, accelerating the recovery of the economy or shortening periods of reduced production can have a clear positive impact on the economic security of the affected regions.

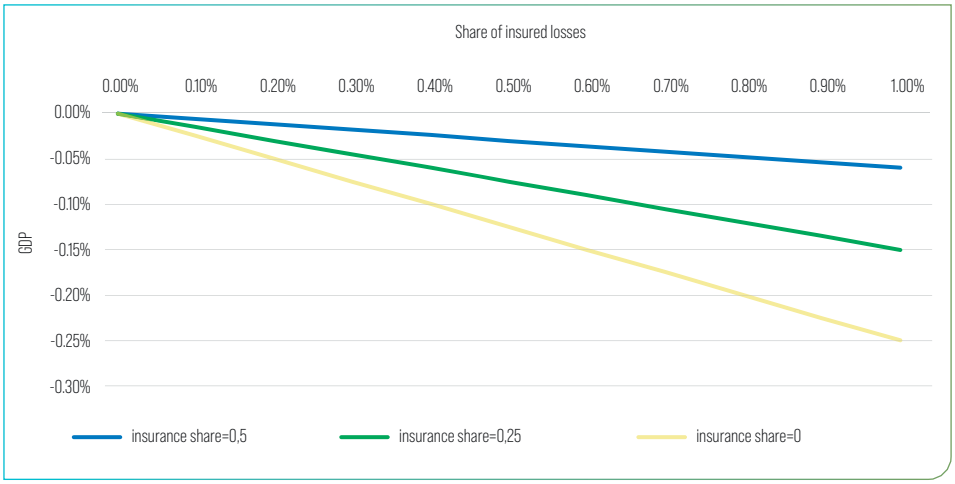
The level of insurance penetration is of particular importance when assessing the impact of disasters on the state economy. The effects of disasters can create a dangerous spiral of stagnant growth and massive debt. Expenditures are being increased by governments to reinstate uninsured property, while production is reduced due to the effects of disasters, thus diminishing budget revenues. In the case of insured property, a large portion of the cost is passed on to insurers[31].

The article "Climate change, catastrophes and the macroeconomic benefits of insurance"[32] prepared by researchers from EIOPA and the ECB **examined the impact of natural catastrophes on GDP depending on the size of loss and the level of insurance penetration**.

A HIGHER LEVEL OF PENETRATION ALLOWS FOR A FASTER ECONOMIC REBOUND FOR THE AFFECTED REGION. THIS IS PARTICULARLY EVIDENT IN EXTREME CASES WHERE A CATASTROPHE HITS THE REGION'S ECONOMY HARD. **INSURANCE CAN THEN SLOW DOWN THE ECONOMIC COLLAPSE SEVERAL TIMES.**

[31] World Bank, The Insurance Sector's Contribution to the Sustainable Development Goals; Susan Holliday, Inna Remizova and Fiona Stewart (openknowledge.worldbank.org).
[32] Climate change, catastrophes and the macroeconomic benefits of insurance (europa.eu).

FIGURE 10
THE IMPACT OF NATURAL CATASTROPHES ON THE DECLINE IN THE GDP OF SELECTED COUNTRIES DEPENDING ON THE SIZE OF THE LOSS AND THE SHARE OF INSURANCE IN THE LOSSES[33]



GLOBAL CONSENSUS AND CLIMATE TARGETS

DUE TO THE INCREASING AWARENESS OF THE MAGNITUDE OF CLIMATE THREATS, THERE IS A SCIENTIFIC AND, TO A SIGNIFICANT EXTENT, ALSO A POLITICAL CONSENSUS ON THE NEED TO LIMIT HUMAN IMPACT ON THE CLIMATE. HUMAN-INDUCED CLIMATE CHANGE HAS BEEN CONFIRMED BY THE UNITED NATION'S SCIENTIFIC BODY, THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC), AS EARLY AS 1990.

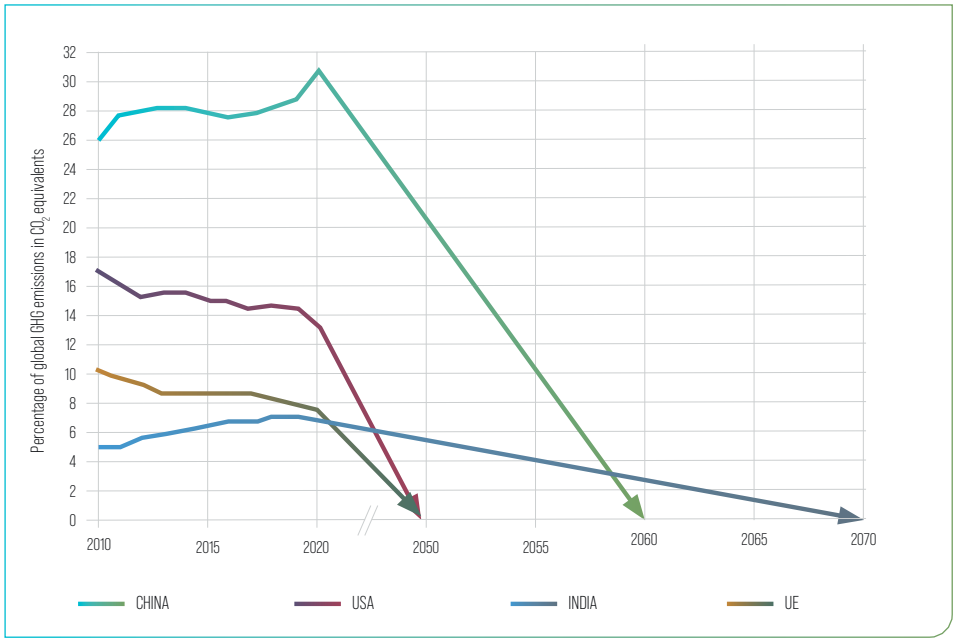
196 countries have pledged to combat climate change and limit a rise in the average temperature of the Earth's surface to below two degrees Celsius in the 2015 Paris Agreement[34].

The outcome of the above events was the announcement of decarbonisation strategies (in the case of the EU, this took the form of a climate and energy policy) by successive signatories – individual states or communities of states.

[33] Climate change, catastrophes and the macroeconomic benefits of insurance (europa.eu). The model uses empirical data on natural catastrophes and GDP for 45 countries. In the paper, you can find detailed information about the models and the data used in them.
[34] For more information, see Chapter 3.

COUNTRY	REDUCTION OF GHG EMISSIONS[35]	MARKET FOR TRADING CO_2 EMISSION ALLOWANCES	DECLARED SHARE OF RES IN THE PRODUCTION OF ELECTRICITY
EUROPEAN UNION	55% in 2030 Net-zero[36] in 2050	YES (EU ETS)	42.5% in 2030
USA	50–52% in 2030 Net-zero in 2050	YES (in some states)	42% in 2050
CHINA	60–65%[37] in 2030 Net-zero in 2060	YES (China National ETS)	39% in 2025
INDIA	Net-zero in 2070	NO	50% in 2030

FIGURE 11
PERCENTAGE SHARE OF SELECTED COUNTRIES IN GLOBAL GHG EMISSIONS IN CO_2 EQUIVALENTS[38]



There is a need to transform the widely understood energy sector **(as any activity that requires the burning of fossil fuels)**, which is responsible for about 73% of global greenhouse gas emissions (in the form of CO_2)[39]. The above commitments have brought about the European Commission policies that have resulted, among other things, in ESG regulations and the transformation of the energy sector, as discussed in the following chapters, and **which have also become significant challenges for the insurance market**.

[35] GHG – greenhouse gases (including CO_2, CH_4, N_2O, CFCs, HCFCs, HFCs). Emission volumes are calculated and reported collectively in the so-called carbon dioxide equivalent (CO2e). Source: US EPA, Overview of Greenhouse Gases, https://www.epa.gov/ghgemissions/overview-greenhouse-gases.
[36] Net-zero means that the sum of emissions produced and absorbed is 0.
[37] Applies only to CO_2.
[38] Hannah Ritchie, Max Roser and Pablo Rosado (2020) - "CO2 and Greenhouse Gas Emissions". Published online at OurWorldInData.org. Dostęp: 'https://ourworldindata.org/co2-and-other-greenhouse-gas-emissions' and EY's own study.
[39] Climate Watch, the World Resources Institute (2020).

CHAPTER 2

THE IMPACT OF EXTREME PHENOMENA AND CATASTROPHES ON POLAND

THE IMPACT OF CLIMATE CHANGE ON POLAND. THE GREATES THREATS

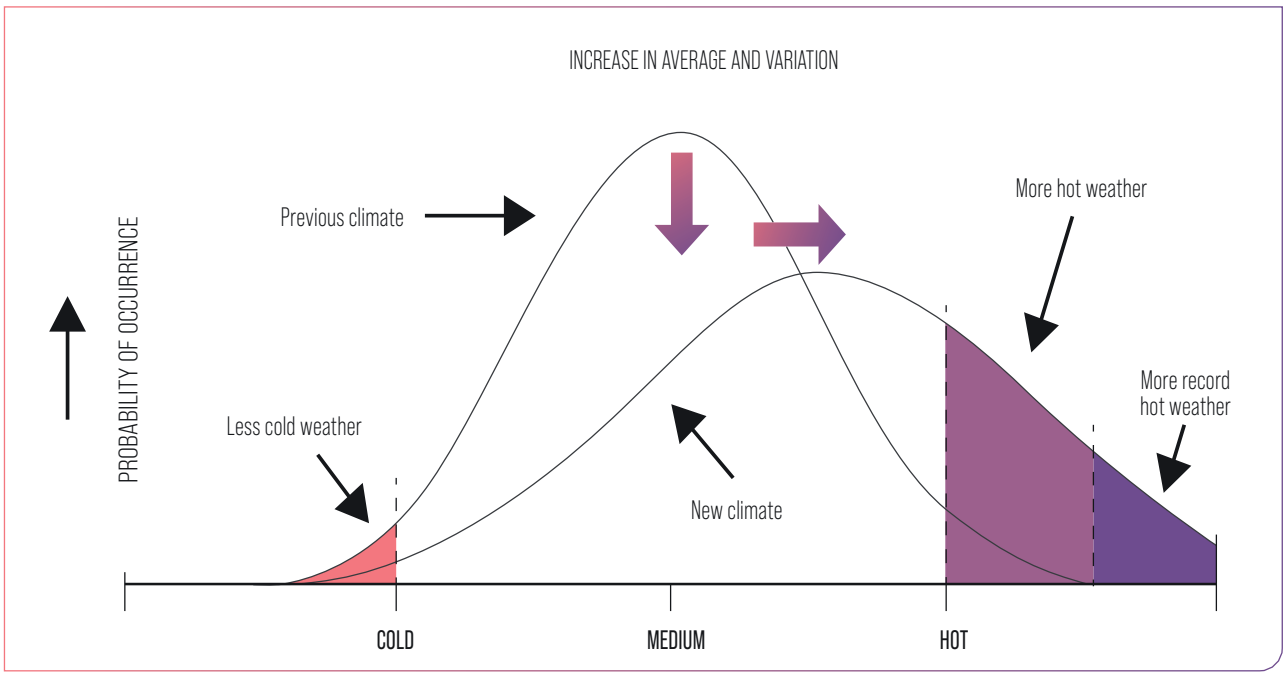
IN POLAND, THE LAST 20 YEARS HAVE BEEN THE WARMEST SINCE THE MID-20TH CENTURY. THE HIGHEST AVERAGE ANNUAL AIR TEMPERATURE WAS RECORDED IN 2019 (10.2°C)[1].

Since 1951, the temperature has increased by more than 2.0°C on average. At the same time, in the lake district belt and in the lowlands, as well as in the Sub-Carpathian region and the Carpathian Mountains the temperature has risen by 2.1°C in the last 70 years, whereas, the lowest increase of temperature has been observed in the Sudetes (1.8°C). **Temperature increases are also unevenly distributed throughout the year. Since the beginning of the second half of the 20th century, the winter temperature has increased by 2.5°C, while the summer one by 1.9°C.**

AIR TEMPERATURES IN POLAND ARE PROJECTED TO INCREASE FURTHER BY AN AVERAGE OF 1.1°C BEFORE 2050 AND BY 2°C OVER THE PERIOD 2071-2100[2].

[1] The so-called average area temperature, Polish Climate, 2020, https://www.imgw.pl/sites/default/files/2021-04/imgw-pib-klimat-polski-2020-opracowanie-final-rozkladowki-min.pdf

[2] Kundzewicz, Zbigniew W., Øystein Hov, and Tomasz Okruszko, eds. Climate change and its impact on selected sectors in Poland. Ridero IT Publishing, 2017, quoting from a paper by Tamara Tokarczyk Eng DSc, Wiwiana Szalińska Eng DSc,, Opis i porównanie susz w wieloleciu 1975-2020 - ich częstości, intensywności oraz zasięgu przestrzennego – na podstawie Indeksowej oceny suszy wraz z opracowaniem scenariusza suszy ekstremalnej w odniesieniu do zdarzeń historycznych i obserwowanych.



Source: Jak zarządzać ryzykiem klimatycznym w sektorze finansowym | Ryzyko klimatyczne | Sektor finansowy | EY Polska.

The rise in temperature caused by climate change has led to a shift in the thermal seasons and the growing season. **The early start of the growing season, interrupted by rapid cooling and intense rainfall, as well as the simultaneous occurrence of hail and strong winds, meant that the total amount of paid crop insurance claims in 2018-2021 was PLN 1.539 billion[3].**

Storms swept across Poland in the first quarter of 2022. Overall, insurers recorded nearly 205 thousand claims under natural catastrophe policies, compared to less than 121 thousand in the first three months of 2021. In the periods discussed, claims paid out amounted to PLN 691 million and PLN 390 million, respectively. **Between 2016 and 2021, insurance companies reported 273 events to the Polish Financial Supervision Authority that they classified as catastrophic, with a value of PLN 3.622 billion.** Most of these were local in nature and the result of violent weather fronts that passed over Poland[4].

[3] PIU data based on reports of insurance companies.
[4] PFSA data based on reports of insurance companies.

FIGURE 12
VALUE OF CLAIMS FROM NATURAL CATASTROPHES PAID OUT AND REPORTED TO OPFSA

YEAR	YEAR VALUE OF CLAIMS PAID [PLN MILLION]
2016	728
2017	485
2018	191
2019	462
2020	762
2021	994

FIGURE 13
TYPES OF NATURAL CATASTROPHES THAT OCCURRED IN A GIVEN YEAR (REPORTED UNDER INSURANCE POLICIES TAKEN OUT)

YEAR	CATEGORY OF THE EVENT	NUMBER OF EVENTS	AMOUNT OF CLAIMS [PLN MILLION]
2016	Torrential rains, inundation events, storms, hail, hurricanes	30	289
	Poor crop overwintering and spring frosts	3	438
	Other (landslide/ground collapse)	1	1
2017	Torrential rains, inundation events, storms, hail, hurricanes	45	428
	Poor crop overwintering and spring frosts	2	54
	Fires	5	3
2018	Torrential rains, inundation events, storms, hail, hurricanes	14	102
	Poor crop overwintering and spring frosts	2	89
2019	Torrential rains, inundation events, storms, hail, hurricanes	38	289
	Poor crop overwintering and spring frosts	3	136
	Fires	3	26
	Other (landslide activation)	1	10
2020	Torrential rains, inundation events, storms, hail, hurricanes	55	562
	Poor crop overwintering and spring frosts	4	198
	Others (shoal entry due to bad weather conditions)	1	2
2021	Torrential rains, inundation events, storms, hail, hurricanes	62	970
	Fires	2	10
	Other	2	15

The above data show that natural catastrophes occurring in recent years, although local in nature, caused high losses. Fortunately, the territory of Poland was spared major floods or extremely severe droughts during this period. However, this does not mean that climate change has eliminated these risks. On the contrary, Polish society must prepare both for the threats resulting from sudden and intense rainfalls that cause river surges and for long-term rainfall deficits.

DROUGHT

AN INCREASE IN AIR TEMPERATURE, A REDUCTION IN THE DURATION OF SNOW COVER AND PROLONGED PERIODS OF RAINFALL DEFICIENCY MEAN AN INTENSIFYING DROUGHT, **THE CONSEQUENCES OF WHICH WE, AS A SOCIETY, WILL BE CONFRONTED WITH IN THE YEARS TO COME.**

Importantly, drought is currently being referred to not only as a natural phenomenon, but as a synergy of natural climatic conditions and human activity affecting the water cycle.

Drought is characterised by a specific cycle of development and an intensity that varies in time and space. The formation of drought is slow, but its nature can be dynamic. The first stage in the development of this phenomenon is the meteorological drought. It arises in conditions of rainfall shortages, i.e. during prolonged rainless periods or when the amount of rainfall is below the multi-year average and accompanied by high temperatures. The result is an even greater scarcity of rainfall over time that manifests itself particularly intensely in the warm season and increases intense surface evaporation (evapotranspiration).

The prolonged duration of meteorological drought leads to the next stage – hydrological drought. It manifests itself in a long-term reduction of surface water resources of rivers and lakes. **As a consequence, the streamflow in rivers drops below the threshold level value that represents normal humidity conditions.** Hydrological drought is usually accompanied by hydrogeological drought, during which groundwater resources are reduced[5].

[5] Based on: https://www.gov.pl/web/susza/susza.

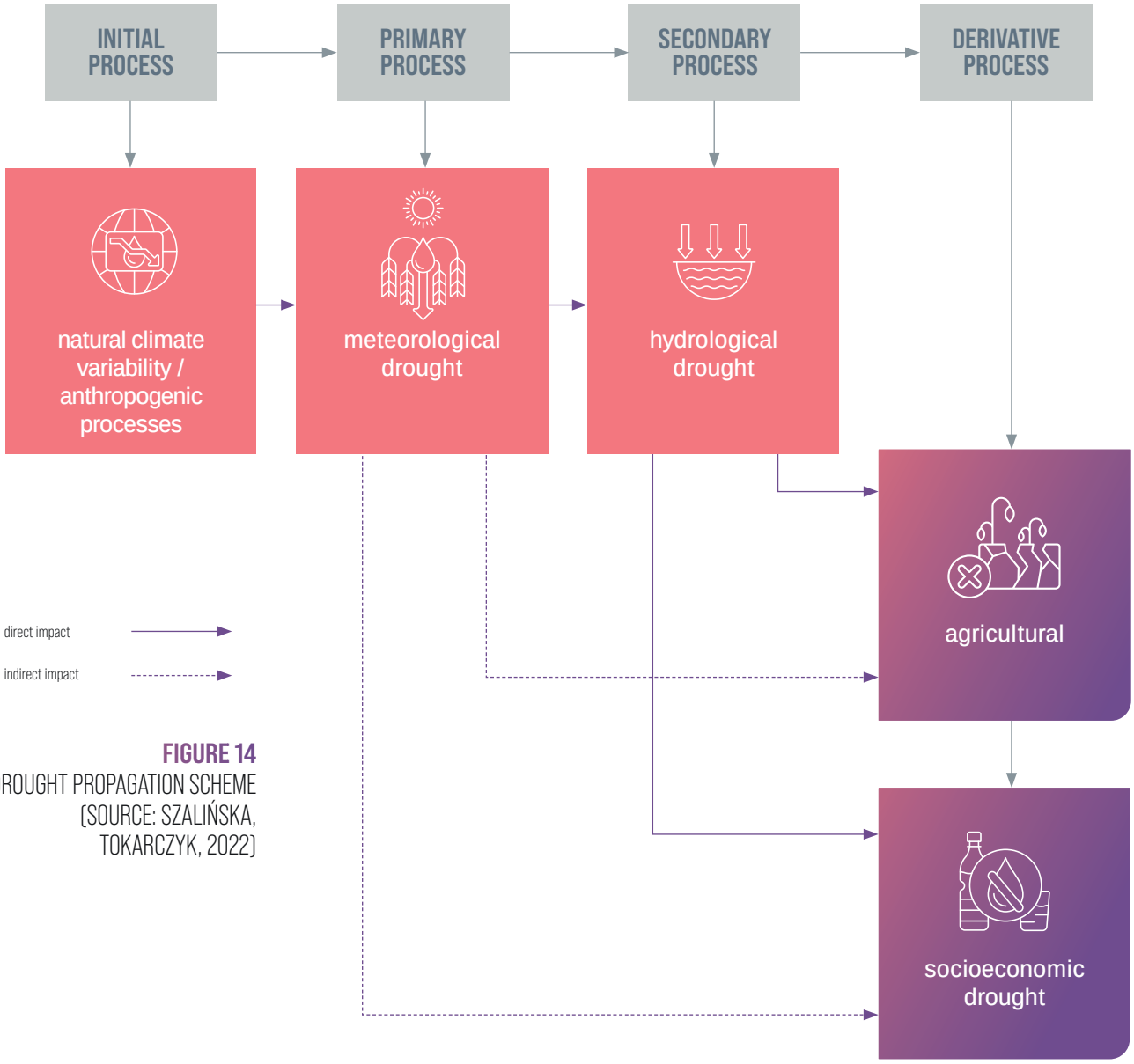


FIGURE 14
DROUGHT PROPAGATION SCHEME (SOURCE: SZALIŃSKA, TOKARCZYK, 2022)

IN THIS CONTEXT, IT IS WORTH LOOKING AT HISTORICAL DATA IN POLAND.

THE PERIOD 1975-1990 WAS MARKED BY EXTREME METEOROLOGICAL DROUGHTS, THE EXTENT OF WHICH PERIODICALLY EXCEEDED 70% OF THE AREA OF OUR COUNTRY.

Droughts occurred in 1976, 1982, 1983, 1984, 1989. An extreme drought is an episode that lasted from January 1982 to January 1983, during which more than 50% of the country's area suffered from intense drought conditions, **with nearly 30% experiencing extreme drought conditions. The meteorological conditions prevailing in this period influenced the development of hydrological droughts.** The droughts observed in April 1984 and May 1990 were characterised by the greatest severity and spatial extent (over 50% of Poland).

ALSO, THE 1990S, UNTIL MID-1997, WERE MARKED BY INTENSE METEOROLOGICAL DROUGHTS OCCURRING VIRTUALLY EVERY YEAR (1991, 1992, 1994, 1996, 1997).

ntensive drought was also recorded in 2003. Hydrologically, the increasing and accumulating shortage of rainfall over time and the accompanying rise in temperature caused a marked increase in the intensity, duration and spatial extent of hydrological droughts, which were particularly severe in March 1991, October 1992, June 1993, March 1996 or October 2003.

n the last twenty years, there has been a significant change in the nature of droughts. The meteorological droughts in the years 2005-2020 were dominated by a higher number of local flash droughts (e.g. in 2006 or 2011). There were also droughts that lasted almost the entire growing season. This was the case in 2015 and 2018.

FIGURE 15
CHANGES IN THE INTENSITY AND SPATIAL EXTENT OF METEOROLOGICAL DROUGHT IN THE MULTIANNUAL PERIOD OF 1975-1990 (SOURCE: SZALIŃSKA, TOKARCZYK, 2022)

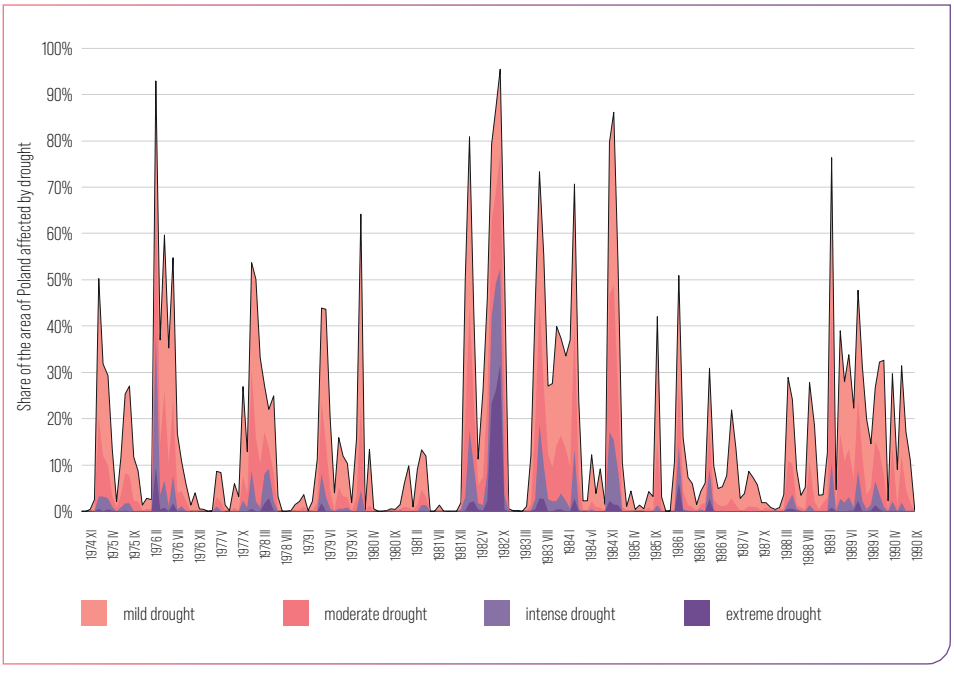
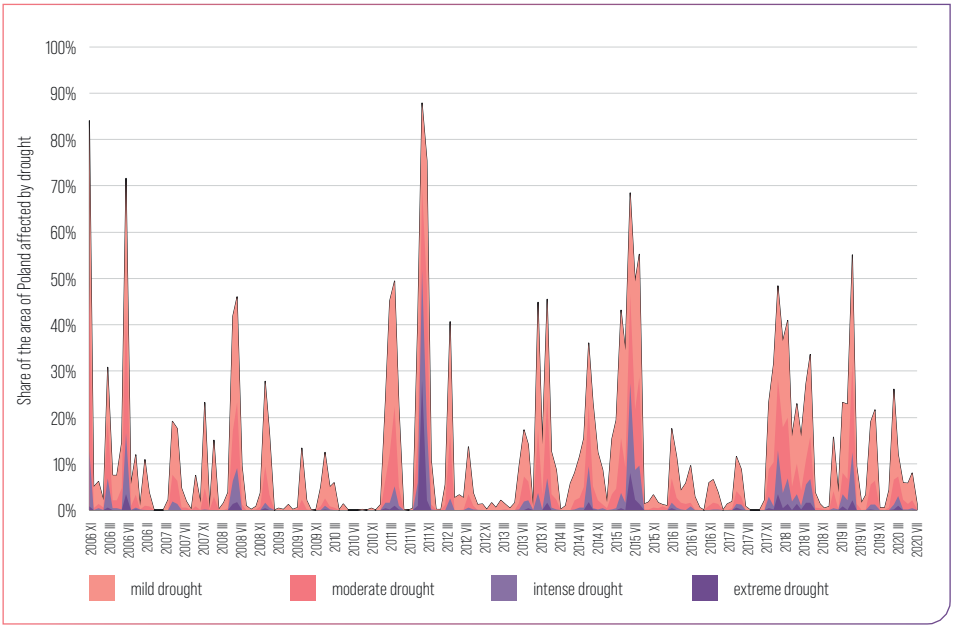


FIGURE 16
CHANGES IN THE INTENSITY AND SPATIAL EXTENT OF METEOROLOGICAL DROUGHT IN THE MULTIANNUAL PERIOD OF 2005-2020 (SOURCE: SZALIŃSKA, TOKARCZYK, 2022)



Between 2011 and 2020, the prolonged hydrological drought resulted in an unprecedented number of cases of intense and extreme drought as compared to previous periods.

FIGURE 17
CHANGES IN THE INTENSITY AND SPATIAL EXTENT OF HYDROLOGICAL DROUGHT IN THE MULTIANNUAL PERIOD OF 1975-1990 (SOURCE: SZALIŃSKA, TOKARCZYK, 2022)

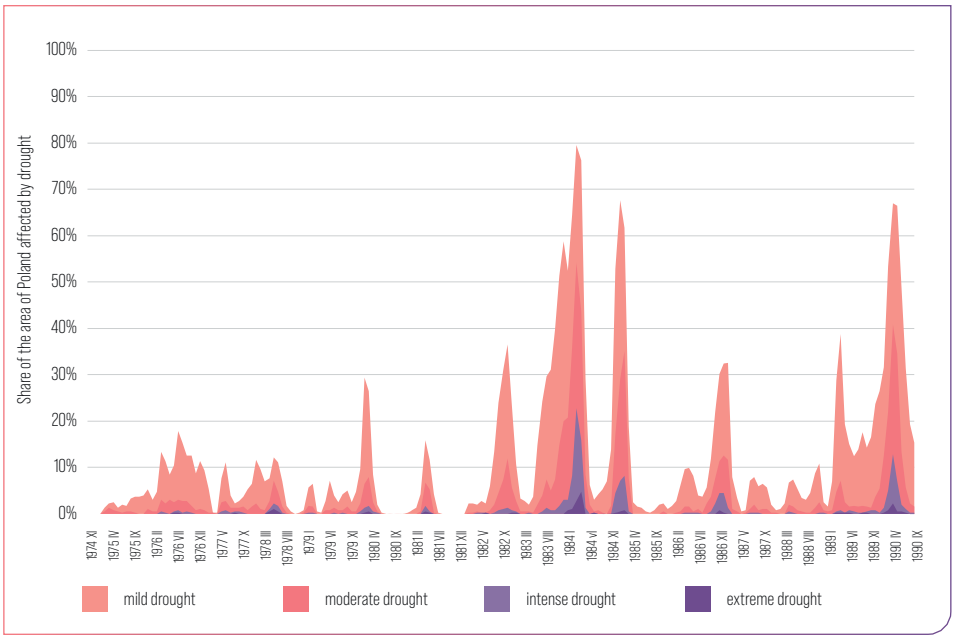
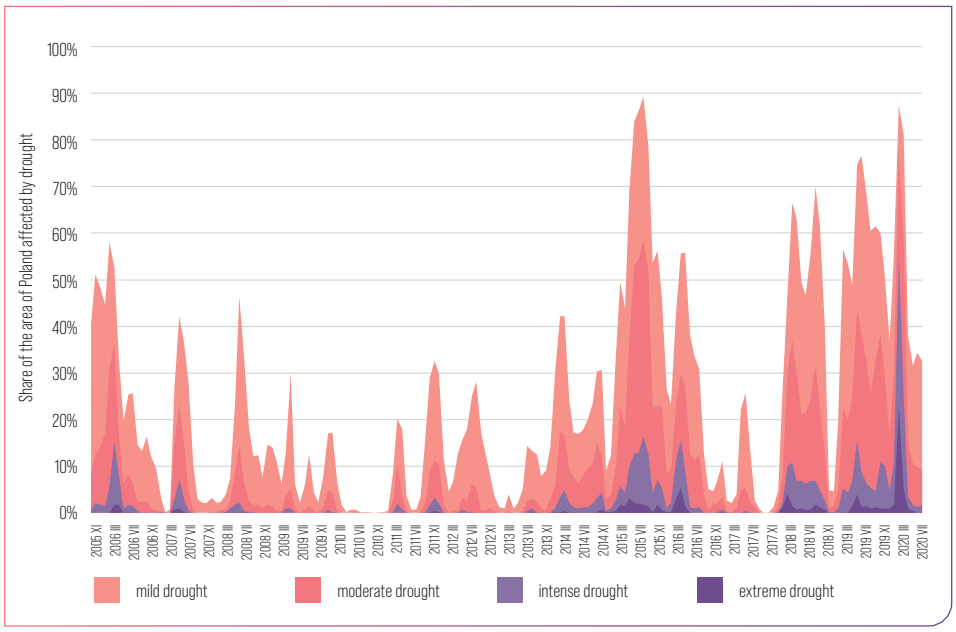


FIGURE 18
CHANGES IN THE INTENSITY AND SPATIAL EXTENT OF METEOROLOGICAL DROUGHT IN THE MULTIANNUAL PERIOD OF 2005-2020 (SOURCE: SZALIŃSKA, TOKARCZYK, 2022)



Analysis of the temporal variability of meteorological and hydrological drought supports the conclusion that the recovery of water resources has been disrupted in recent years. The reason is attributed to the cumulative shortage of water resources caused by the intense droughts of the 1980s and 1990s and ongoing climate change.

IT IS WORTH NOTING THAT THE WET PERIODS IN 1997 AND 2010 ASSOCIATED WITH CATASTROPHIC FLOODS HAVE NOT RESULTED IN A LONG-TERM IMPROVEMENT OF THE SITUATION, I.E. MAKING UP FOR THE LACK OF WATER RESOURCES.

In the illustration below, periods of extreme drought are marked with red ellipses. An extreme hydrological drought is currently developing in Poland. This is not only due to the lack of rainfall in recent years, which was by no means record-breaking compared to previous decades, but above all to the prolonged and severe meteorological droughts in the 1980s and 1990s. Therefore, we have a situation different from past hydrological droughts, when a hydrological drought resulted from meteorological droughts that had occurred in months or years immediately preceding the said hydrological drought. **A truly catastrophic scenario can occur if conditions of the currently observed hydrological drought and extremely severe meteorological droughts overlap, thus exacerbating already existing hydrological drought.**

	METEOROLOGICAL DROUGHT													HYDROLOGICAL DROUGHT											
year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
1975	0.9	0.4	-0.9	-0.6	-0.4	0.1	0.4	0.1	-0.4	-0.5	-0.2	0.2	1975	2.8	2.2	0.7	0.2	0.2	0.5	0.7	0.7	0.3	-0.5	0.0	0.0
1976	0.7	0.4	0.3	-1.8	-0.7	-1.1	-0.7	-1.1	-0.3	-0.1	0.5	0.5	1976	0.2	0.2	0.1	-0.3	-0.1	0.0	-0.3	-0.5	-0.5	-0.4	-0.2	0.0
1977	0.4	0.7	0.7	1.3	0.8	0.3	0.1	0.7	0.9	0.5	-0.2	-0.5	1977	0.0	0.3	0.7	1.1	0.8	0.5	0.3	0.6	1.1	1.1	0.7	0.4
1978	-0.2	-1.1	-0.9	-0.6	-0.4	-0.4	-0.6	0.2	0.8	1.6	1.1	0.7	1978	0.2	-0.2	-0.1	0.0	0.4	0.2	0.1	0.1	0.5	1.3	1.4	1.1
1979	0.4	0.4	0.4	0.2	-0.2	-0.8	-0.8	-0.4	0.0	-0.2	0.0	0.2	1979	0.4	0.2	0.0	0.9	1.5	0.8	0.0	0.0	0.1	0.0	0.0	0.4
1980	0.2	-0.4	-1.2	0.2	-0.4	0.8	1.0	1.3	0.8	0.6	0.6	0.8	1980	0.2	0.1	-0.6	-0.4	0.0	0.7	1.5	2.1	2.0	1.7	1.8	1.9
1981	-0.2	-0.2	0.5	0.1	-0.1	-0.1	0.6	0.8	0.4	0.8	1.0	1.8	1981	1.5	1.2	1.0	0.6	0.1	0.1	0.4	0.8	0.9	1.0	1.3	2.0
1982	1.2	0.0	-1.0	-1.4	-0.9	-0.2	-0.6	-0.9	-1.8	-1.9	-2.0	-0.9	1982	2.0	1.3	0.8	0.5	0.6	0.4	0.3	0.0	-0.3	-0.6	-0.7	-0.8
1983	0.3	1.0	1.1	0.8	0.8	-0.1	-0.8	-1.3	-1.0	-0.6	-0.6	-0.7	1983	-0.4	0.0	0.3	0.3	0.5	0.1	-0.4	-0.6	-0.7	-0.7	-0.8	-0.9
1984	-0.6	-0.7	-0.8	-1.3	-0.4	0.4	0.4	-0.2	0.0	-0.1	0.1	-1.4	1984	-1.0	-0.9	-1.2	-1.5	-1.4	-0.6	0.0	0.2	0.0	0.0	-0.2	-0.4
1985	-1.5	-1.1	-0.4	0.1	0.1	0.7	0.2	0.9	0.4	0.5	-0.8	0.0	1985	-1.0	-1.2	-1.1	-0.4	0.2	0.6	0.7	0.9	0.8	0.6	0.2	0.1
1986	0.8	0.6	-0.4	-1.0	-0.1	0.2	-0.1	0.1	-0.1	0.1	0.8	0.0	1986	0.5	0.5	0.1	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	-0.2	-0.4
1987	0.2	0.5	-0.3	-0.4	-0.3	0.3	0.2	0.2	0.2	0.1	-0.4	0.5	1987	-0.7	-0.6	-0.6	0.1	0.2	0.8	0.6	0.3	0.2	0.2	0.0	0.1
1988	0.6	0.6	0.6	0.3	-0.6	-0.4	0.1	0.2	0.0	0.7	-0.5	0.0	1988	0.5	0.8	0.5	0.5	0.3	0.0	0.1	0.2	0.2	0.0	-0.2	-0.3
1989	0.1	-0.4	-1.4	-0.2	-0.7	-0.1	-0.6	-0.4	-1.0	-0.7	-0.5	0.1	1989	0.4	0.4	0.1	-0.6	-0.7	-0.3	-0.1	-0.3	-0.4	-0.5	-0.4	-0.5
1990	-0.7	-0.6	-0.7	0.0	-0.6	-0.1	-0.5	-0.3	0.1	0.3	0.8	-0.1	1990	-0.3	-0.5	-0.7	-0.9	-1.2	-1.2	-0.9	-0.7	-0.4	-0.2	-0.1	-0.2
1991	-0.4	-1.3	-1.5	-0.8	-0.3	0.4	-0.1	-0.3	-0.8	-0.6	-0.4	0.0	1991	-0.1	-0.5	-0.7	-1.1	-0.9	-0.6	-0.3	-0.3	-0.5	-0.6	-0.6	-0.7
1992	-0.1	-0.2	0.4	0.8	0.1	-1.4	-1.6	-1.6	-0.8	-0.2	0.4	0.4	1992	-0.6	-0.3	0.0	0.0	-0.2	-0.5	-1.1	-1.4	-1.3	-1.1	-0.7	-0.3
1993	0.3	0.2	0.3	-0.5	-1.1	-0.7	0.0	0.2	0.3	-0.1	-0.2	-0.1	1993	-0.2	-0.4	-0.7	-0.6	-0.9	-1.3	-1.1	-0.7	-0.3	-0.3	-0.4	-0.3
1994	0.6	0.7	1.0	1.3	1.5	0.0	-1.4	-1.3	-0.6	0.6	0.4	0.5	1994	0.1	0.3	0.4	0.8	0.8	0.2	-0.2	-0.9	-0.9	-0.7	-0.4	-0.1
1995	0.2	0.7	0.5	0.6	0.3	0.6	-0.1	0.0	0.2	0.4	0.1	-1.6	1995	0.0	0.6	0.4	0.5	0.2	0.4	0.3	-0.3	-0.3	-0.1	0.0	-0.3
1996	-1.6	-1.4	-1.3	-0.7	0.2	0.2	0.6	0.3	0.8	0.6	0.4	-1.1	1996	-0.7	-1.2	-1.5	-1.6	0.3	0.8	0.3	0.1	0.5	0.9	1.0	0.4
1997	-2.4	-1.9	-1.1	0.1	0.3	0.3	1.3	0.8	0.8	-1.2	0.0	0.4	1997	-0.4	-1.0	0.9	-0.4	-0.4	0.0	0.5	0.9	0.7	0.4	0.4	0.7
1998	0.0	0.2	0.5	0.9	0.4	0.5	0.1	0.3	0.1	0.7	0.8	0.8	1998	0.9	1.0	0.9	0.8	0.4	0.2	0.5	0.3	0.2	0.3	0.8	0.9
1999	-0.4	0.1	0.2	1.2	0.6	1.1	0.1	-0.1	-1.1	-0.6	-0.3	0.3	1999	0.7	0.5	0.5	0.7	0.7	0.7	0.8	0.5	-0.1	-0.2	-0.3	-0.2
2000	0.1	0.4	1.3	1.1	0.5	-1.0	0.3	0.3	0.5	-0.9	-0.6	-0.6	2000	-0.2	0.3	1.0	1.4	0.8	-0.7	-0.5	-0.2	0.0	-0.2	-0.4	-0.5
2001	-0.1	-0.4	0.0	0.9	0.6	0.4	0.7	0.8	1.4	0.7	0.9	-0.4	2001	-0.5	-0.4	-0.2	0.0	0.1	0.0	0.4	0.8	1.2	1.2	1.1	0.5
2002	-0.1	-0.4	0.0	0.9	0.6	0.4	0.7	0.8	1.4	0.7	0.9	-0.4	2002	-0.5	-0.4	-0.2	0.0	0.1	0.0	0.4	0.8	1.2	1.2	1.1	0.5
2003	-0.8	-1.4	-1.1	-1.4	-0.8	-0.9	-0.4	-0.8	-0.6	-0.6	-0.4	0.1	2003	0.1	-0.4	-0.5	-0.5	-0.3	-0.4	-1.0	-1.1	-1.1	-1.1	-0.9	-0.9
2004	-0.2	0.8	0.8	0.7	0.0	-0.1	0.0	0.0	-0.3	-0.3	0.1	0.4	2004	-0.9	-0.6	-0.2	0.1	-0.3	-0.2	-0.4	-0.3	-0.4	-0.5	-0.5	-0.3
2005	0.6	0.3	0.5	-0.1	0.1	-0.2	0.1	-0.3	-0.3	-1.0	-1.5	0.0	2005	0.0	-0.1	-0.2	-0.3	0.3	0.4	0.1	-0.1	-0.3	-0.5	-0.9	-1.0
2006	0.2	0.7	-0.6	0.2	0.0	-0.2	-1.3	0.1	0.0	0.9	-0.2	0.0	2006	-0.9	-0.8	-1.1	-1.0	-0.6	-0.1	-0.6	-0.6	-0.4	-0.3	-0.4	-0.2
2007	1.4	1.3	1.6	-0.1	-0.1	0.0	0.6	0.4	0.6	0.1	0.5	-0.4	2007	0.1	0.5	1.1	0.6	-0.6	-0.9	-0.6	-0.3	-0.1	0.1	0.4	0.4
2008	0.3	-0.2	0.8	0.8	0.4	-0.8	-0.9	-0.1	0.3	0.6	0.1	0.0	2008	0.4	0.3	0.2	0.1	0.1	-0.4	-0.8	-0.7	-0.4	-0.3	-0.3	-0.2
2009	-0.7	-0.2	0.7	0.3	0.3	0.6	1.0	0.5	-0.4	0.1	0.6	1.2	2009	-0.4	-0.2	-0.1	0.2	-0.2	-0.6	-0.1	0.2	-0.2	-0.5	-0.1	0.4
2010	0.2	0.0	-0.1	-0.2	1.7	1.2	1.2	1.0	1.6	1.2	1.1	1.0	2010	0.1	-0.3	-0.2	0.2	1.0	1.4	1.5	1.1	1.2	1.4	1.3	1.3
2011	1.4	0.3	-0.7	-0.8	-1.0	-0.5	1.0	1.0	0.8	-0.8	-1.9	-1.4	2011	1.6	1.7	1.0	0.2	-0.2	-0.4	0.0	0.6	0.8	0.1	-0.4	-0.7
2012	-0.3	1.0	0.5	-0.1	-0.8	0.4	0.5	0.6	0.0	0.0	0.1	0.2	2012	-0.7	-0.5	-0.1	0.0	0.0	-0.4	-0.4	-0.3	-0.4	-0.6	-0.5	-0.4
2013	0.3	0.5	0.8	0.2	0.8	1.2	0.6	-0.1	-0.3	-0.2	0.3	-0.9	2013	-0.3	0.0	0.2	0.4	0.4	1.3	1.1	0.4	-0.2	-0.2	-0.1	-0.1
2014	-0.2	-0.9	-0.1	-0.1	1.0	0.6	0.3	0.0	0.1	0.1	-0.6	-0.5	2014	-0.1	-0.2	-0.5	-0.9	-0.9	-0.6	-0.1	0.0	0.1	0.1	-0.2	-0.5
2015	-0.1	0.1	0.1	-0.5	-0.3	-0.9	-0.7	-1.4	-1.0	-1.1	0.4	0.2	2015	-0.5	0.0	-0.2	-0.6	-0.8	-0.9	-1.3	-1.5	-1.5	-1.5	-1.4	-1.0
2016	0.2	0.4	0.6	0.8	-0.2	-0.1	0.4	0.3	-0.1	0.3	0.7	1.7	2016	-1.0	-0.8	-0.4	-0.4	-0.9	-1.2	-1.1	-0.7	-0.7	-0.5	0.0	0.5
2017	0.0	0.0	-0.1	1.0	0.5	0.5	0.2	0.5	1.1	1.7	2.0	1.7	2017	0.3	0.0	-0.2	0.0	0.2	0.0	-0.5	-0.5	0.0	0.7	1.6	1.9
2018	0.4	-0.4	-0.6	-1.0	-0.8	-0.8	-0.2	-0.4	-0.3	-0.6	-0.8	0.0	2018	1.8	1.3	0.3	-0.4	-0.9	-1.2	-1.2	-1.0	-1.0	-1.1	-1.2	-1.1
2019	0.4	0.9	0.4	-0.5	0.4	-0.4	-0.5	-1.1	-0.3	0.1	0.2	-0.3	2019	-0.8	0.0	0.1	-0.4	-0.9	-0.9	-0.9	-1.4	-1.2	-1.1	-1.0	-1.1
2020	-0.4	0.6	0.5	-0.1	-0.6	0.4	0.4	0.3	-0.1	1.1	1.7	0.3	2020	-1.1	-0.9	-0.6	-1.0	-2.0	-1.5	-0.5	-0.4	-0.6	-0.5	-0.1	-0.1

FIGURE 19

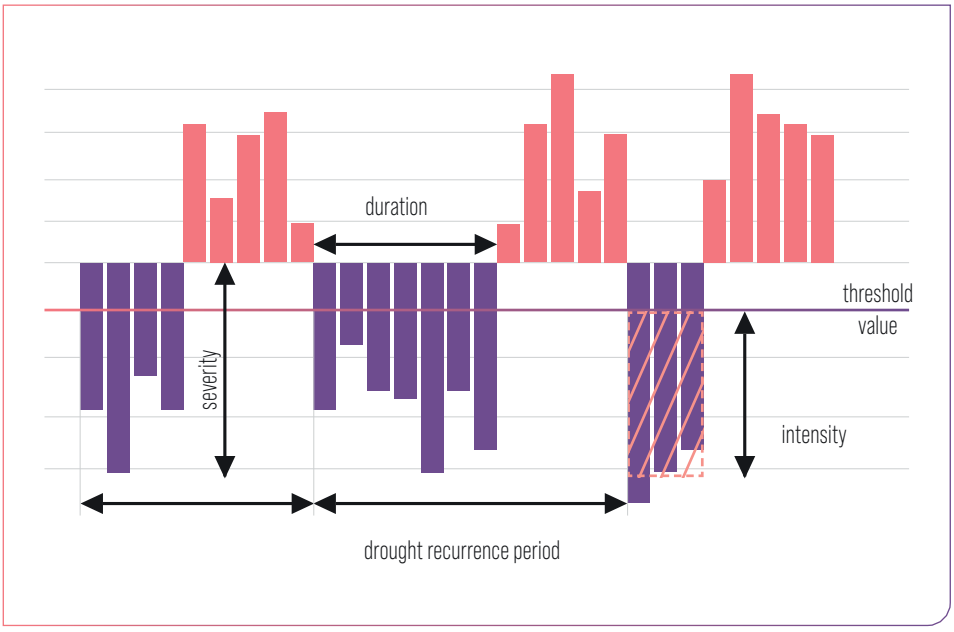
THE TIME COURSE OF CHANGES IN THE INTENSITY OF METEOROLOGICAL DROUGHT (LEFT PANEL) AND HYDROLOGICAL DROUGHT (RIGHT PANEL) FROM 1975 TO 2020 IN THE MONTHLY COURSE. THE INTENSITY OF DROUGHT CONDITIONS INCREASES AS THE VALUE OF THE SPI (STANDARDISED PRECIPITATION INDEX) (METEOROLOGICAL DROUGHT) AND THE SRI (STANDARDISED RUNOFF INDEX) (HYDROLOGICAL DROUGHT) DECREASE (SOURCE: SZALIŃSKA, TOKARCZYK, 2022).

EXTREME DROUGHT

IN EXTREME CASES, THE DROUGHT CAN COVER THE ENTIRE COUNTRY AND LAST FROM SEVERAL MONTHS TO SEVERAL YEARS. EACH PHASE OF DROUGHT DEVELOPMENT – **METEOROLOGICAL, SOIL, HYDROLOGICAL** – CAN BRING SPECIFIC SOCIAL AND ENVIRONMENTAL LOSSES, TRIGGERING THE SO-CALLED ECONOMIC DROUGHT.

Economic drought refers to those episodes of drought that are notable for their particular severity in terms of drought's duration, intensity or severity. The beginning of the drought is marked by the date when a certain threshold value indicating a rainfall or streamflow deficit is crossed, and the end of the drought is reached with the return to normal conditions. Drought intensity indicates the cumulative moisture deficiency in the atmosphere, soil, surface water or groundwater. **Drought severity is defined as the maximum intensity of drought during an episode (Fig. 6). Drought hazard is defined by frequency of occurrence of drought at a given level of intensity, duration and severity at a given time and in a given area (year, 10 years, 50 years,...).**

FIGURE 20
ELEMENTS OF DROUGHT HAZARD ASSESSMENT IN A GIVEN AREA: DURATION, INTENSITY, SEVERITY OF DROUGHT, RECURRENCE PERIOD (SOURCE: SZALIŃSKA, TOKARCZYK, 2022)



AREAS OF EXTREME DROUGHTS, CONSIDERING THE PHASE OF METEOROLOGICAL AND HYDROLOGICAL DROUGHT, ARE SHOWN IN FIGURE 21.

The extremity levels of droughts (1, 2, 3) are as follows:
1) the occurrence of droughts of extreme duration, intensity or severity;
(2) the occurrence of droughts of extreme duration and intensity or duration of drought and severity or intensity and severity of drought and
(3) the occurrence of extreme droughts in terms of their duration, intensity and severity.

METEOROLOGICAL DROUGHT

In the case of meteorological drought, the areas classified as Level 3 and Level 2 mainly included regions in northern and central Poland, with the exception of the Lower Vistula and the coastal and upland areas. **The extent of the extreme drought areas largely coincides with the areas used for agriculture.**

HYDROLOGICAL DROUGHT

In the case of hydrological drought, Level 3 and Level 2 occur mainly in mountainous areas and the north-eastern part of Poland, which poses an exceptional threat to the formation of water resources throughout the country.

FIGURE 21
AREAS OF METEOROLOGICAL DROUGHTS OF THE HIGHEST INTENSITY AGAINST THE BACKGROUND OF AVERAGE VALUES OF DROUGHT INTENSITY (SOURCE: SZALIŃSKA, TOKARCZYK, 2023)

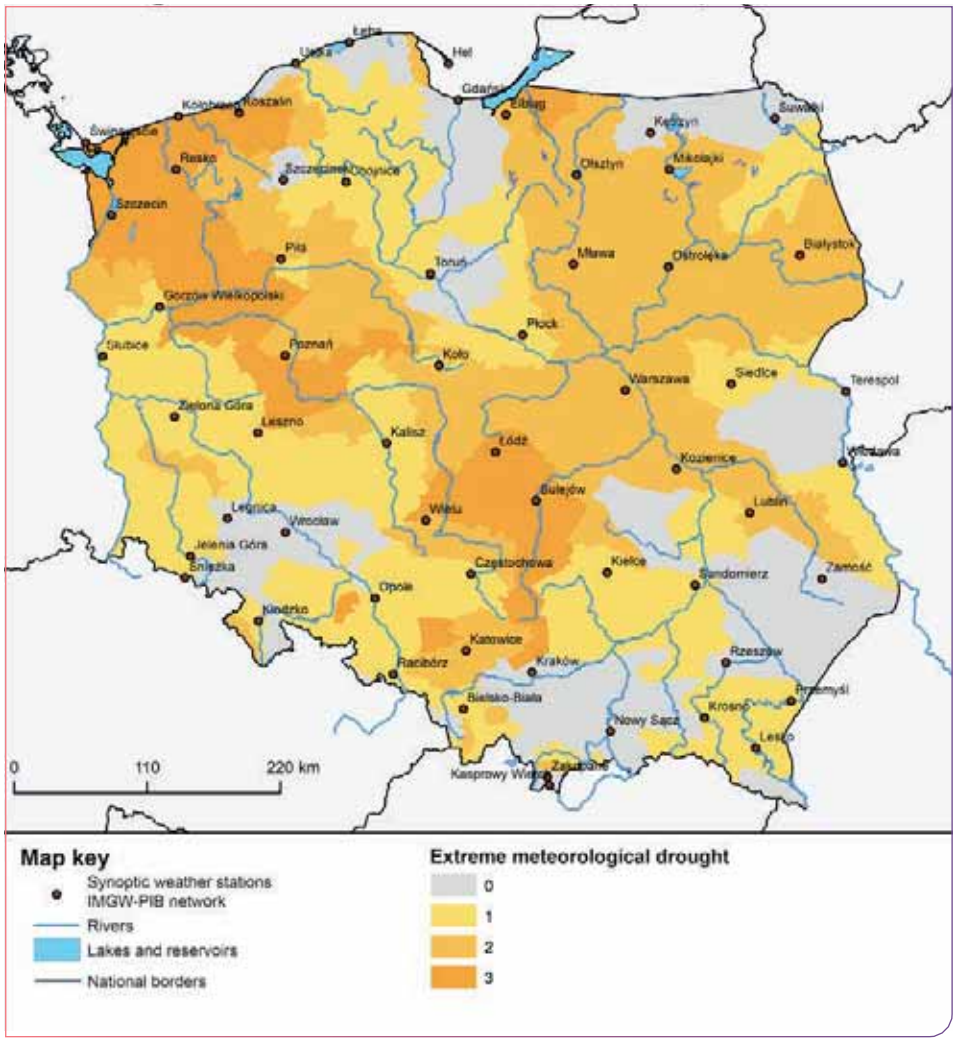
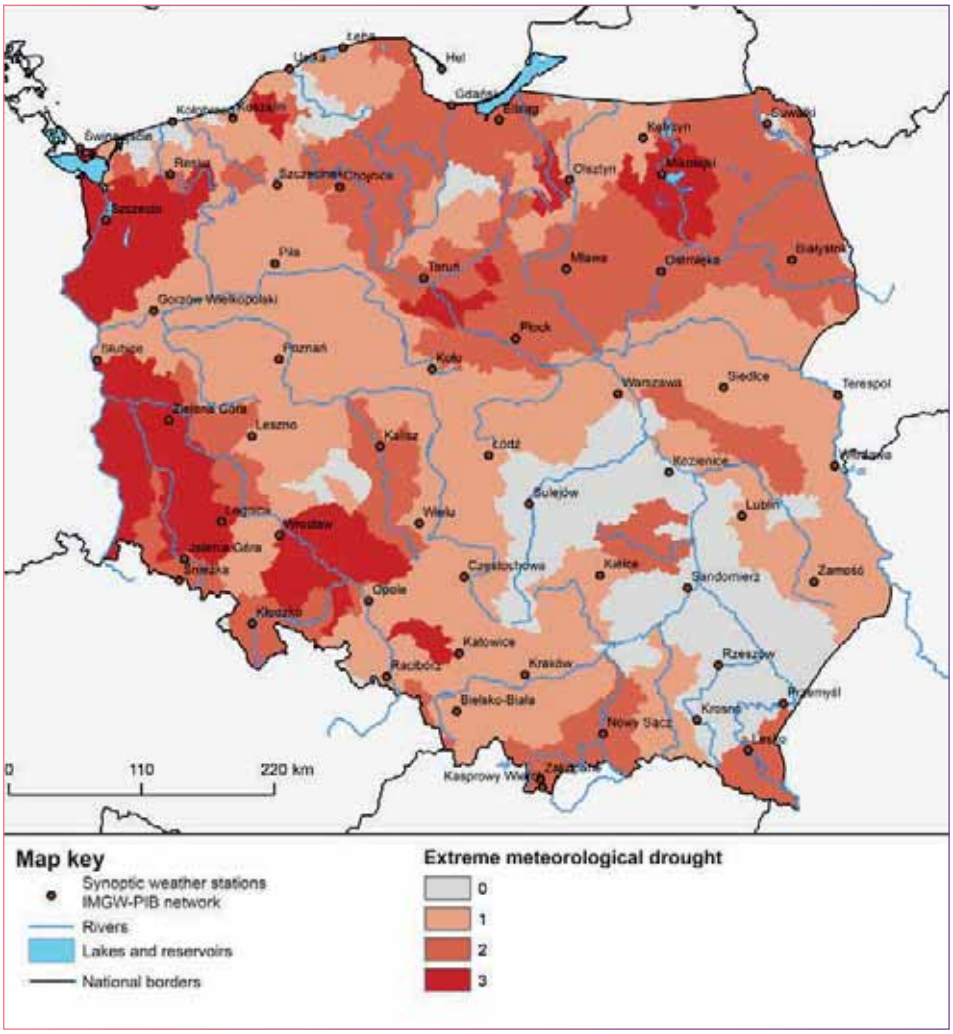


FIGURE 22
AREAS OF HYDROLOGICAL DROUGHTS OF THE HIGHEST INTENSITY AGAINST THE BACKGROUND OF AVERAGE VALUES OF DROUGHT INTENSITY (SOURCE: SZALIŃSKA, TOKARCZYK, 2023)



IN THE EVENT OF A DROUGHT SCENARIO INVOLVING THE OVERLAP OF **EXTREME METEOROLOGICAL AND HYDROLOGICAL DROUGHT**, EXTREME DROUGHT IN TERMS OF DURATION, SEVERITY AND INTENSITY WILL AFFECT LARGE SWATHES OF THE COUNTRY.

EXTREME DROUGHT IS ASSOCIATED WITH HEAVY ECONOMIC LOSSES.

This is not just about direct damage to agriculture. It can mean a lack of access to water, which can interrupt the continuity of operations of many businesses and institutions.

A decline in the water level in rivers and lakes or their drying up can lead to restrictions in the production of electricity and thus to a considerable increase in the price of electricity. Further consequences can be restrictions in the power supply, which lead to price peaks, as well as shutdowns in industrial production, trade and services. These losses are difficult to estimate today.

However, as the extreme phenomena will affect a large part of Poland, including areas that are central to the Polish economy, such as Western Pomerania, Greater Poland and Silesia, the exposure to them is so high that it is impossible to insure against the effects of drought. Both the insurance and reinsurance markets lack such capital.

As in Western Europe, a prolonged hydrological drought could contribute to geological changes that in turn lead to collapses or landslides.

LANDSLIDES AND COLLAPSES POSE A SIGNIFICANT THREAT TO THE CONSTRUCTION OF BUILDINGS.

In many cases, they can lead to construction disasters, as we described in Chapter 1.

DROUGHT PREVENTION MEASURES

THE PROJECT *WATER FOR AGRICULTURE* HAS BEEN INDICATED IN THE NATIONAL ENVIRONMENTAL POLICY 2030 (PEP2030)[6].

Its aim is to improve the stability and continuity of agricultural production under conditions of periodic water shortages and surpluses and, above all, to support family farms in the construction, restoration and proper use of drainage facilities in order to improve production conditions, increase water retention and help the environment.

[6] https://www.gov.pl/web/srodowisko/polityka-ekologiczna-panstwa-polityka-ekologiczna-panstwa-2030

In addition, the Ministry of Agriculture and Rural Development is implementing a programme to support on-farm irrigation, taking into account the need to prevent extreme weather events. Under this programme, investments can be made to upgrade an existing irrigation system or to create a new irrigation system on a farm.

In addition, a Retention Development Programme for the years 2021–2027 with an Outlook to 2030 and a drought plan have been prepared.

ADAPTATION OF THE WATER SECTOR TO EXTREME WEATHER EVENTS SHOULD ALSO TAKE INTO ACCOUNT REGULATIONS ON URBAN PLANNING, CONSTRUCTION.

Investment projects should assume changes in climate impacts. Both investors and competent authorities should use the ***Guide to Investment Preparation Respecting Climate Change Mitigation and Adaptation as well as Resilience to Natural Disasters***[7].

7%

was the water retention rate in Poland in 2021

15%

is the desired water storage rate of the average annual runoff into the Vistula River

[7] https://www.rpo.malopolska.pl/download/program-regionalny/o-programie/pobierz-poradniki-i-publikacje/2016/03/Poradnik_przygotowania_inwestycji_z-uwzglednieniem-zmian-klimatu-ich-lagodzenia-i-przystosowania-do-tych-zmian-oraz-odpornosci-na-kleski-zywiolowe.pdf

FLOODS AND TORRENTIAL RAINS

ANOTHER IMPORTANT EFFECT OF CLIMATE CHANGE IS AN INCREASE IN THE RAINFALL INTENSITY.

The nature of warm-season rainfall events has changed in recent years, and increasingly they are more violent, short-lived and destructive. They result in flash floods and urban floods.

60% OF ALL FLOODS IN POLAND ARE DUE TO PRECIPITATION[8].

The Climate Change Project for Central Europe (IPCC Report 6)[9] indicates that torrential rainfalls are increasing in intensity and frequency, the effects of which are being felt more and more due to increasing urbanisation. However, we must not underestimate floods caused by frontal rains such as those in 1997 and 2010, as they are of greater magnitude and potentially more severe.

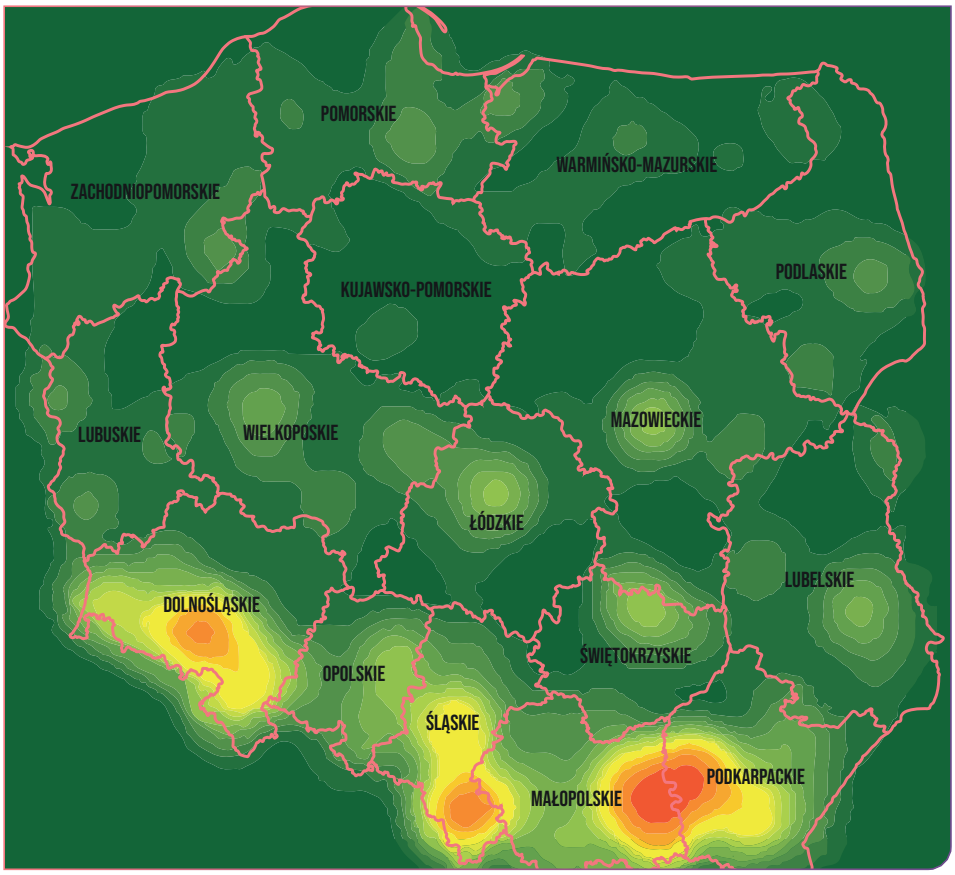
[8] Dobrowolski et al. 2010 citing Tamara Tokarczyk, Wiwiana Szalińska, "Opis powodzi rzecznych w dorzeczu Odry i Wisły z uwzględnieniem działań przeciwpowodziowych zawartych w I cyklu planistycznym planów zarządzania ryzykiem powodziowym".
[9] https://www.ipcc.ch/report/ar6/wg2/

THE MOST VIOLENT RAINFALL FLOODS ARE CAUSED BY TORRENTIAL RAINS.

Their spatial extent is local and they are more common in mountainous and foothill areas. Mainly in the basin of the upper Vistula to the mouth of the San, in the rivers flowing out of the Świętokrzyskie Mountains and in the mountain and foothill tributaries of the upper and central Oder.

Frontal rains usually cause floods with much larger impacts. They cover large areas of the country, entire river basins, causing regional and catastrophic floods. **Rainfall floods are less common in lowland areas, in northern and north-eastern Poland. Rainfall storms usually occur between May and September, with an increase in July-August.**

FIGURE 23
AREAS OF POLAND WHERE THE NEGATIVE EFFECTS OF HEAVY RAINS ARE MOST COMMON.



Source: a study based on Tamara Tokarczyk, Wiwiana Szalińska, Opis powodzi rzecznych w dorzeczu Odry i Wisły z uwzględnieniem działań przeciwpowodziowych zawartych w I cyklu planistycznym planów zarządzania ryzykiem powodziowym.

64 litres
of water per sqm²

THIS IS HOW MUCH WATER FELL IN 30 MINUTES OF HEAVY RAINFALL IN POZNAŃ IN JUNE 2021. THIS AMOUNT SHOULD FALL WITHIN A MONTH NORMALLY[10].

[10] Nasze_Wody_nr_6.pdf

A flash flood is a type of rainfall flood, with a local scope, very rapid progression and short duration (usually less than 6 hours). It is caused by heavy rainfall, often of a thunderstorm nature. It can happen anywhere, most often in mountainous areas. A special case is urban flooding, where heavy rainfall hits sealed ground. In addition, man-made barriers (e.g., walls across the slope) and the density of buildings and infrastructure on lower-lying areas that form the basin (Archimedes' law) affect water storage. Increased surface water runoff results in local inundation events and overflows. **Urban floods are often accompanied by the failure of hydro-technical installations. Moreover, it may be their main cause.**

Only in 2021, such floods occurred, in Kraków, Toruń, Olsztyn and Poznań, among other places, The flood in Poznan resulted in flooding of tunnels, roads, streets and cars, as well as residential and commercial buildings. The fire service intervened 1,500 times[11].

In Warsaw in 2020, a rainstorm flooded many places in the city center; within a few hours of the rainstorm, the fire brigade received about 440 reports in the capital itself[12].

Flash floods also affect smaller towns. The flooding of the Stradomka River in the Łapanów commune (after record rainfall of nearly 150 litres of water per square metre in 6 hours) caused damage estimated at several million zloty. **The cause of the flooding, as pointed out by experts of Wody Polskie (Polish water management authority), was poor infrastructure that prevented the proper drainage of excess water.**

EXPERTS IDENTIFY FLOOD HAZARDS (INCLUDING MAINLY URBAN FLOODS AND FLASH FLOODS) AS THE MOST DANGEROUS AND UNPREDICTABLE THREATS TO POLAND. THE MAIN FACTORS THAT INCREASE FLOOD RISKS FOR CITIES ARE:

- the presence of drainless areas
- the presence of flat areas with a low slope, from which water drains slowly enough to create a hazard
- areas with large differences between the lowest and highest points of the terrain
- soil sealing ("concreting of urban spaces"), which causes obstruction or complete lack of infiltration of rainwater[13]

[11] imgw-pib_raport-klimat-polski_2021_0.pdf
[12] Ulewa w Warszawie. Zalane ulice, zamknięta stacja metra (interia.pl).
[13] Miejskie powodzie – winny klimat czy człowiek? (imgw.pl).

ADAPTATION OF CITIES – RESPONSE TO THE GROWING THREAT OF URBAN FLOODING

IN THE YEARS 2017-2019, AS PART OF THE ***LET'S GET IN THE CLIMATE*** **PROJECT OF THE MINISTRY OF THE ENVIRONMENT, CLIMATE CHANGE ADAPTATION PLANS WERE PREPARED FOR 44 MAJOR URBAN CENTRES IN POLAND.** AN ANALYSIS WAS ALSO MADE OF THE CURRENT STATE OF URBAN ADAPTATION TO CLIMATE CHANGE; MAIN RISK FACTORS AND THE ACTIONS NEEDED TO IMPROVE THE SITUATION WERE IDENTIFIED.

CITIES ARE AREAS THAT ARE PARTICULARLY VULNERABLE TO CLIMATE CHANGE, AND THEIR INHABITANTS MAKE UP MORE THAN 60% OF THE COUNTRY 'S POPULATION.

THE ANSWER TO THESE THREATS: URBAN ADAPTATION PLANS[14].

Urban Adaptation Plans (miejskie plany adaptacji, MPA) were created as part of cooperation between the Ministry of the Environment, local authorities and experts on climate change. A comprehensive climate, demographic, economic and structural analysis was conducted for each city to properly identify threats and propose changes.

Adaptation measures developed with an estimate of their cost include the introduction of air quality monitoring systems, hazard information systems, education campaigns, the development of water management programmes, the development of smart transport system, the development of heat supply systems (replacement of stoves, connection of buildings to the urban system), the development of urban vegetation – creation of green walls at public facilities, planting around transport infrastructure.

PARTICULAR ATTENTION WAS PAID TO THE THREAT OF URBAN FLOODS, WHICH MAY AFFECT MOST LARGE POLISH CITIES.

The Urban Adaptation Plans attach great importance to flood protection, especially to increasing water infiltration into the ground and increased retention of water bodies. Some of the activities are strictly tied to the city's schedule.

In Toruń, expenditure of more than PLN 20 million is planned for on-site rainwater management as well as for improving retention conditions and repairing river channels[15].

[14] Miejskie Plany Adaptacji, Wczujmy się w klimat! (44mpa.pl).
[15] https://www.torun.pl/sites/default/files/pliki/plan_adaptacji_miasta_torunia_do_zmian_klimatu_do_oku_2030.pdf

Gdańsk will spend almost PLN one billion on adaptation measures by 2030, and plans to monitor and improve the infrastructure of the water supply network, purchase medical equipment for rescue units and develop a hazard information system, among other things, as well as educational measures and constructing bicycle lanes, improving the city's air quality and reducing the volume of vehicle traffic[16].

An interesting example is Bydgoszcz, where adaptation measures are monitored on an ongoing basis, and a report on their performance is presented on the city's website[17]. In this way, residents can see how the implementation of certain investments is going. Bydgoszcz earmarked more than PLN 17 million for adapting stormwater drainage to climate change by the end of 2020, and together with funds raised from outside, this amounts to more than PLN 63 million. These measures can protect the city from the effects of torrential rains and thus from flash floods.

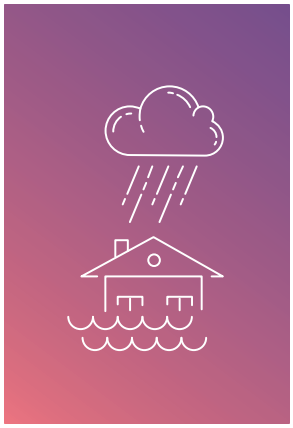
THE STRATEGY FOR WARSAW TAKES INTO ACCOUNT THE RISKS PER INDIVIDUAL DISTRICTS[18].

Among other things, it points out the risks associated with excessive concreting of the space, which can cause surfaces to heat up to over 40 degrees Celsius. **Therefore, the adaptation package draws attention to solutions such as increasing the proportion of biologically active areas by reducing impervious surfaces, e.g. unsealing impervious surfaces or planting trees as part of the *One million trees for Warsaw* campaign[19].**

THANKS TO THE ABOVE AND OTHER MEASURES, CITIES CAN BOTH BECOME RESISTANT TO VIOLENT WEATHER PHENOMENA, WHICH IS ALSO HELPED BY A GOVERNMENT CENTRE FOR SECURITY ALERT WARNING OF DISASTERS, AND PREVENT THE EFFECTS OF, AMONG OTHER THINGS, DROUGHT IN THE LONG TERM. THESE ACTIVITIES ARE ALSO LINKED TO CLIMATE EDUCATION THAT DEVELOPS AWARENESS AMONG RESIDENTS.

[16] mpa_projekt_gdansk.pdf (cloudgdansk.pl).
[17] RAPORT 2019_2020 MPA_v2 do publikacji (www.bydgoszcz.pl).
[18] strategia_2030.pdf (um.warszawa.pl).
[19] Miasto Warszawa, Milion drzew – program nasadzeń (um.warszawa.pl).

PREVENTION OF RIVER FLOODS



FLOOD PROTECTION IS IMPLEMENTED IN ACCORDANCE WITH THE PROVISIONS OF THE WATER LAW ACT. FLOOD HAZARD AND RISK MAPS WERE DEVELOPED, FOLLOWED BY FLOOD RISK MANAGEMENT PLANS. ON THEIR BASIS, DECISIONS WERE MADE ABOUT INVESTMENTS IN FLOOD PROTECTION.

FOR FLOOD PROTECTION, THE WAY FLOODS ARE FORMED IS IMPORTANT.

Most r**egional and nationwide flooding is caused by heavy rainfall in southern Poland. As a result of the terrain, a flood wave forms.** The purpose of the flood protection infrastructure is to intercept excess water in the upper reaches of the Vistula and Oder rivers. Therefore, dry and flood retention basins in the south of the country and polders in the middle reaches of the rivers play an important role.

STRATEGIC INVESTMENTS – FLOOD MITIGATION

In 2018, the State Water Company Wody Polskie (PGW WP) was established as the main body responsible for water management in Poland. As part of the development of the Flood Risk Management Plan, lists of strategic investments were drawn up for the Oder and Vistula river basins in relation to their water regions and catchment areas. **A list of 147 strategic actions was identified for the Oder River Basin, of which 104 are technical and 43 are non-technical.**

SINCE THE BEGINNING OF ITS ACTIVITY PGW WP HAS CARRIED OUT THE FOLLOWING CONSTRUCTION AND MODERNISATION WORKS:

153 km
flood embankments

6
new basins with a total capacity of **189 million m³** (Racibórz Dolny, **Pogrzebień, Lubomia,** Buków, Syrynka, Roztoki)

12
locks

31
damming structures

31
fish

3
new pumping stations

20
new river training structures

THE MOST IMPORTANT PLANNED INVESTMENTS ARE:

- reconstruction of the Żelazna Polder in Opole on the Oder River;
- construction of the Ścinawa barrage on the Oder River;
- Siarzewo barrage on the Vistula River;
- 2nd stage of construction of the Malczyce barrage (backwater);
- Lubiąż barrage on the Odra River[20].

[20] PGW Wody Polskie, "Nasze wody", 2(6)/2021.

THE FLOOD PROTECTION INVESTMENTS MADE IN THE LAST 4 YEARS WERE CARRIED OUT IN EACH PROVINCE ACCORDING TO THEIR ADAPTATION NEEDS.

The largest single investment was the construction of the Racibórz basin, which protects 2.5 million people from flooding. It was commissioned in June 2020. The cost of the investment amounted to almost PLN 2 bn.

PLN 2.4 bn

Total amount of PGW WP activities carried out in 2021 to protect against the effects of floods and drought

PLN 20 bn

Total amount of investments currently being made by PGW Wody Polskie

Source: PGW Wody Polskie, Nasze wody, 2(6)/2021.

THE IMPACT OF ADAPTATION MEASURES ON REDUCING DAMAGE FROM RIVER FLOODING

As part of a study on the impact of flood protection investments, we examined by how much the losses from the construction of the Racibórz basin would be reduced if the floods of 1997 and 2010 were to take place now. Information from insurers on insured losses in these floods from almost the entire Polish market (94.3% of the market) was included. The information was then calibrated to reflect all insured property in the country. The calculations are presented under today's economic conditions, so that the damage values given for both events are comparable.

ACCORDING TO THE MODEL, FLOOD-RELATED INSURED LOSSES [PLN] WOULD AMOUNT TO[22]:

RESTORATION OF THE 1997 FLOOD

without the Racibórz basin

PLN 4.3 bn

Including the Racibórz basin

PLN 3.5 bn

RESTORATION OF THE 2010 FLOOD

without the Racibórz basin

PLN 2.5 bn

Including the Racibórz basin

PLN 2.2 bn

The construction of the basin would thus reduce the total insured losses in the 1997 and 2010 floods by more than PLN 1 billion. The losses would have been 19% lower in the 1997 flood and 11% lower in the 2010 flood. The impact of the Racibórz basin on the insured losses, which leads to the difference found, results from the nature of the flood. The wave on the Oder River that reached Racibórz was lower in 2010 than in 1997, and therefore losses in the area were lower.

ASSUMING THAT 30-40% OF THE DAMAGE WAS INSURED, IT CAN BE ESTIMATED THAT THANKS TO THE RACIBORZ BASIN, DAMAGE WITH A TOTAL VALUE OF BETWEEN PLN 2 AND 2.67 BILLION WOULD HAVE BEEN AVOIDED, AND IN THE CASE OF THE 2010 FLOOD, PLN 0.75 – 0.9 BILLION.

It should be noted that the above estimates refer to direct damage. Indirect damage in the form of business interruptions and interruptions to the functioning of institutions, disrupted supply chains, restrictions on tourism, costs arising from faulty infrastructure, etc., is not included.

[22] Own study based on the model created by Aon.

The table below shows the impact of the basin on losses in the individual provinces.

FIGURE 24
POTENTIAL IMPACT OF THE RACIBÓRZ BASIN ON INSURED LOSSES FOR THE FLOODS OF 1997 AND 2010

PROVINCE	1997 reduction in %	2010 reduction in %	1997 reduction PLN	2010 reduction PLN
DOLNOŚLĄSKIE	-10.7%	-73.3%	-112,485,451	-109,565,404
KUJAWSKO-POMORSKIE	0.0%	0.0%	0	0
ŁÓDZKIE	0.0%	0.0%	0	0
LUBELSKIE	0.0%	0.0%	0	0
LUBUSKIE	-8,1%	-32.3%	-23,901,039	-11,170.449
MAŁOPOLSKIE	0.0%	0.0%	0	0
MAZOWIECKIE	0.0%	0.0%	0	0
OPOLSKIE	-54%	-42.3%	-538,217,498	-134,010,053
PODKARPACKIE	0.0%	0.0%	0	0
PODLASKIE	0.0%	0.0%	0	0
POMORSKIE	0.0%	0.0%	0	0
ŚLĄSKIE	-14.8%	-3.7%	-84,928,998	-24,366,290
ŚWIĘTOKRZYSKIE	0.0%	0.0%	0	0
WARMIŃSKO-MAZURSKIE	0.0%	0.0%	0	0
WIELKOPOLSKIE	0.0%	0.0%	0	0
ZACHODNIOPOMORSKIE	-5.8%	0.0%	-392,453	0

The basin would have a particularly great impact on the Opole Province – due to the fact that it would block the Oder overflow north of Racibórz.

HURRICANES

THE LOCAL NATURE OF THE OCCURRENCE OF HIGH WINDS, HURRICANES OR EVEN TORNADOES – UNLIKE DROUGHTS AND FLOODS – MAKES IT DIFFICULT TO IDENTIFY AREAS THAT ARE NOT AT RISK OF DAMAGE FROM THEIR EFFECTS. **HOWEVER, EXPERTS IDENTIFY BOTH PERIODS AND REGIONS THAR ARE MORE AT RISK.**

During the cold season (October-April) there are winds with gusts of up to 17 m/s, which pose a considerable danger. In summer (June-August), however, wind speeds of hurricane force, i.e. over 33 m/s, occur. **In recent years, high-speed winds have been observed lasting many hours or even several days.**

INSURERS REPORT THAT THEY RECEIVE THREE TO EIGHT TIMES AS MANY WEATHER CLAIMS IN WEEKS WITH STRONG WINDS AS IN CALM WEEKS.

The most susceptible to such phenomena are the central and eastern parts of the Slovincian Coast from Koszalin to Rozewie and Hel, as well as a broad belt of latitude in northern Poland up to the Suwałki region, the region of the Silesian Beskids, the Żywiec Beskids, the Silesian Foothills and Podhale and the Dynowskie Foothills, as well as the central part of Poland with Mazovia and the eastern part of Greater Poland.

SQUALLS AND TORNADOES (WIND SPEED IN THE VORTEX 50 TO 100 M/S) OCCUR MOST FREQUENTLY FROM JUNE TO AUGUST IN THE AREA OF THE LESSER POLISH UPLAND AND THE LUBLIN UPLAND.

They extend in a broad belt in a southwest-northeast direction through the area of the Kutno Upland, Mazovia to the Suwałki region. Such winds occur on average 6 times a year, and in recent years their frequency has increased to 7-20 in a year[23].

In collaboration with Aon, we prepared a hurricane scenario that mirrored **Cyclone Kyrill, which occurred in January 2007 and affected Western and Central Europe.** The model used to estimate losses for the developed scenario was created on the basis of information received from insurers operating on the Polish insurance market and showed that the insured losses caused under current conditions by a similar hurricane in Poland would amount to approximately PLN 544 million.

REDUCING THE IMPACT OF HURRICANES

THE LOSSES CAUSED BY HURRICANES CAN BE SIGNIFICANTLY REDUCED BY PROPER ADAPTATION.

The EU's key recommendations for preparing for future high wind events include:

IMPROVING INFRASTRUCTURE

to make it resitant to hurricanes, for example, constructing roofs of buildings so that they are properly inclined in the prevailing wind direction, using covers in the form of outbuildings, or using modern materials for construction

IMPROVING THE QUALITY OF SPATIAL PLANNING,

developing cities and forest areas with a view to the risk of hurricanes

IMPROVING THE QUALITY OF THE DATA COLLECTED

in relation to hurricanes, in order to build future scenarios based on them and to react more quickly to new threats, which is already partly implemented in Poland through RCB activities (e.g. RCB safety alert)

[23] Based on a publicly available extract from the *2020 Report on Threats to National Security*.

The Government Centre for Security, as part of the 2020 *Report on Threats to National Security*, also points to recommendations for targeted actions to reduce the risk or impact of realising the threat of high winds. These include the following recommendations:

- to use new power supply systems in companies, with a special focus on emergency power systems;
- to design transmission networks with a view to extreme weather situations in order to reduce the risk of damage in the event of high winds;
- to use the Guide to Investment Preparation Respecting Climate Change Mitigation and Adaptation as well as Resilience to Natural Disasters, which provides relevant guidance for industry that can help reduce the impact of catastrophic events resulting from high winds.

EXTREME WEATHER EVENTS SUCH AS HURRICANES INCREASE THE RISK OF DAMAGE TO TRANSMISSION AND DISTRIBUTION LINES, THREATENING TO DISRUPT POWER SUPPLY.

The intensification of strong wind events is also a threat to the wind energy industry. The use of this energy source can therefore entail risks, both because of the predictability of energy production and because of the destruction of installations. The expansion of distributed renewable energy sources should take into account the deterioration of wind conditions (long periods without wind or short periods with hurricane force winds).

HOME INSURANCE AGAINST NATURAL CATASTROPHES

IN POLAND, THE LEVEL OF COVERAGE FOR RESIDENTIAL PROPERTIES AGAINST NATURAL DISASTERS IS RELATIVELY HIGH.

It is highest for residential buildings that are part of farms and for individual residential buildings. A lower insurance prevalence is found in housing units. It can be assumed that a large proportion of the housing units are insured due to the requirements of the banks that granted the loan for the purchase of these units. Many flat owners who are not encumbered by a loan assume that the premises are already insured by a building insurance contract with a housing cooperative or association.

The prevalence of insurance for multi-family dwellings is much lower than for single-family dwellings. The lack of insurance may be the case especially in poorer housing associations and cooperatives and in residential buildings owned by local governments.

TOTAL NUMBER OF HOUSING UNITS (ESTIMATES BASED ON CSO DATA)

11,129,625

NUMBER OF INSURED UNITS COVERED BY ACTIVE POLICIES AS AT 31 MARCH 2022, INCLUDING BANCASSURANCE CHANNELS

total number of insured units	of which: number of units – hurricane / high wind	of which: number of units – flood
4,493,453	4,491,500	3,964,631
40%	40%	36%

TOTAL NUMBER OF RESIDENTIAL SINGLE-FAMILY DWELLINGS (ESTIMATES BASED ON CSO DATA)

4,070,375

NUMBER OF INSURED SINGLE-FAMILY DWELLINGS COVERED BY VOLUNTARY POLICIES, ACTIVE AS AT 31 MARCH 2022, INCLUDING BANCASSURANCE CHANNELS

number of insured single-family dwellings	of which: number of single-family dwellings – hurricane / high wind	of which: number of single-family dwellings – flood
2,911,293	2,876,962	2,558,912
72%	71%	63%

TOTAL NUMBER OF RESIDENTIAL SINGLE-FAMILY DWELLINGS THAT ARE PART OF FARMS (ESTIMATES BASED ON CSO DATA)

1,317,000

NUMBER OF INSURED SINGLE-FAMILY DWELLINGS THAT ARE PART OF FARMS COVERED BY MANDATORY ACTIVE CONTRACTS AS AT 31 MARCH 2022

number of insured single-family dwellings	of which: number of single-family dwellings – hurricane / high wind	of which: number of single-family dwellings – flood
1,008,644	1,008,556	992,954
77%	77%	75%

TOTAL NUMBER OF RESIDENTIAL MULTI-FAMILY DWELLINGS (ESTIMATES BASED ON CSO DATA)

557,620

NUMBER OF MULTI-FAMILY DWELLINGS INSURED AS A WHOLE ON THE BASIS OF ACTIVE CONTRACTS AS AT 31 MARCH 2022 BY HOUSING ASSOCIATIONS

number of insured multi-family dwellings	of which: number of multi-family dwellings – hurricane / high wind	of which: number of multi-family dwellings – flood
252,291	251,708	229,883
45%	45%	41%

CHAPTER 3

THE IMPACT OF THE NEW ESG REGULATIONS ON THE INSURANCE SECTOR IN POLAND AND WORLDWIDE

ESG (ENVIRONMENT, SOCIAL, GOVERNANCE)

INTERNATIONAL ORGANISATIONS' RESPONSE TO CLIMATE CHANGE

IN RESPONSE TO ONGOING CLIMATE CHANGE AND PROGRESSIVE ENVIRONMENTAL DEGRADATION, INTERNATIONAL ORGANISATIONS SUCH AS THE UN AND THE EUROPEAN UNION ARE CREATING A FRAMEWORK FOR SUSTAINABLE DEVELOPMENT. **THE MOST IMPORTANT GOALS OF SUSTAINABLE DEVELOPMENT ARE CLIMATE PROTECTION, THE IMPROVEMENT OF LIVING CONDITIONS AND THE PROMOTION OF BUSINESS ETHICS.**

PARIS2015
UN CLIMATE CHANGE CONFERENCE
COP21·CMP11

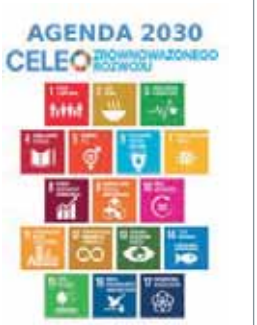
The first measures to implement the principles of sustainable development were taken in 2015 with the signing of the Paris Agreement at the conclusion of the 21st United Nations Conference (UN) on Climate Change.

AS PART OF THE PARIS AGREEMENT, THE FOLLOWING POINTS WERE AGREED:

- limiting the increase in average temperature well below 2°C and
- making efforts to keep the temperature increase below 1.5 °C compared to the pre-industrial era.

In the same year, the heads of state and government of the United Nations adopted the 2030 Agenda for Sustainable Development. Poland formally joined the Agenda.

THE STRATEGY OF SUSTAINABLE DEVELOPMENT OF THE WORLD UNTIL 2030 INCLUDES:



17
Goals

5
Areas: People, Planet, Prosperity, Peace, Partnership

169
Activities in total listed for each of the 5 areas

Based on the Paris Agreement, the European Commission adopted the assumptions for the Green Deal policy in 2019. The European Green Deal is the EU's growth strategy to transition Europe to a climate-neutral, equitable and prosperous society with a modern, resource-efficient and competitive economy.

THE OVERARCHING AIM OF THE EUROPEAN GREEN DEAL IS TO:

- achieve climate neutrality for Europe by 2050,
- reduce net greenhouse gas emissions in the European Union by at least 55% by 2030 compared to 1990.

According to the United Nations Sustainable Development Agenda, many elements need to be taken into account to ensure a decent life for people while taking into account the needs of future generations. These can be divided into environmental factors (E), social factors (S) and governance factors (G).

MAIN GOALS:

01

MEETING THE NEEDS OF PEOPLE LIVING TODAY

02

GIVING FUTURE GENERATIONS THE OPPORTUNITY TO SATISFY THEIR OWN NEEDS

SPECIFIC GOALS

E ENVIRONMENT ENVIRONMENT AND CLIMATE PROTECTION

- Ensure access to affordable, reliable, sustainable and modern energy
- Ensure sustainable consumption and production patterns
- Take urgent action to combat climate change and its impacts
- Conserve and sustainably use the oceans, seas and marine resources
- Ensure sustainable use of ecosystems, combat degradation and halt biodiversity loss

S SOCIAL IMPROVEMENT OF SOCIAL RELATIONS

- End poverty in all its forms everywhere
- End hunger, achieve food security and improved nutrition and promote sustainable agriculture
- Ensure healthy lives and promote well-being for all at all ages
- Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
- Ensure access to water and sanitation for all through sustainable management of water
- Make cities and human settlements inclusive, safe, resilient and sustainable

G GOVERNANCE INTRODUCTION OF CORPORATE GOVERNANCE RULES

- Achieve gender equality and empower all women and girls
- Promote inclusive and sustainable economic growth, employment and decent work for all
- Build resilient infrastructure, promote sustainable industrialisation and foster innovation
- Reduce inequality within and among countries
- Promote peaceful and inclusive societies, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
- Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development

On 29 September 2020, at the invitation of the Ministry of Development and Technology, PIU joined the Partnership for the Implementation of Sustainable Development Goals (SDGs). In fulfilling the so-called Commitment, the Chamber pursues Goal 4 "good quality education" within the framework of the Sustainable Finance Working Group of PIU. PIU collaborates on the SDGs Newsletter published by the Ministry.

THE ROLE OF INSURERS IN THE FIGHT AGAINST CLIMATE CHANGE

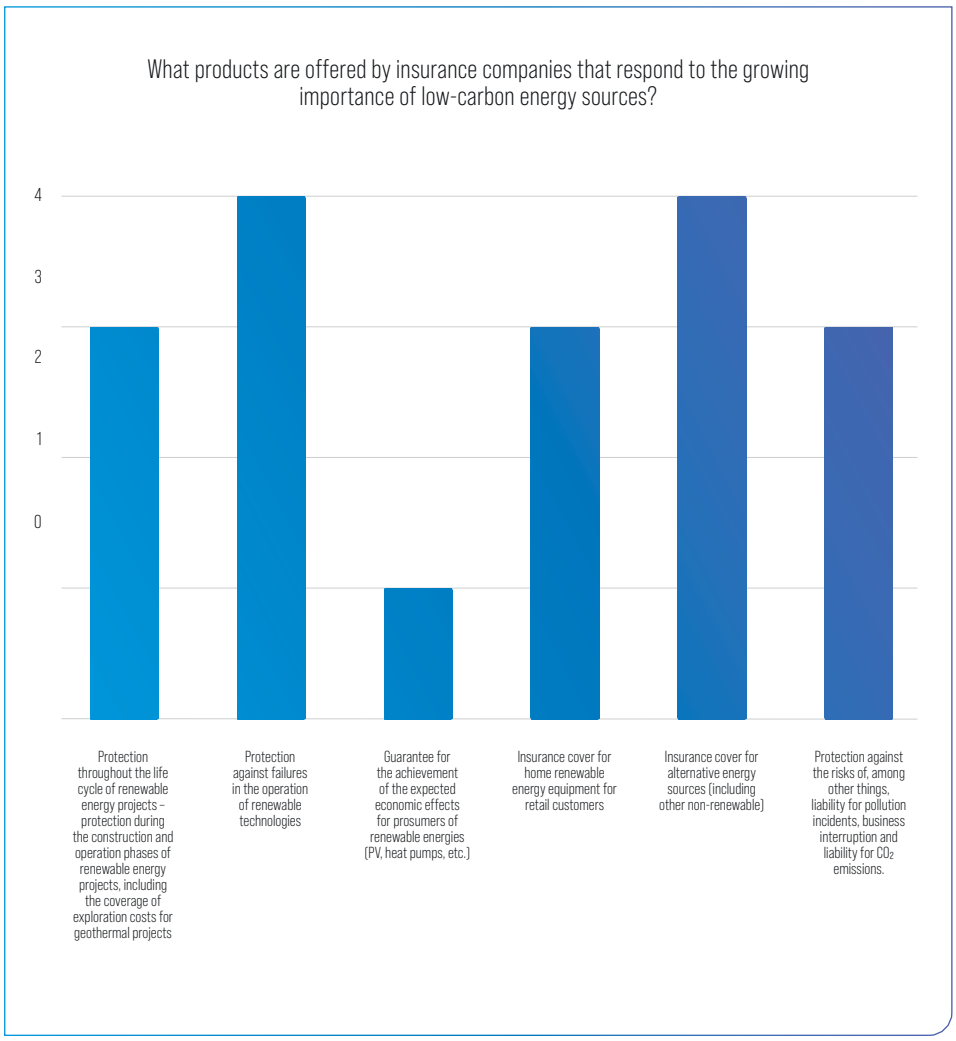
MANY EUROPEAN UNION LEGISLATIVE INITIATIVES AIM TO REDIRECT CAPITAL FLOWS TOWARDS SUSTAINABLE INVESTMENTS. FINANCIAL INSTITUTIONS AS KEY INVESTORS IN THE MARKET ARE AN IMPORTANT LINK IN ACHIEVING THE ADOPTED CLIMATE POLICY GOALS.

Insurance companies play an important role in the green transition by supporting the energy transition or securing against the effects of climate change. Insurers offer products that include policies related to clean energy generation, including policies for wind farms and hydroelectric power plants. They introduce restrictions on the insurance of the fossil fuel sector.

INSURERS ALSO PLAY A SPECIAL ROLE AS INSTITUTIONAL INVESTORS, DIRECTING FINANCIAL FLOWS TO COMPANIES AND FOR THE IMPLEMENTATION OF PROJECTS THAT CONTRIBUTE TO THE FIGHT AGAINST CLIMATE CHANGE.

Insurance companies in Poland already offer products that are responsible for the increase in importance of low-carbon energy sources. In the survey conducted for the report insurance companies indicated the following products:

FIGURE 25
PRODUCT OFFER FOR LOW-CARBON ENERGY SOURCES AT INSURANCE COMPANIES IN POLAND



Source: study prepared on the basis of responses obtained from insurance companies as part of the sustainable development policy implementation survey conducted by PIU and EY in July 2022.

Insurance companies are also entrepreneurs, consuming energy and other resources, employing people and maintaining relationships with many businesses. **It is therefore important that insurance companies themselves operate in an environmentally friendly manner and support ESG goals.**

Through their decisions, insurance companies can influence the reality around us. Global financial institutions, such as the UN and the European Union, are working together to improve the climate and living conditions.

THE IMPACT OF CLIMATE CHANGE ON INSURANCE COMPANIES

CLIMATE CHANGE AND THE ENERGY TRANSITION WILL HAVE AN IMPACT ON INSURERS' FINANCES.

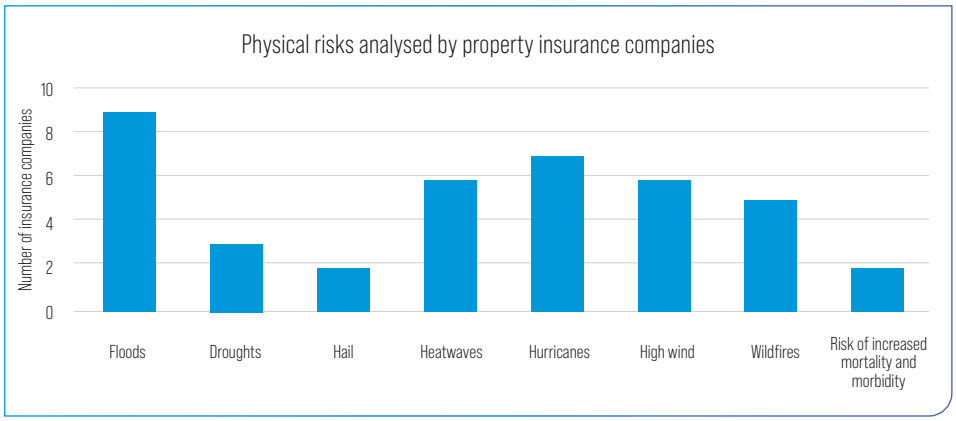
This means that it is necessary to change the approach to risk assessment by insurance companies. Phenomena that used to be considered extreme are becoming more frequent, and consequently insurers must take these trends into account when assessing the insured events for which they provide cover. In addition, new risks are emerging (such as physical risks and transition risks) that need to be properly assessed and monitored. Physical risks are those directly related to atmospheric phenomena. They result from a change in the frequency and strength of events. These can be sudden events (fires, floods, storms, heat waves) as well as long-term events (droughts, landslides, rainfall variability, rising sea levels).

FOR INSURANCE COMPANIES, TRANSITION RISKS ARE THOSE THAT FORCE ADAPTATION TO CHANGE.

These include regulatory, financial and social issues (e.g. impairment of securities, risks associated with reinsurance of polluting companies or loss of reputation).

The survey conducted by PIU and EY examined which physical and transition risks are analysed by insurance companies. For life insurers, it is primarily the risk of increased mortality and morbidity; for property insurers, it is floods and strong wind events. Of the transition risks, the most frequently mentioned is the risk of impairment of securities.

FIGURE 26
PHYSICAL RISKS ANALYSED BY INSURANCE COMPANIES



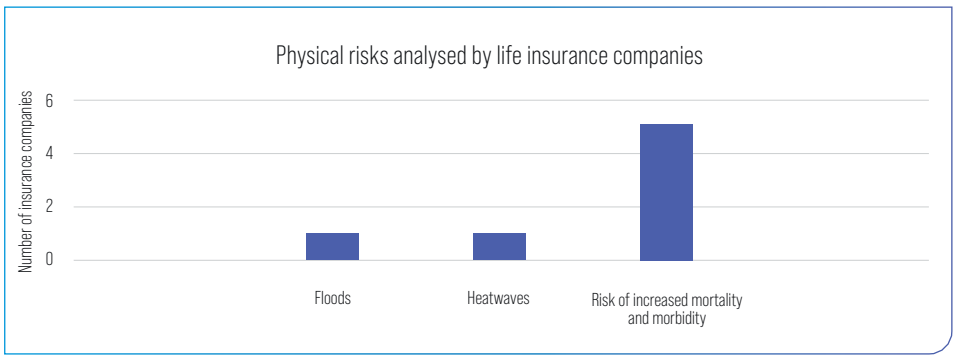
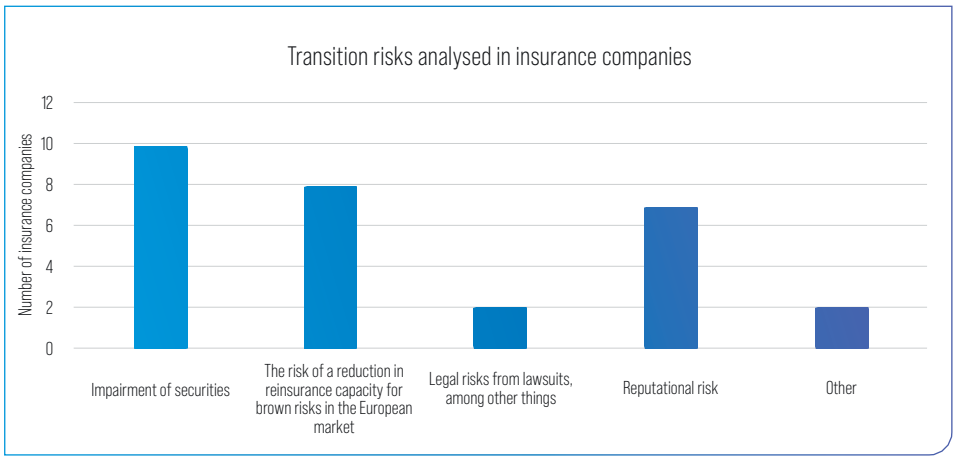


FIGURE 27
TRANSITION RISKS ANALYSED BY INSURANCE COMPANIES IN POLAND



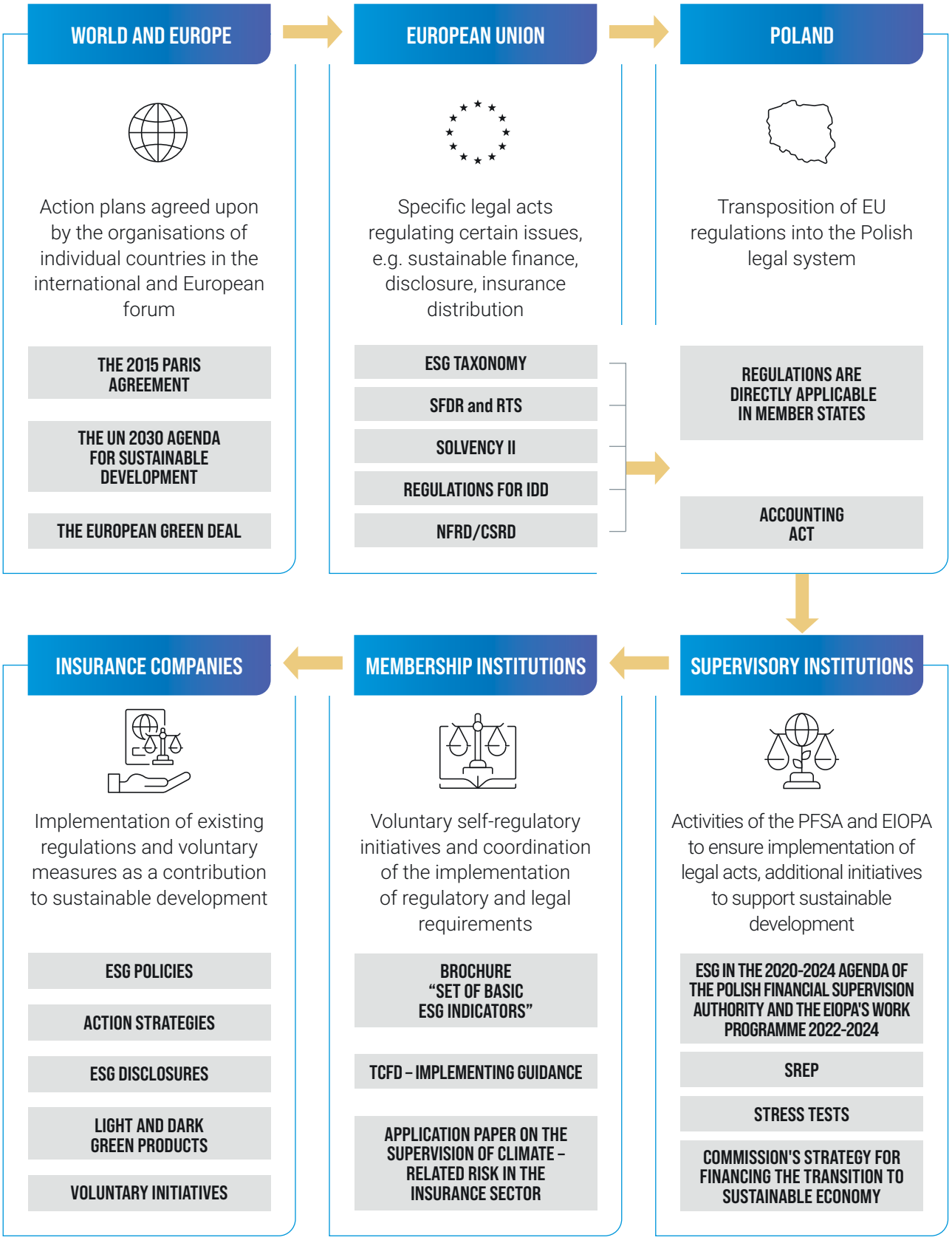
Source: study prepared on the basis of responses obtained from insurance companies as part of the sustainable development policy implementation survey conducted by PIU and EY in July 2022.

SUPPORTING SUSTAINABLE DEVELOPMENT IN THE EUROPEAN UNION THROUGH REGULATION

INTERNATIONAL AGREEMENTS SET THE DIRECTION FOR THE LEGISLATION OF THE EUROPEAN UNION AND THUS OF THE MEMBER STATES.

They also require action by European and national supervisory authorities (e.g. EIOPA, PFSA). Insurance companies are obliged to align their activities with laws, guidelines and recommendations to promote sustainable development.

In addition, they can voluntarily take initiatives to support sustainable development, for example by committing to develop products that support climate change, offering discounts for ESG solutions or working to improve public health, quality of life and safety through social campaigns.



Source: own study

RULES TO PROMOTE SUSTAINABLE DEVELOPMENT AND THEIR RELEVANCE FOR THE INSURANCE SECTOR

EU LEGISLATION WITH THE GREATEST IMPACT ON THE ACTIVITIES OF INSURANCE COMPANIES IN THE FIELD OF SUSTAINABILITY INCLUDES[3]:

SFDR (SUSTAINABLE FINANCE DISCLOSURE REGULATION)

The FDR introduces an obligation for life insurers offering insurance-based investment products (e.g. insurance capital funds, UFK) or pension products (e.g. IKE, IKZE) to disclose information on sustainability (e.g. in their investment process strategy, investment decisions, remuneration policy, client communication, product design and regular reporting). It includes provisions for reporting on whether a life insurance company has a balanced portfolio of investments. Thanks to SFDR disclosures, customers can know whether the financial product they are investing in is sustainable. By choosing green investment products, customers participate in the fight against climate change. Their savings finance the energy transition.

[3] https://eur-lex.europa.eu/legal-content/PL/TXT/PDF/?uri=CELEX:32019R2088&from=PL
https://eur-lex.europa.eu/legal-content/PL/TXT/PDF/?uri=CELEX:32014L0095&from=EN
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IDD – INSURANCE DISTRIBUTION DIRECTIVE (DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL (EU) 2016/97 ON INSURANCE DISTRIBUTION TOGETHER WITH THE COMMISSION DELEGATED REGULATION (EU) 2021/1257 OF 21 APRIL 2021).

According to the IDD, sustainability factors should be taken into account in the approval process of each insurance product and should be presented transparently so that insurance distributors can provide relevant information to customers.

THE CUSTOMER'S PERSONAL SUSTAINABILITY PREFERENCES SHOULD BE TAKEN INTO ACCOUNT WHEN SURVEYING CUSTOMER PREFERENCES WHEN OFFERING INSURANCE-BASED INVESTMENT PRODUCTS.

Sustainability aspects will therefore be one of the factors taken into account when a customer decides on a product. While the customer used to look at whether a product was safe, they will now also look at whether it supports the green transformation.

UE TAXONOMY – REGULATION OF THE EP AND OF THE COUNCIL 220/852 ON THE ESTABLISHMENT OF A FRAMEWORK TO FACILITATE SUSTAINABLE INVESTMENT

Taxonomy (a system for the uniform classification of sustainable development activities) sets criteria for determining whether an activity is environmentally sustainable. It prevents greenwashing, i.e. the unjustified presentation of one's activities and products as sustainable.

WITH A UNIFORM APPROACH, DIFFERENT STAKEHOLDERS (CUSTOMERS, INVESTORS, ETC.) SHOULD BE ABLE TO COMPARE INSURANCE COMPANIES WITH REGARD TO ESG FACTORS.

Insurance companies that are required to report on non-financial aspects under the CSRD will eventually need to indicate what part of the insurance portfolio and what percentage of investments are environmentally sustainable in relation to the total amount of assets. A survey[4] shows that in Poland, 8 out of 16 insurance companies (half of those surveyed) currently have to produce this type of information.

[4] For the report, a survey was conducted among Polish insurance companies on the implementation of sustainable development measures. Seven life insurers (with a total share of over 63% of premiums written) and nine non-life insurers (with a total share of over 46% of premiums written) responded.

NFRD / CSRD – NON-FINANCIAL REPORTING DIRECTIVE / CORPORATE SUSTAINABILITY REPORTING DIRECTIVE

The NFRD sets out disclosure requirements on the impact of sustainability issues on the company's performance, position and development ("outside-in" perspective) and on the company's impact on people and the environment ("inside-out" perspective).

The CSRD, which replaces the NFRD, extends the scope of reporting obligations to more companies and broadens the scope of information to be reported, which must comply with EU reporting standards. The disclosures are required to provide investors with sustainability information that should be considered in the investment process. For insurance companies, the NFRD and CSRD disclosures are a source of information on how sustainable a company's operations are, which can influence the decision to purchase its securities.

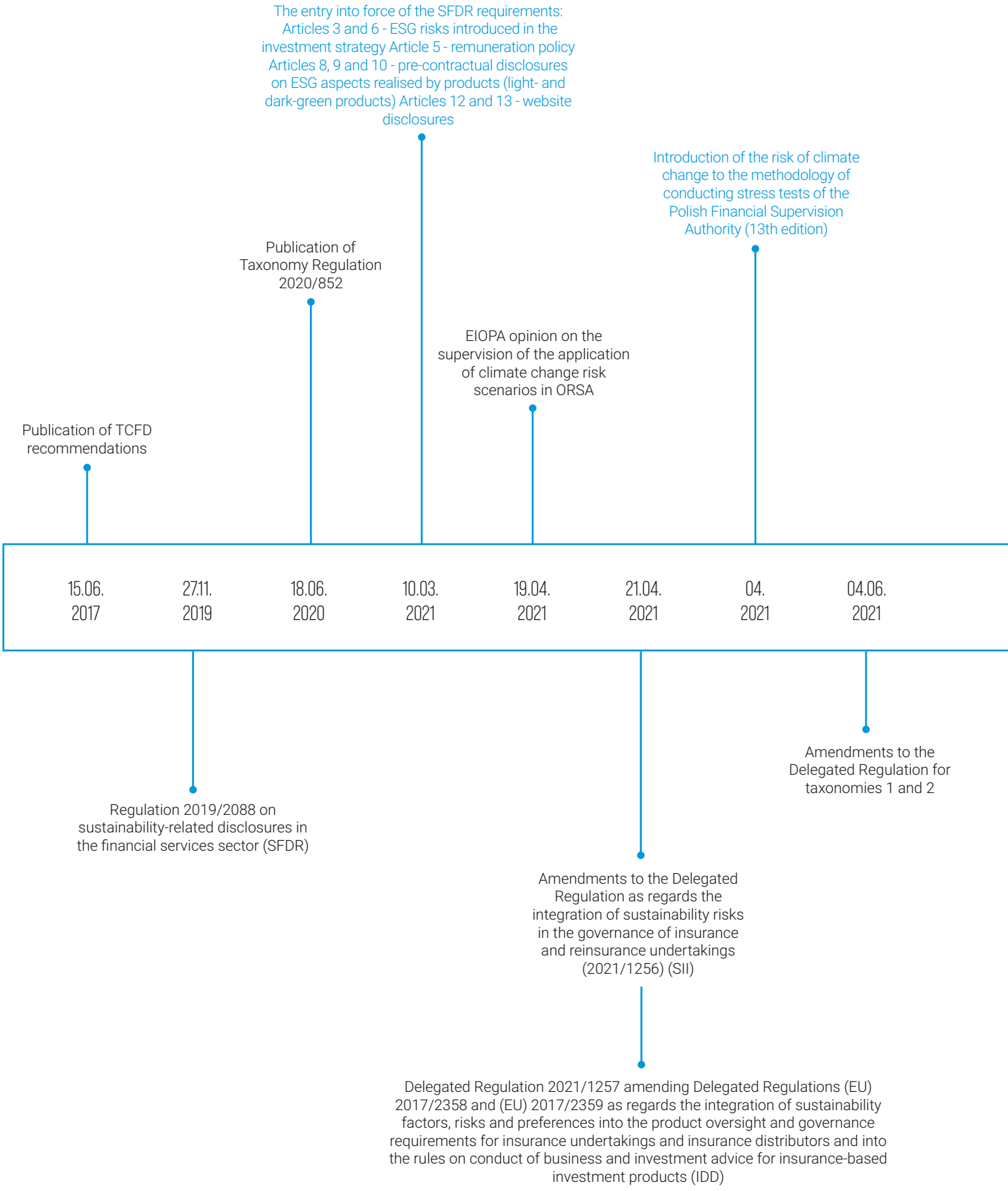
AN INSURANCE COMPANY THAT OFFERS GREEN PRODUCTS TO ITS CUSTOMERS MUST INVEST IN SUSTAINABLE BUSINESSES. NFRD AND CSRD DISCLOSURES ENABLE INSURANCE COMPANIES TO MEET SFDR OBLIGATIONS.

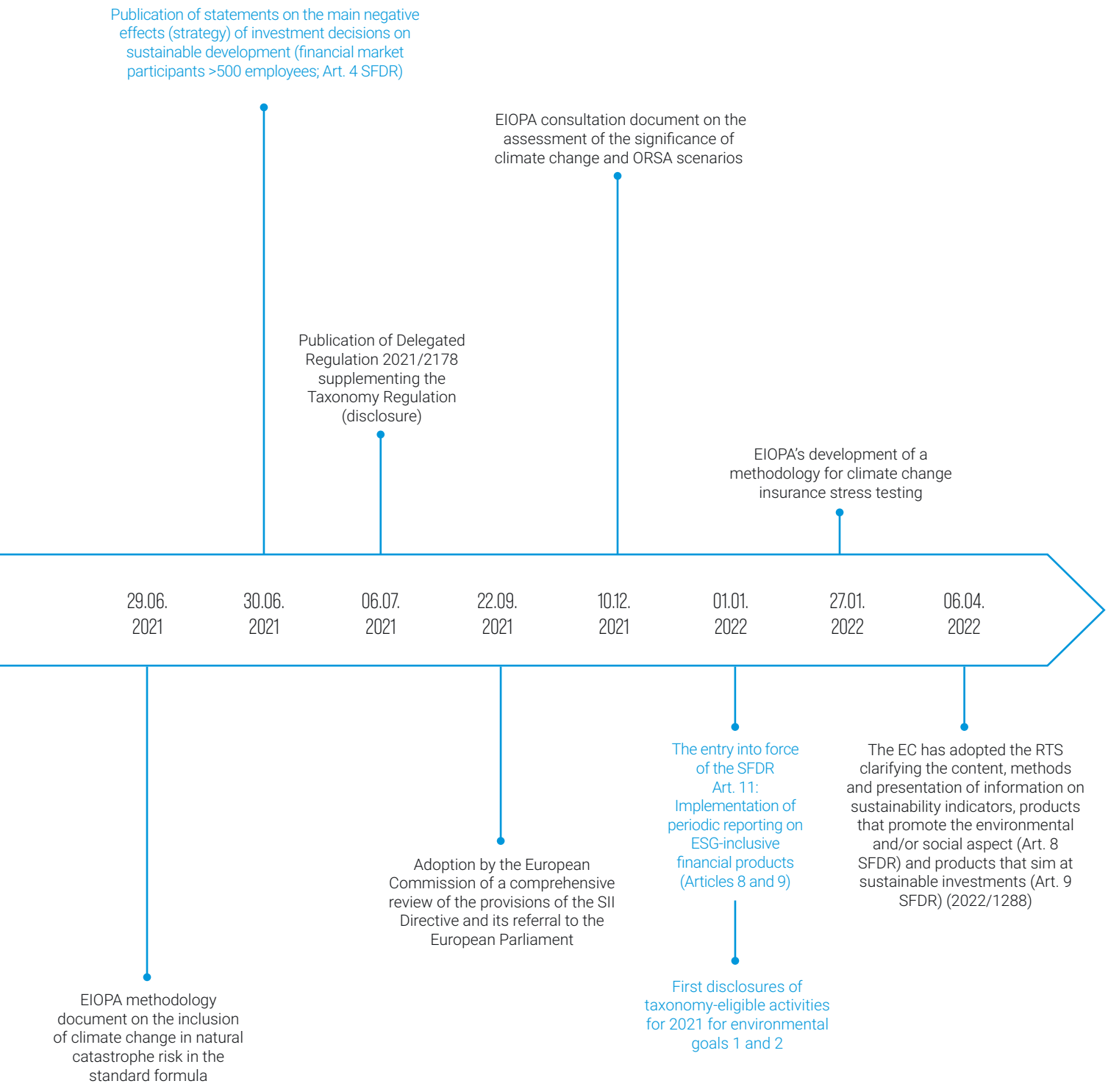
SOLVENCY II DIRECTIVE AND DELEGATED REGULATION

The expansion of the Solvency II Directive comprises the inclusion of sustainability factors in risk management processes and in the assessment of own solvency needs as well as in remuneration rules. **Risks for sustainable development are also to be included in the principle of the "prudent investor". This means that insurers will have to change their approach to investment and risk assessment, which will indirectly affect the products offered to customers.**

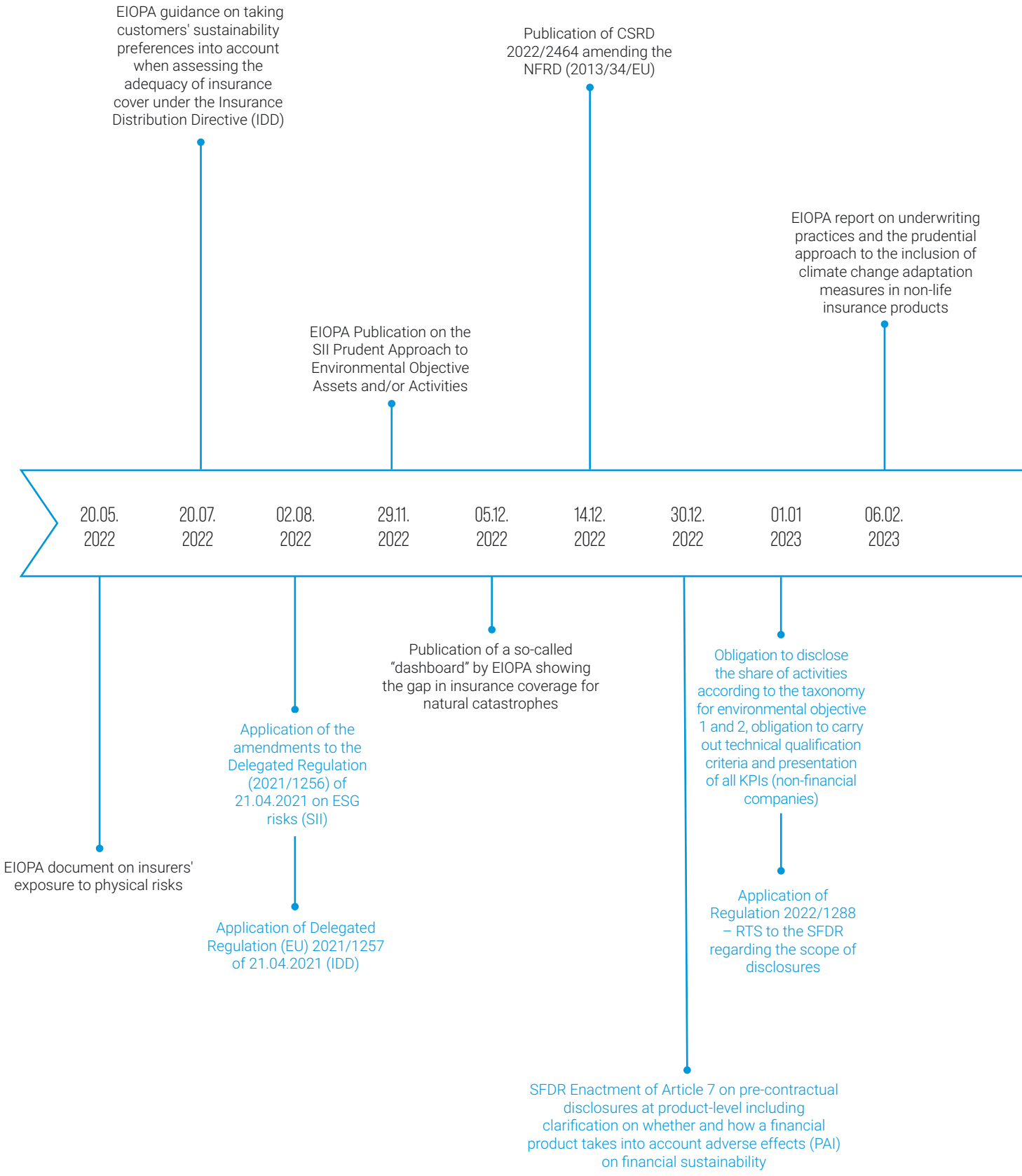
The timetable for legislative changes to support the achievement of the Sustainable Development Goals in insurance is very tight. Insurance companies must continuously react to changes and adjust their activities accordingly. Implementing new standards can be very challenging, especially because there is no developed market practice.

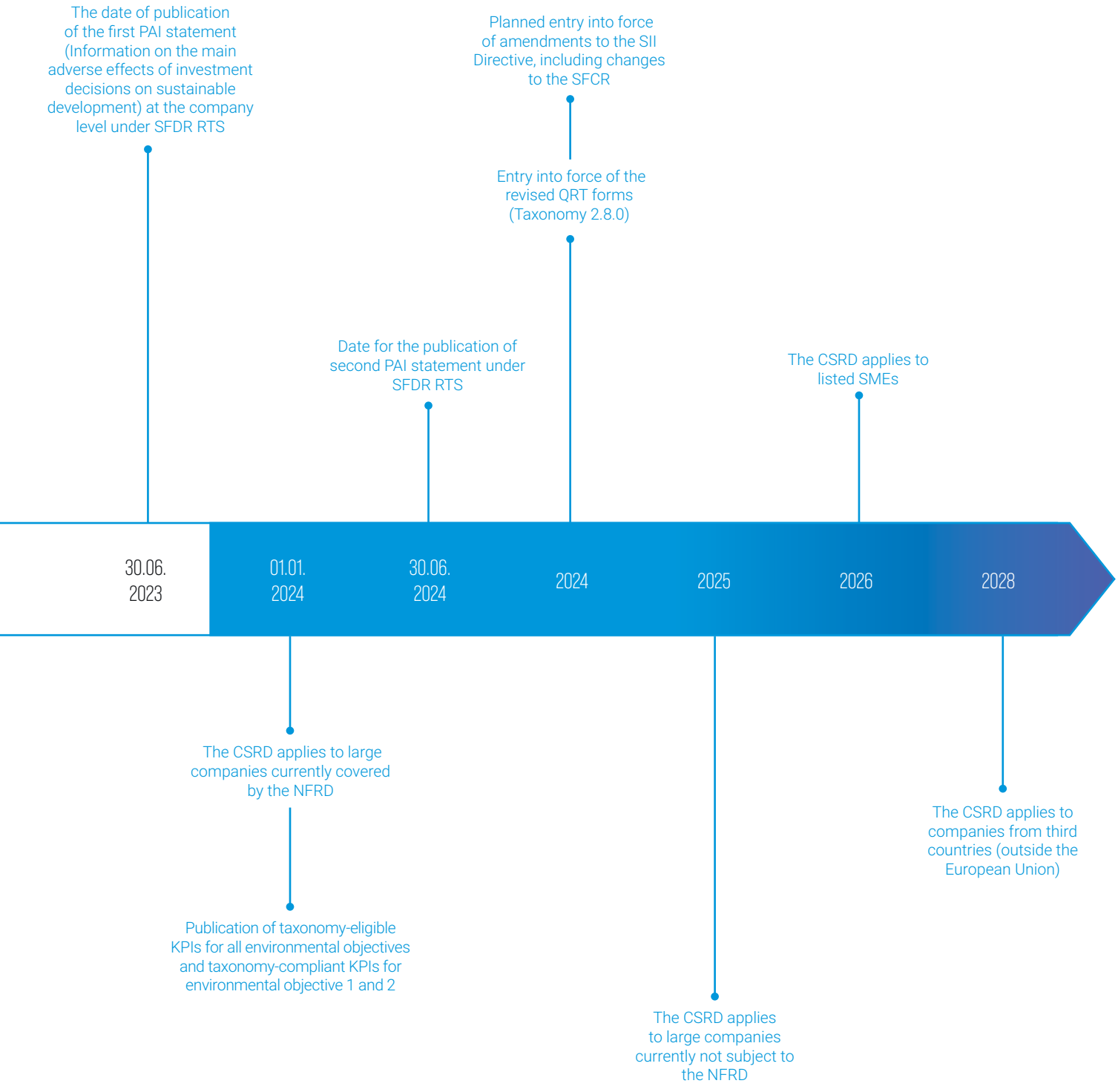
Entry into force and the moment of first disclosure




29.06. 2021
EIOPA methodology document on the inclusion of climate change in natural catastrophe risk in the standard formula
30.06. 2021
Publication of statements on the main negative effects (strategy) of investment decisions on sustainable development (financial market participants >500 employees; Art. 4 SFDR)
06.07. 2021
Publication of Delegated Regulation 2021/2178 supplementing the Taxonomy Regulation (disclosure)
22.09. 2021
Adoption by the European Commission of a comprehensive review of the provisions of the SII Directive and its referral to the European Parliament
10.12. 2021
EIOPA consultation document on the assessment of the significance of climate change and ORSA scenarios
01.01. 2022
The entry into force of the SFDR Art. 11: Implementation of periodic reporting on ESG-inclusive financial products (Articles 8 and 9)
First disclosures of taxonomy-eligible activities for 2021 for environmental goals 1 and 2
27.01. 2022
EIOPA's development of a methodology for climate change insurance stress testing
06.04. 2022
The EC has adopted the RTS clarifying the content, methods and presentation of information on sustainability indicators, products that promote the environmental and/or social aspect (Art. 8 SFDR) and products that sim at sustainable investments (Art. 9 SFDR) (2022/1288)

Entry into force and the moment of first disclosure




The date of publication of the first PAI statement (Information on the main adverse effects of investment decisions on sustainable development) at the company level under SFDR RTS
Planned entry into force of amendments to the SII Directive, including changes to the SFCR
Entry into force of the revised QRT forms (Taxonomy 2.8.0)
Date for the publication of second PAI statement under SFDR RTS
The CSRD applies to listed SMEs
30.06. 2023
01.01. 2024
30.06. 2024
2024
2025
2026
2028
The CSRD applies to large companies currently covered by the NFRD
Publication of taxonomy-eligible KPIs for all environmental objectives and taxonomy-compliant KPIs for environmental objective 1 and 2
The CSRD applies to large companies currently not subject to the NFRD
The CSRD applies to companies from third countries (outside the European Union)

ASPECTS OF ESG IN RELATIONS WITH INVESTORS AND CUSTOMERS AND THE IMAGE OF AN INSURANCE COMPANY

The sustainability agenda affects various areas of activity of insurance companies and its importance is constantly increasing. In particular, the sustainable development measures taken by insurers and the degree of compliance with applicable regulations have an impact on the company's image and its perception by various stakeholders.

FIGURE 28
EXPECTATIONS OF VARIOUS RECIPIENTS WITH REGARD TO ESG THAT AFFECT THE INSURANCE COMPANY

[5] The Supervisory Review and Evaluation Process (SREP) of insurance companies is part of the supervisory system based on the PFSA's risk analysis and follows a uniform approach for supervised entities in all sectors of the financial market. The SREP considers issues related to new and emerging risks, including issues related to the concept of sustainable development.
[6] ESG is one of the priorities in the work of the Polish Financial Supervision Authority in the area of reviewing and updating the Solvency II system. The PFSA 2020-2024 agenda in the area of ESG includes:
- Analysis of how to implement taxonomy,
- Climate risk analysis as part of risk management,
- Better consideration of climatic factors in stress tests,
- Estimating the impact of green bond issuance and purchase on capital needs and capital.

[7] Stress tests/PFSA stress tests of the PFSA are a set of techniques used to estimate the extent of the impact of adverse factors on a particular organisation, especially on the level of risk it takes. In its stress test methodology, the PFSA considers mandatory climate change scenarios, such as:
- Physical risks – the risk of flooding and high winds, hail, wildfires (non-life segment),
- Physical risks – the risk of increased mortality and morbidity (life segment),
- Transition risks – impairment of securities (life and non-life segments),
- Transition risks – the risk of reducing the reinsurance capacity for bronze risks on the European market (non-life segment).

INVESTORS

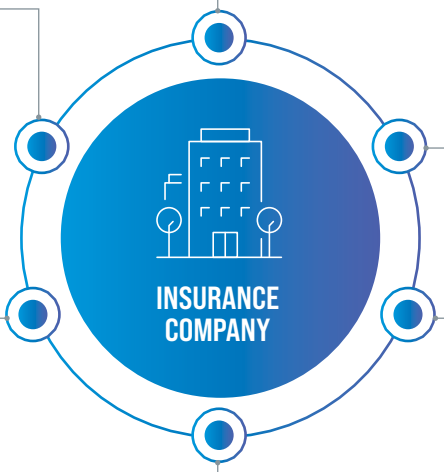
- ESG aspects are increasingly influencing investor relations and the market valuation of the company.
- There is a greater willingness to invest in companies that pay close attention to ESG.

RATING AGENCIES

- Ratings take into account how the company considers ESG aspects in its operations as well as in its investment and product policies.

SHAREHOLDERS

- ESG factors have an impact on the equity and ability of insurance companies to pay dividends (the need to provide funds to cover potential physical risks may limit the ability to pay dividends).
- The management of ESG aspects has an impact on the perception and image of the Group as a whole.



SUPERVISORS

- The approach to ESG aspects influences the BION assessment[5] and the intensity of the supervisory measures taken by the PFSA (in line with the PFSA agenda[6]).
- Insurance companies are required to conduct stress tests to assess the degree of impact of climate change on their business in line with the recommendations of the PFSA and EIOPA[7].
- One of the most important items on the EIOPA agenda is closing the insurance gap for climate risks.

CONSUMERS

- Consumers are increasingly paying attention to ESG aspects when choosing insurance products.
- New insurance needs arise, e.g. in connection with the construction of wind farms.

EMPLOYEES

- ESG factors have an impact on working conditions.
- Employees are often guided by the values of the company when choosing their employer.

Source: EY's own study.

To manage their reputation, insurance companies are aligning their business strategies with Agenda 2030 – the UN Sustainable Development Goals and the Paris Agreement. They are also broadening their communication with stakeholders to include ESG elements. **EU rules to ensure transparent communication and reporting on the consideration of ESG factors in companies' operations support these efforts. This should help market participants in their decision-making.**

DISCLOSURE OF NON-FINANCIAL RISK INFORMATION BECOMES AN INTEGRAL PART OF COMPANIES' ANNUAL REPORTS AND ESG ASPECTS ARE DESCRIBED IN THE FINANCIAL STATEMENTS.

The purpose of the disclosures is to assess the impact of ESG factors on the company, both from a financial perspective and in terms of human and environmental impacts. Some of the information disclosed by the insurance companies is publicly available, others are provided only to selected target groups (e.g. the PFSA, investors, shareholders).

A survey of Polish insurance companies on the implementation of the sustainable development policy was conducted for the report. **Seven life insurance companies (with a total share of over 63% of premiums written) and nine non-life insurance companies (with a total share of over 46% of premiums written) responded[8].**

A SURVEY CONDUCTED BY PIU AND EY SHOWS THAT AMONG THE ESG CHALLENGES CITED BY INSURANCE COMPANIES, MOST ARE RELATED TO A LACK OF MARKET EXPERIENCE IN THIS AREA. ESG ISSUES ARE RELATIVELY NEW, THERE IS A LACK OF DATA, BUT ALSO A LACK OF ADEQUATE STAFF TO ASSESS ESG INVESTMENTS.

[8] Written premiums figures according to PFSA data: Komisja Nadzoru Finansowego, Rynek ubezpieczeniowy (knf.gov.pl).

FIGURE 29
ESG OPPORTUNITIES IDENTIFIED BY INSURANCE COMPANIES[9]

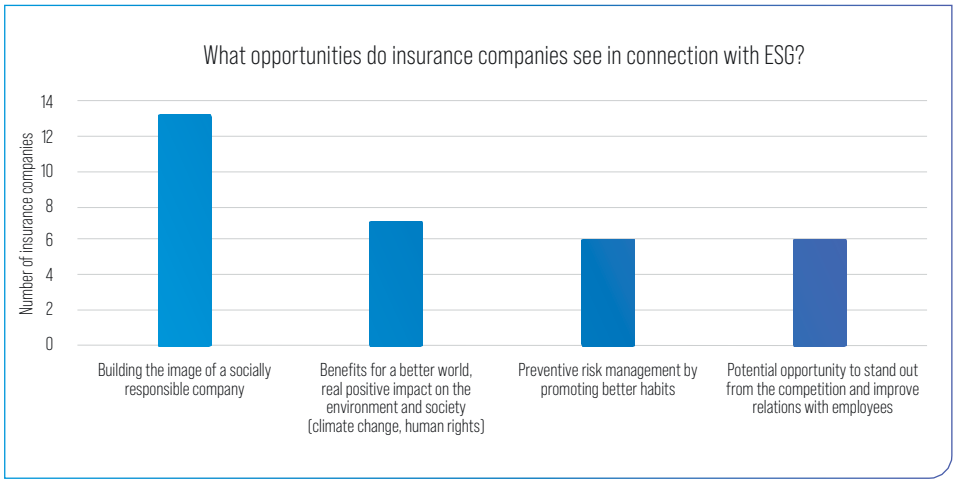
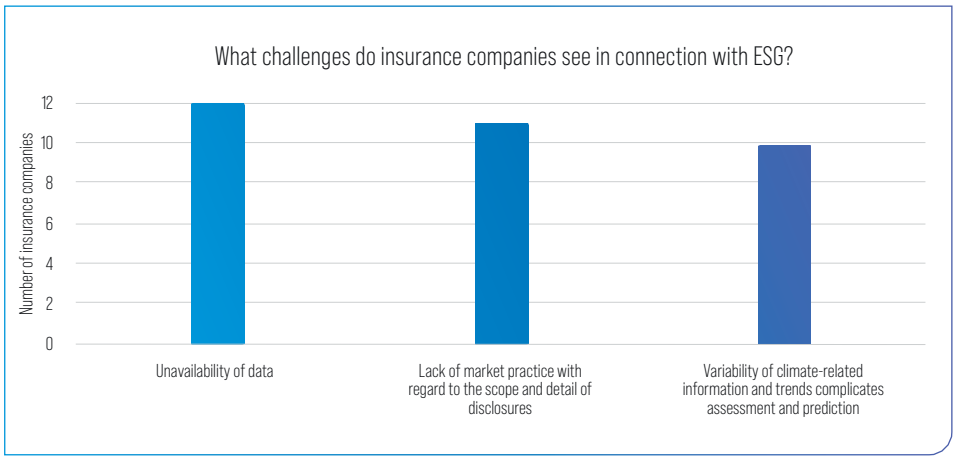


FIGURE 30
ESG CHALLENGES IDENTIFIED BY INSURANCE COMPANIES[10]



Source: study prepared on the basis of responses obtained from insurance companies as part of the sustainable development policy implementation survey conducted by PIU and EY in July 2022.

ESG INDICATORS – KEY DISCLOSURES

NEW REGULATIONS WILL REQUIRE INSURANCE COMPANIES TO DISCLOSE ESG INDICES.

Its main purpose is to ensure that a company's ESG activities and portfolio can be objectively assessed by tracking changes over time and comparing them with other companies. European Union regulations require 18 indicators for the financial sector.

MEMBERSHIP INSTITUTIONS (INCLUDING PIU, ZBP AND SEG) HAVE DEVELOPED RULES FOR THEIR CALCULATION.

[9] Insurance companies were asked the question: "What opportunities related to ESG issues are seen in the insurance company? Please give a rating from 1 to 5 (1 – least opportunity, 5 – greatest opportunity)". The graph shows answers 4 and 5, i.e. those indicating high opportunities.
[10] Insurance companies were asked the question: "What challenges related to ESG issues are seen in the insurance company? Please give a rating from 1 to 5 (1 – least challenge, 5 – greatest challenge)." The graph shows answers 4 and 5, i.e. those indicating major challenges.

E INDICATORS

1

greenhouse gas emissions

2

carbon footprint

3

exposure of fossil fuel sector companies

4

Energy intensity of a sector with high climate impacts
(e.g. agriculture, mining, transport)

5

Emissions of pollutants and harmful substances to the aquatic environment (in thousands of tonnes)

6

Share of consumption and production of non-renewable energies

7

Activities that have a negative impact on biodiversity-sensitive areas
(e.g. due to proximity to Natura 2000 protected areas, UNESCO World Heritage Sites)

8

Hazardous waste factor

9

Intensity of greenhouse gas emissions from companies in which investments are made

FIGURE 31
EXAMPLES OF MANDATORY ESG INDICATORS[11]

10

Exposure to fossil fuels through real estate investments

11

Exposure to energy **inefficient real estate** investments

S INDICATORS

1

Gender diversity in corporate boards

2

Gender wage gap

G INDICATORS

1

Violation of the principles on human rights, labour standards, environmental protection and anti-corruption described in the UN Global Compact

2

Exposure to controversial weapons

3

Lack of processes and mechanisms to monitor compliance with the UN Global Compact Principles and the OECD Guidelines for Multinational Enterprises

[11] Zbiór podstawowych wskaźników ESG (Collection of ESG Core Indicators), https://piu.org.pl/wp-content/uploads/2021/06/Zbior_podstawowych_wskaznikow_ESG.pdf

ESG REGULATION AND CONSUMER CHOICE

THE EU'S DISCLOSURE SOLUTIONS ARE PRIMARILY AIMED AT CUSTOMERS. IT IS THEY WHO, THROUGH THEIR CHOICES, HAVE AN IMPACT ON CLIMATE TRANSITION AND THE ACHIEVEMENT OF ESG GOALS. WHEN CUSTOMERS CHOOSE SUSTAINABLE PRODUCTS AND INSURANCE COMPANIES THAT ARE ACTIVELY ENGAGED IN THE FIGHT AGAINST CLIMATE CHANGE, THEY MAKE THEIR EXPECTATIONS CLEAR AND PUT PRESSURE ON THEM.

Ultimately, customers can expect insurance companies to provide the information required by EU regulations to help them choose sustainable products and insurance companies. **It is important that they learn to interpret this correctly and take it into account when making decisions.**

FIGURE 32
TYPES OF DISCLOSURE BY INSURANCE COMPANIES TO SUPPORT CONSUMER DECISIONS ON ESG ASPECTS

CUSTOMER'S DECISION	SPECIFIC GOALS	HOW?
 **SELECTION OF INSURANCE-BASED INVESTMENT PRODUCT**	• Is the product sustainable (light green or dark green)? • How does the product meet environmental objectives or promote ESG aspects? • What is the impact of likely ESG risks on product returns? • Does the product meet the client's preferences in terms of ESG aspects?	• Inclusion of the customer's personal preferences in the survey • Product data sheet • Advertising materials • Website
 **SELECTION OF INSURANCE PROTECTION PRODUCT**	• Is the product sustainable? • How does the product address ESG aspects?	• Product data sheet • Advertising materials • Website
 **CHOICE OF INSURER**	• Does the insurance company integrate ESG aspects into its strategy, investment policy and value chain, and if so, how? • What are the main ESG objectives pursued by the insurance company? How and to what extent have the ESG objectives been achieved? • What adverse sustainability impacts does the insurer identify?	• Website • Report on the company's operations (non-financial information) • Business strategies / ESG • Statements

Source: EY's own study based on EU legislation.

ESG RATINGS – A TOOL FOR COMMUNICATING WITH INVESTORS

INVESTORS INFLUENCE THE BUSINESS OF INSURANCE COMPANIES AND ATTACH INCREASING IMPORTANCE TO ESG ISSUES, AS DO CONSUMERS.

ESG RATINGS AND INDICES ARE AN IMPORTANT COMMUNICATION TOOL FOR INVESTORS.

The major rating agencies already include ESG aspects in credit ratings (e.g. AM Best) or issue separate ESG ratings at the company or financial instrument level (e.g. S&P, Fitch).

The ratings are based on the non-financial reports and disclosures of the insurance companies. This is why the quality of the disclosures and information on the measures taken by the insurance companies with regard to their contribution to the Sustainable Development Goals is so important.

EACH OF THE AGENCIES THAT ASSIGN ESG RATINGS HAS DEVELOPED ITS OWN METHODOLOGY TO ASSESS THE DIFFERENT ELEMENTS OF E, S AND G (THE AREAS TO BE RATED, THE WAY INDUSTRY SPECIFICS ARE TAKEN INTO ACCOUNT, THE WAY INFORMATION IS GATHERED, THE WEIGHTING OF THE RATINGS, THE PRESENTATION OF THE RESULTS).

Their aim is to provide an objective, comparable assessment of companies' sustainability performance. Companies with ESG ratings are included in renowned ESG indices and benchmarks.

It should be noted, however, that the lack of transparency and the significant differences in the methodologies of credit rating agencies do not contribute to the development of the market for green financial instruments. **It is hoped that the situation will improve following the implementation of European legislation, including the Level 2 taxonomy acts, which clarify which activities are sustainable.**

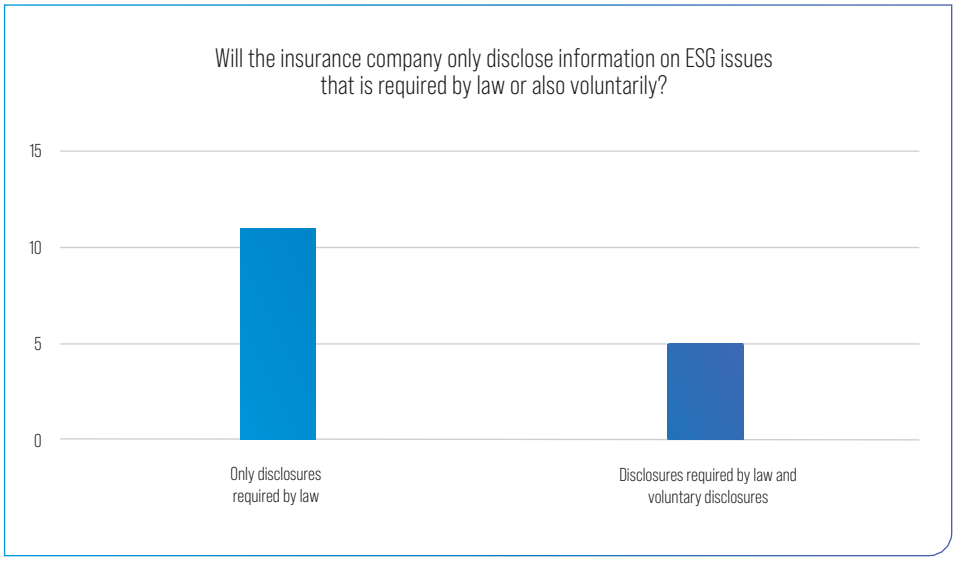
FIGURE 33
ESG RATINGS AND INDICES

Source: own study based on websites of rating agencies, indices and institutions that issue ratings for financial instruments.

IT IS A CHALLENGE FOR INSURANCE COMPANIES TO ENSURE THAT DISCLOSURES ARE COMPLETE AND MEET THE HIGHEST STANDARDS.

According to the responses to the PIU and EY survey[12] of Polish insurance companies, some of them plan to expand their disclosures to include voluntary disclosures mainly related to indirect emissions such as business travel and commuting. **However, as the survey results for WIG 20 companies show, it is often more important to ensure the quality of mandatory disclosures than voluntary ones.**

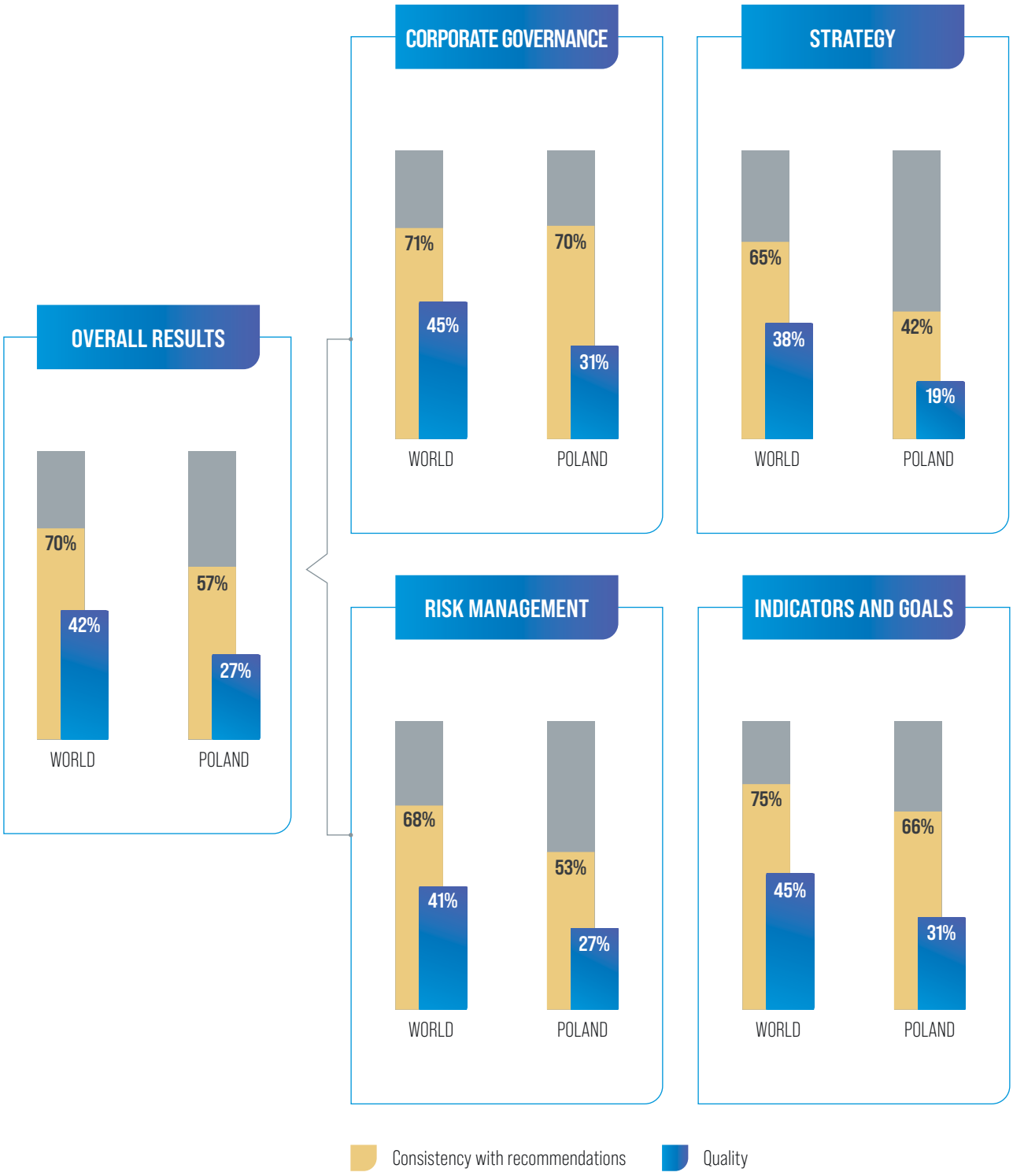
FIGURE 34
DISCLOSURES ON THE ESG OF INSURANCE COMPANIES



Source: study prepared on the basis of responses obtained from insurance companies as part of the sustainable development policy implementation survey conducted by PIU and EY in July 2022.

[12] For the report, a survey was conducted among Polish insurance companies on the implementation of sustainable development measures. Seven life insurers (with a share of more than 63% of premiums written) and nine non-life insurers (with a share of more than 46% of premiums written) responded.

According to a study by EY, the disclosures of most Polish companies in the WIG20 index deviate qualitatively from the global level in practically all reporting areas examined (corporate governance, strategy, risk management, and indicators and targets). However, it should be noted that both Polish and global companies are at the beginning of their journey to ensure good, standardised disclosure practises[13].



Source: Raport EY: Barometr Ujawnień Ryzyka Klimatycznego[14].

[13] Websites of rating agencies, indices and institutions that issue ratings for financial instruments.
[14] ey-raport_barometr_ujawnien_ryzyka_klimatycznego.pdf

CHAPTER 4

THE MOST IMPORTANT TRENDS IN THE ENERGY SECTOR FOR POLAND

THE MOST IMPORTANT TRENDS IN THE ENERGY SECTOR FOR POLAND

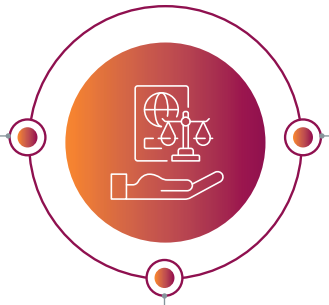
THE EU'S ENERGY AND CLIMATE POLICY, WHICH IS A RESPONSE TO ONGOING CLIMATE CHANGE AND CONSTITUTES A STRATEGY TO MAKE THE COMMUNITY INDEPENDENT OF FOSSIL FUELS, **ASSUMES THAT THE EU ECONOMY WILL BE CLIMATE NEUTRAL BY 2050**.

As part of this overarching goal, EU policy also sets national interim targets for the near future, such as the degree of decarbonisation of the energy and transport sectors, increasing the share of RES sources in the energy system **or increasing energy efficiency in industry and households.** In order to achieve Poland's ambitious climate and energy policy goals by 2030, but also climate neutrality by 2050, a thorough and dynamic overhaul of the electricity system is needed.

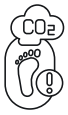
INVESTMENTS IN THE ENERGY SECTOR ARE CAPITAL-INTENSIVE AND TIME-CONSUMING.

For this reason, the conversion of the electricity sector will be technologically, logistically and financially complex. The transformation of the electricity sector is associated with many risks that may lead to disruptions in the implementation of investments, damage to property, environmental pollution or financial claims from individuals and entities affected by companies and institutions implementing projects in the energy sector.

IT IS IMPOSSIBLE TO MAKE THE NECESSARY CHANGES WITHOUT SIGNIFICANT INVOLVEMENT OF THE INSURANCE MARKET. THE TRENDS IN THE ENERGY SECTOR AT BOTH GLOBAL AND POLISH LEVEL CAN BE CATEGORISED AS "3XD":



DECARBONISATION
- reduction of greenhouse gases and development of RES



- The consequence of this trend, stimulated by EU climate and energy policies, is the desire to reduce the emission level of the energy sector, especially the amount of fossil fuels burned.
- The optimisation of RES technologies and increasing climate pressure, together with falling costs and capital expenditure, will lead to an increasing share of renewable energies in energy production.

DECENTRALISATION OF PRODUCTION AND NEW BUSINESS MODELS

- Decentralisation means that large power plants are replaced by decentralised renewable energy sources with lower output.
- The decline in production costs for RES technologies will promote their further development, also at the micro level. This will lead to further decentralisation of power generation and possibly the loss of market share for large-scale conventional power generation.
- The development of decentralised energy and the change in the role and importance of large-scale traditional energy is leading to an evolution of competition, not only in electricity generation, but also in other value chains.

DIGITALISATION

- This is made possible by technological advances (both in RES technologies and in IT systems), but also by the increasing technical requirements associated with maintaining the stability of grid operations with a growing share of photovoltaic generation.
- The increase in the share of volatile energy sources in the energy mix requires the use of digital technologies to produce accurate forecasts and load profiles, among other things.
- Increasing pressure to provide customers with sustainable energy is forcing energy companies to look for new digital solutions to monitor, measure and reduce emissions.
- Digitalisation and the expansion of prosumer systems are leading to growing energy awareness among the population and greater participation in energy resource management at household level.

TECHNOLOGICAL CHANGE IN POWER GENERATION TOWARDS DECARBONISATION AND DECENTRALISATION

DUE TO HISTORICAL TECHNICAL CONDITIONS, THE ELECTRICAL ENERGY SYSTEMS THAT CURRENTLY FUNCTION ARE CENTRALISED SYSTEMS.

Electricity generation there is based on large-scale sources such as coal-fired power plants (in Poland) or nuclear power plants (in many Western countries and the USA). As part of the decarbonisation of the electricity industry, which includes the construction of renewable energy sources (e.g. onshore wind farm technologies or photovoltaic systems), the decentralisation of the system is progressing. Emerging RES sources are often characterised by smaller capacities and greater geographical dispersion, and in many cases are also developed individually by households or small businesses. **These phenomena significantly change the technical and economic basis for the functioning of the energy system.**

Parallel to the construction of many smaller sources, the conversion of the most powerful sources (the so-called large-scale energy) also takes place. In particular, work is underway to develop strategic sectors for Poland, namely offshore wind farms in the Baltic Sea and the development of nuclear energy. Investments in new large-scale energy sources are expected to supply a significant part of the electricity currently generated from fossil fuels.

THEREFORE, OFFSHORE WIND FARMS, NUCLEAR POWER PLANTS, PHOTOVOLTAICS, BIOGAS PLANTS AND OTHER LOW- AND ZERO-EMISSION ENERGY SOURCES WILL BE BUILT INSTEAD OF COAL-FIRED POWER PLANTS BY 2040.

These changes require intensive investment activities, which have been outlined, for example, in the national strategy documents. Poland's energy policy is implemented, among other things, through the strategic policy document *Poland's Energy Policy until 2040* (Polityka Energetyczna Polski do 2040 r., PEP 2040).

According to the plans in PEP 2040, the assumed target of a 23% share of RES in gross final energy consumption will lead to a share of at least 32% of RES in net electricity generation in 2030 and can reach at least 40% in 2040. It is also predicted that by 2040, the installed capacity of RES could account for about half of all installed generation sources.

MOST LIKELY, THESE TARGETS WILL BE INCREASED AS PART OF THE EU'S RESPONSE TO RUSSIA'S ATTACK ON UKRAINE BY FURTHER ACCELERATING THE DECARBONISATION OF EU ECONOMIES.

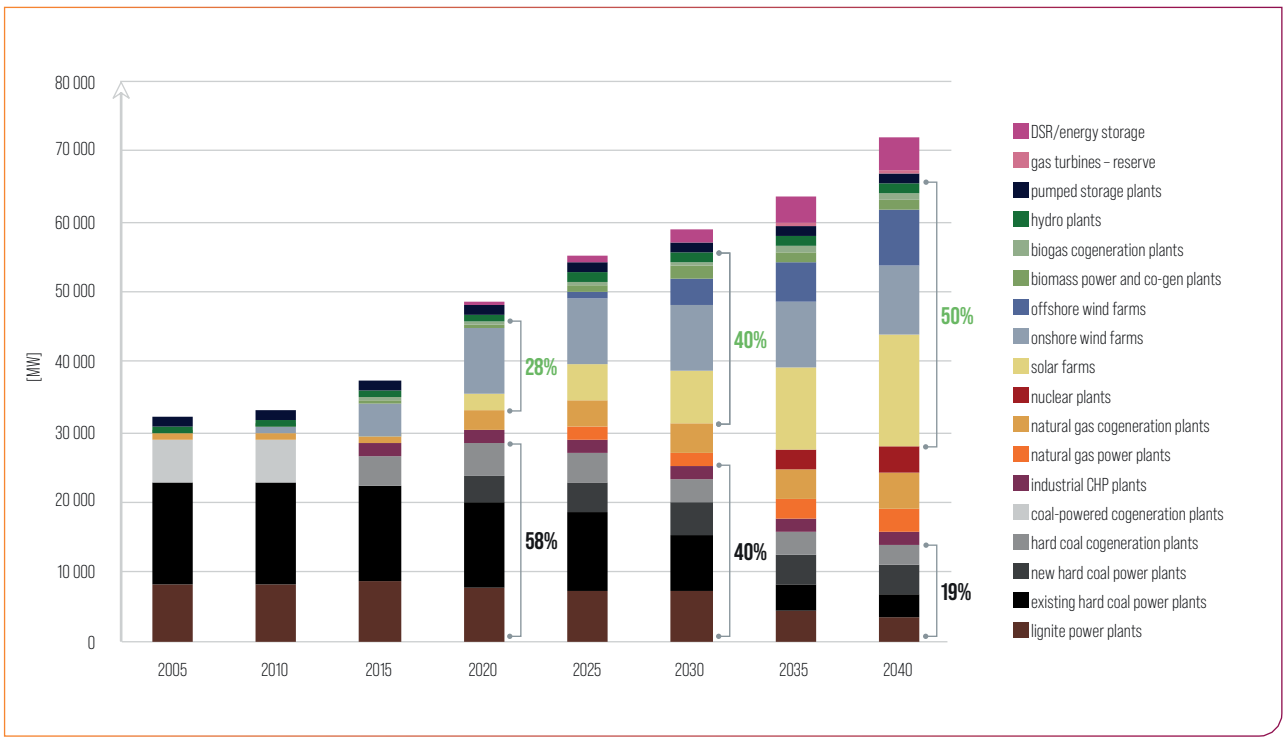


FIGURE 35
TRANSFORMATION OF THE POLISH ENERGY MIX BY 2040[1]

To achieve climate neutrality, it is not enough to replace emission sources with new RES. To ensure energy security for consumers, the issue of system balancing must be addressed, which involves ensuring a stable energy supply during periods of scarcity from RES. To ensure energy security, it is necessary to develop relatively new energy technologies, such as hydrogen technology and battery energy storage. In turn, the development of technologies to capture carbon dioxide from the atmosphere may be necessary to achieve complete decarbonisation of the economy.

This would serve to reduce cumulative carbon dioxide emissions from the industrial era. Emission reduction measures would be used for fossil fuel-based technologies if zero-emission solutions are not available. The following parts of this chapter provide an overview of the changes in existing and emerging technological sectors related to the transformation of the Polish energy mix in the coming decades.

[1] Ministerstwo Klimatu i Środowiska, Conclusions from forecast analyses for the energy sector, Appendix 2 to Energy Policy of Poland until 2040

NEW TECHNOLOGIES THAT COULD ENABLE THE NET ZERO TARGET TO BE REACHED BY 2050

Battery-based electricity storage enables the balancing of energy during periods of low RES production. The advancement of energy storage systems will also facilitate the integration of more RES into the system, thereby mitigating the need for expensive investments in grid infrastructure expansion.

Hydrogen technologies, including power-to-gas technologies, can be used together with RES to produce carbon-free fuel. The production of green hydrogen can contribute to the decarbonisation of hard-to-reach economic sectors and provide an alternative to the current applications of natural gas in the energy sector.

Carbon capture and storage technologies (CCS, CCSU) may prove crucial to reduce the cumulative level of carbon dioxide in the atmosphere and achieve the targeted level of economic decarbonisation in EU Member States.

PROSPECTS FOR THE TRANSFORMATION OF SELECTED POWER GENERATION TECHNOLOGIES IN POLAND

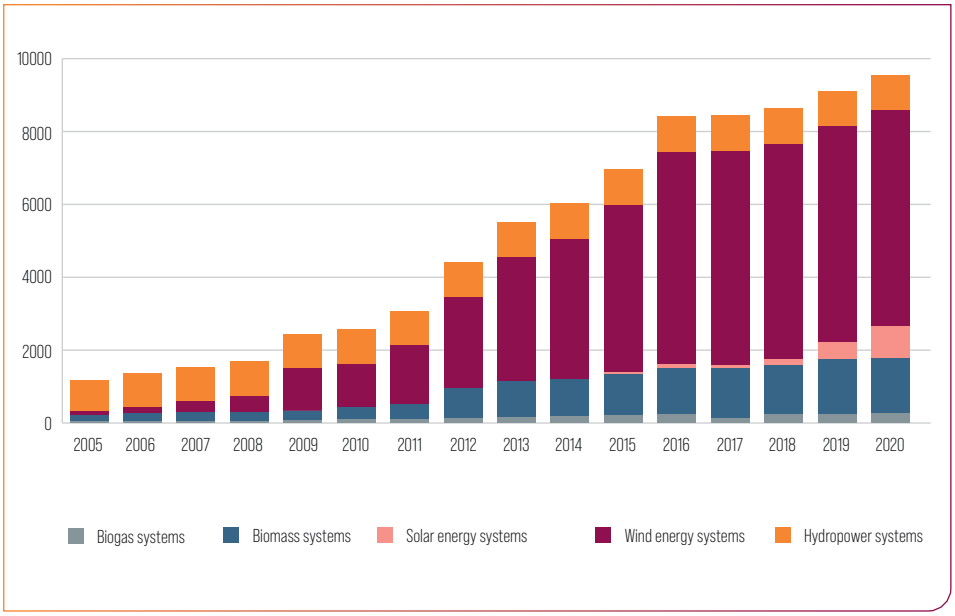
THE TRANSFORMATION OF POLAND'S ENERGY MIX WILL HAVE A SIGNIFICANT IMPACT ON THE INDIVIDUAL TECHNOLOGY SECTORS THAT MAKE UP ITS ELEMENTS.

The following subchapters provide an overview of the changes in selected power generation technologies. Notably, the energy transition will affect more sectors than just electricity generation. The development path currently being pursued also includes increasing interconnection between economic sectors (so-called sector coupling). Other sectors subject to transformation that are not directly presented in the following report are energy CHP, transport (land, sea and air) and industry (especially heavy industry in the perspective of decarbonisation, e.g. chemical processes, i.e. in addition to emissions from electricity and heat consumption).

ONSHORE WIND FARMS

ONSHORE WIND FARMS ARE CURRENTLY THE MOST IMPORTANT SOURCE OF RENEWABLE ENERGY IN POLAND, BUT THEIR FURTHER EXPANSION HAS BEEN SIGNIFICANTLY SLOWED DOWN BY REGULATORY CHANGES INTRODUCED IN 2016.

FIGURE 36
INSTALLED RES CAPACITY BY INDIVIDUAL TECHNOLOGIES



Source: PIU study based on: https://www.ure.gov.pl/pl/oze/potentially-krajowy-oze/5753, Moc-instalowana-MW.html.

THE WIND FARMS INVESTMENT ACT OF 20 MAY 2016 INHIBITED THE EXPANSION OF ONSHORE WIND ENERGY BY INTRODUCING THE 10H RULE.

The rule introduces a prohibition on the construction of wind turbines at a distance of less than 10 times the total height of the wind turbines from residential buildings, buildings with a residential function and forms of nature conservation and forest support facilities.

THESE REGULATIONS LED TO A FREEZE ON INVESTMENTS IN ELECTRICITY FROM WIND TURBINES IN 2017–2019. FROM 2020 ONWARDS, AN INCREASE IN CAPACITY CAN BE OBSERVED, WHICH IS PARTLY DUE TO THE INVOLVEMENT OF LARGE ENERGY COMPANIES.

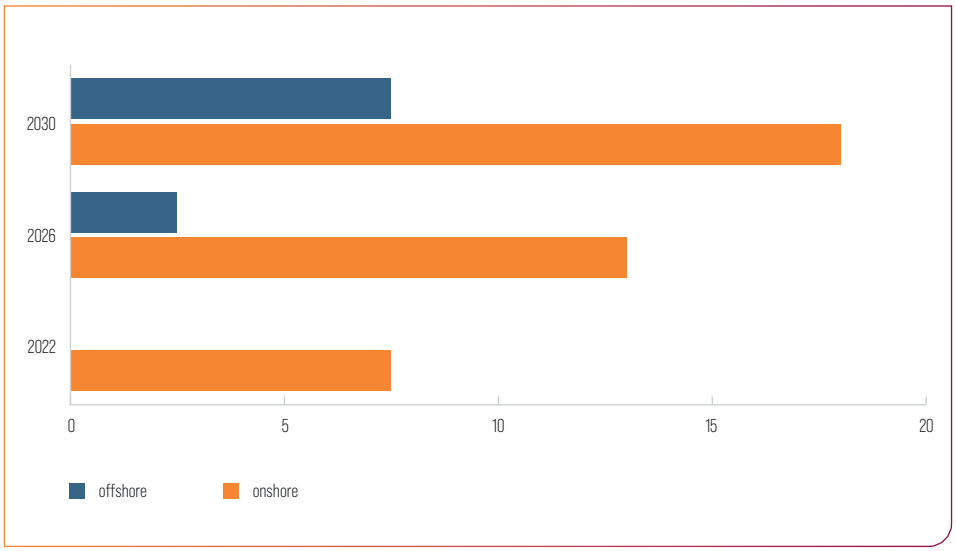
FIGURE 37
INSTALLED WIND TURBINE CAPACITY IN POLAND

Figures in MW	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Installed capacity	1180	1616	2497	3390	3834	4582	5807	5849	5864	5917	6347	7117
Increase in the period	456	436	880	893	444	748	1225	41	16	53	430	770
Change YoY	63%	37%	54%	36%	13%	20%	27%	1%	0%	1%	7%	12%

Source: Polish Energy Regulatory Office and ARE.

ON 14 MARCH 2023, THE PRESIDENT OF POLAND SIGNED THE ACT AMENDING THE WIND FARM INVESTMENTS ACT AND CERTAIN OTHER ACTS, WHICH INTRODUCES SOME LIBERALISATION OF THE 10H RULE.

FIGURE38
FORECAST OF TOTAL INSTALLED CAPACITY [GW] AT THE END OF 2022 WITH AN OUTLOOK FOR 2026 AND 2030



Source: PIU study based on United Nations Global Compact, PSEW: Energetyka wiatrowa na lądzie. Założenia reformy i propozycja ustawy, https://ungc.org.pl/strefa-wiedzy/ energetyka-wiatrowa-l adzie-zalozeniareformy-propozyja ustawy/, September 2020, p. 71, Energy Policy of Poland until 2040, and own data.

According to the new regulations on the relaxation of restrictions associated with the land use plan, the distance of the wind farm from residential development can be set at a deviation from the 10H rule, but not less than 700 metres. According to the analysis of EMBER, maintaining a minimum distance of 700 metres means that a maximum of 4 GW of new wind capacity can be created by 2030. By comparison, maintaining the 500 metre distance originally proposed by the government would mean that more than 10 GW of new onshore wind turbines could be built by that time.

KEY ISSUES IN INSURANCE RISK ASSESSMENT

Insurance companies can provide cover throughout the life cycle of wind farm projects.

For the risk assessment, it is relevant whether new generators are installed and whether equipment dismantled elsewhere (including abroad) is overhauled. A trend that would increase the likelihood of damage would be to base investments on second-hand equipment.

Maintenance is important for the safety of the wind farm. When writing a policy, insurance companies check whether the insured company has proper maintenance contracts and verify the scope of these contracts and the experience of the maintenance services providers.

Proper foundation construction is important for wind farm development. Foreign damage statistics show that poor execution of this type of work can lead to a high claims frequency.

OFFSHORE WIND FARMS

THE DEVELOPMENT OF THE OFFSHORE WIND FARM SECTOR IS A STRATEGIC PILLAR OF DECARBONISATION OF THE POLISH ENERGY SECTOR.

Offshore generated energy will replace an important part of fossil fuel based production and possibly produce green hydrogen for energy purposes. Currently, no offshore wind farms are in operation in Poland, while these are expected to generate around 20% of the country's energy needs in 2030.

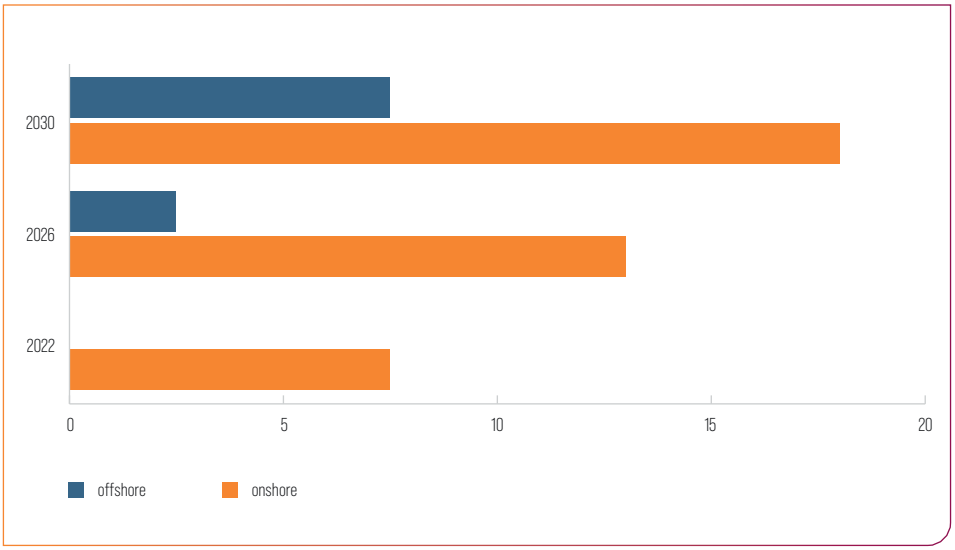
IN POLAND, OFFSHORE WIND FARMS IN THE BALTIC SEA WITH A TOTAL CAPACITY OF APPROX. 5.9 GW ARE TO BE COMMISSIONED BETWEEN 2027 AND 2030. BY 2040, A FURTHER 12 GW ARE TO BE COMMISSIONED, **BRINGING THE TOTAL INSTALLED CAPACITY OF OFFSHORE PARKS TO 18 GW.**

The planning of offshore wind farms is extremely complex from a technical point of view, as it has to take into account the harsh offshore conditions. The most frequent type of damage occurs to the cables, including both internal cables connecting individual wind turbines and wind power plants to the offshore substation, as well as the export cables responsible for transmitting electricity from the offshore substation to the shore.

Cable damage accounts for about 40% of all claims, but its share in the total costs of insurers is over 80%.

The second most common type of damage is to the foundations that connect the wind towers to the seabed. Special ships and submersibles are being deployed to repair the damage, which can cost up to €200,000 per day[3].

FIGURE 39
FORECAST OF TOTAL INSTALLED CAPACITY [GW] AT THE END OF 2022 WITH AN OUTLOOK FOR 2026 AND 2030



Source: PIU study based on PSEW based on United Nations Global Compact, Energetyka wiatrowa na lądzie. Założenia reformy i propozycja ustawy, *https://ungc.org.pl/strefa- wiedzy/energetyka-wiatrowa-l adzie-zalozeniareformy-propozyja ustawy/, September 2020, p. 71*, Energy Policy of Poland until 2040, *and own data.*

[3] Morska energetyka wiatrowa i kontrola ryzyka (TUiR Warta), based on: https://www.lloydwarwick.com.

FIGURE 40
PERCENTAGE DISTRIBUTION OF THE NUMBER OF LOSSES IN OFFSHORE WIND FARMS

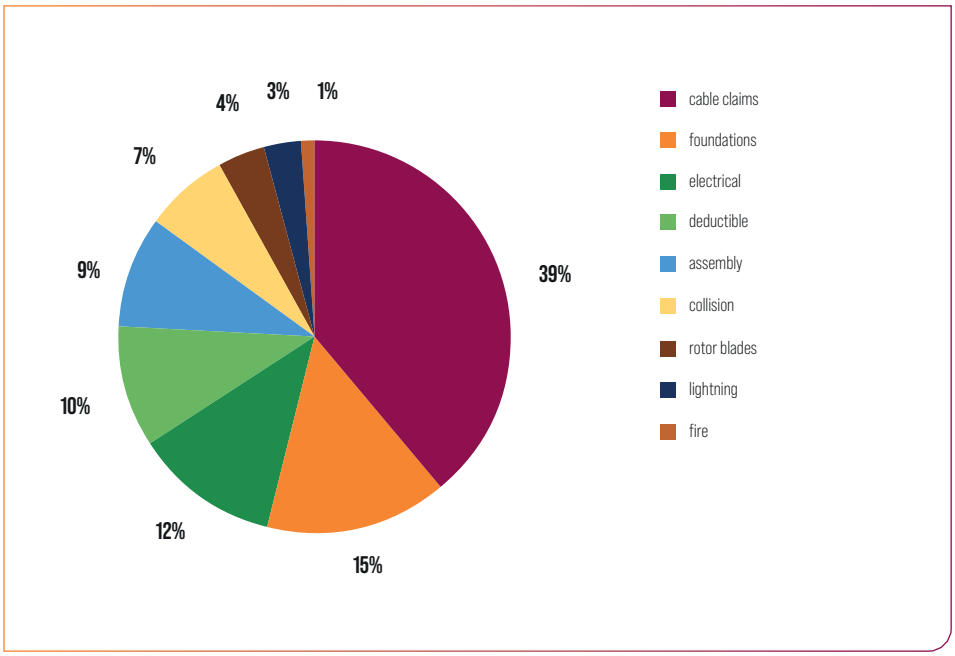
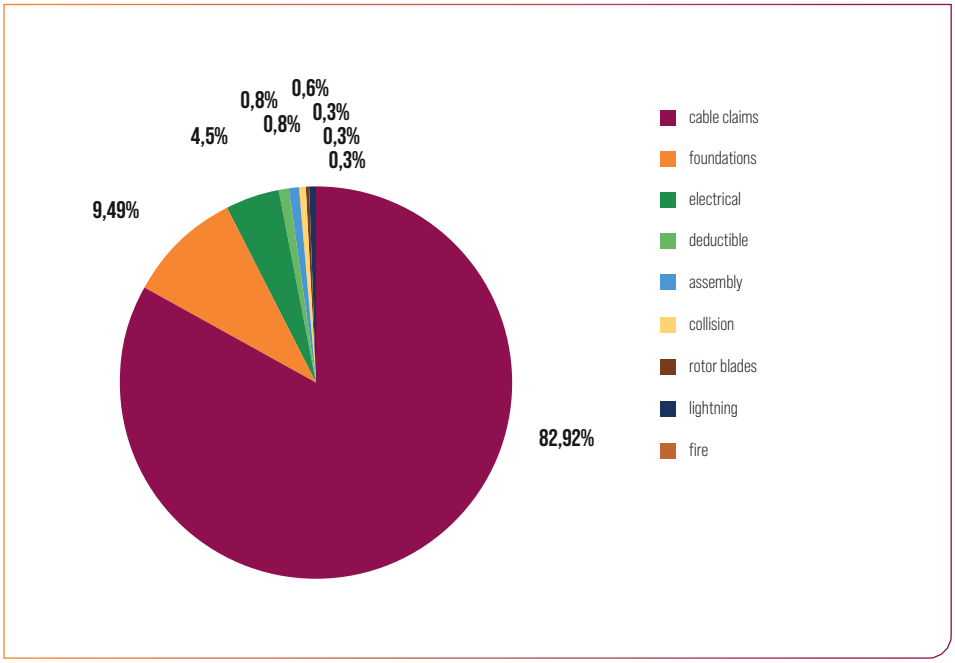


FIGURE 41
PERCENTAGE STRUCTURE OF CLAIMS COSTS



Source: TUiR Warta S.A., Morska energetyka wiatrowa i kontrola ryzyka *based on: https://www.lloydwarwick.com.*

As with other risks in the marine insurance segment, the international market in **this industry has created universal clauses specifically for offshore wind farm construction projects.** These are the conditions of WINDCAR, the all-risk insurance for the construction of an offshore wind farm. It is widely used in projects around the world. These conditions are similar to those of WELLCAR, which covers risks in offshore construction projects (all-risk insurance for offshore construction and building projects in the oil & gas sector).

The WINDCAR conditions take into account the specificities of the construction of an offshore wind farm, such as the complexity of the process, including the fact that the transport, cable laying and construction of the structure take place offshore and require specialised vessels, etc.

Under WINDCAR, all property damage (to equipment, machinery, materials, fixtures, etc.) related to construction (during assembly work, storage, transport) is covered as standard, as is the liability risk towards third parties and their property, as well as the business interruption risk. As usual with marine risks, the insurance also covers General Average and Salvage, as well as the costs associated with the clean-up of the remnants of the damage and the removal of the wreck.

As with all major offshore developments in the sector, the Marine Warranty Surveyor (MWS) plays a key role in supporting insurance risk management and protecting the insurer and contractor from improper execution of the work.

The MWS (often referred to as the "eyes and ears of the insurer") is an independent supervisory institution accepted by the insurers and appointed by the project owner to carry out constant checks on the correctness and diligence of the process. It also issues the Certificate of Approval (COA) for individual work steps, proving that they have been carried out properly. The MWS personally inspects the vessels involved in the construction and should also be present at all times during the transport, unloading and laying of the export cables. The above inspection activities are among the many tasks the MWS performs. The absence of MWS approval for individual works may, in the event of a loss, release the insurer from liability.

Good cooperation between the insurer, the MWS and the project developer is crucial for the safe, smooth and, above all, claim-free construction of offshore wind farms. It is therefore advisable to starting working with the insurer 6-12 months before the construction work begins (even before funding is finalised) to build mutual understanding.

Source: TUiR Warta SA.

PHOTOVOLTAICS

THE MOST IMPORTANT EVENTS FOR THE DEVELOPMENT OF THE PV MARKET IN POLAND WERE, IN CHRONOLOGICAL ORDER:

- Abolition of prosumers' obligation to obtain a service connection approval (2013)
- Launch of the *Prosumer* programme (2014)
- A positive reaction from the industry to the adoption of the Prosumer Amendment with guaranteed tariffs (2015)
- The implementation of *My Electricity* programme, including a tax relief scheme (2018)[4]

THEY HAVE LED TO A SIGNIFICANT ACCELERATION OF PV DEVELOPMENT IN POLAND, ESPECIALLY IN THE AREA OF PROSUMER PV, WHERE ALMOST 9 GW HAVE BEEN BUILT SO FAR.

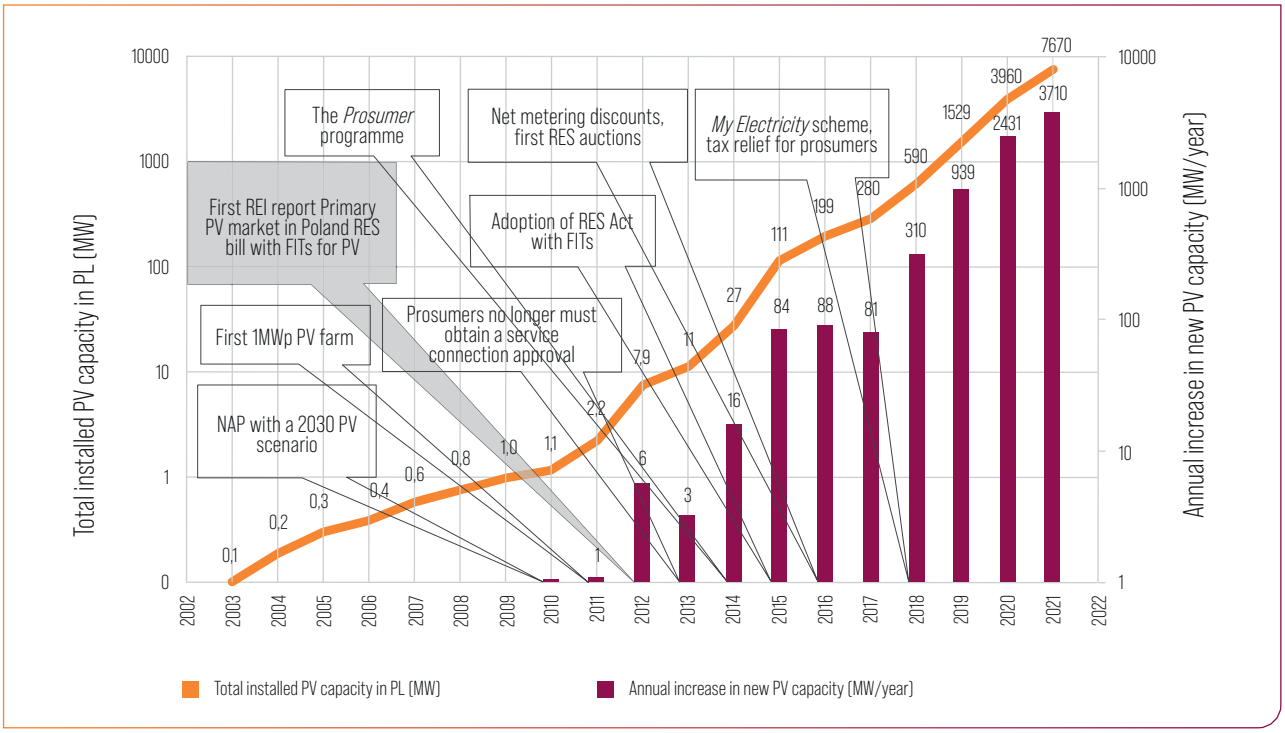


FIGURE 42
INCREASE IN INSTALLED CAPACITY BASED ON REI GRAPHICS

Source: Renewable Energy Institute, EC BREC Photovoltaics (ieo.pl).

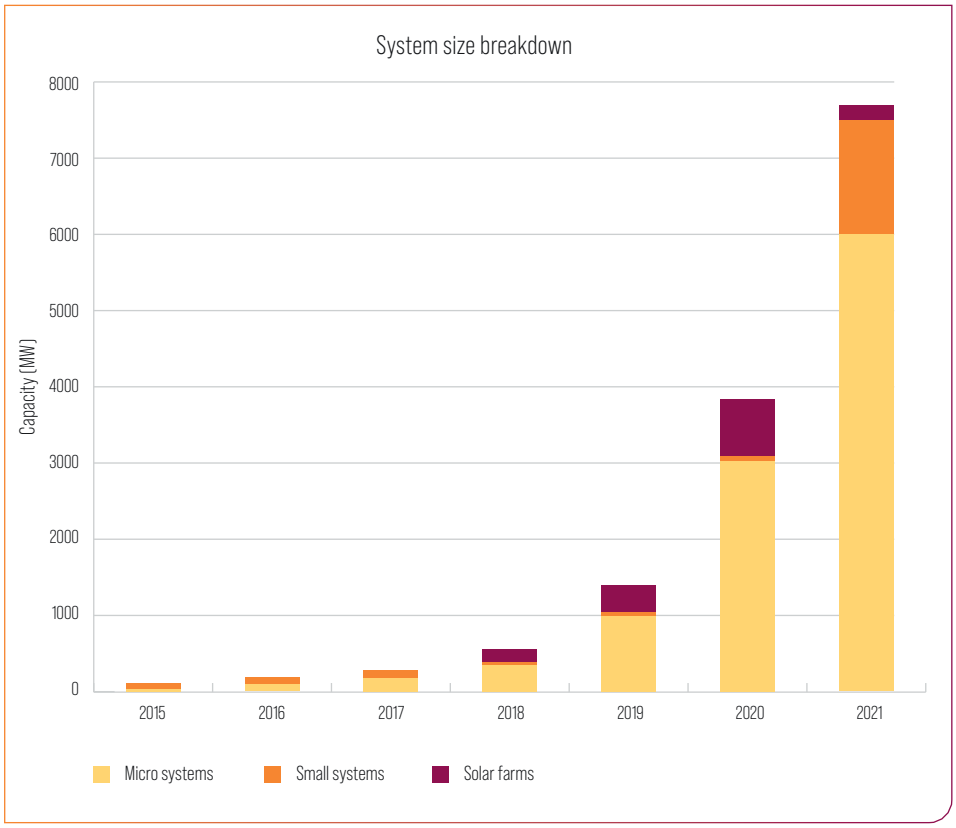
[4] 2022 Report of the Renewable Energy Institute.

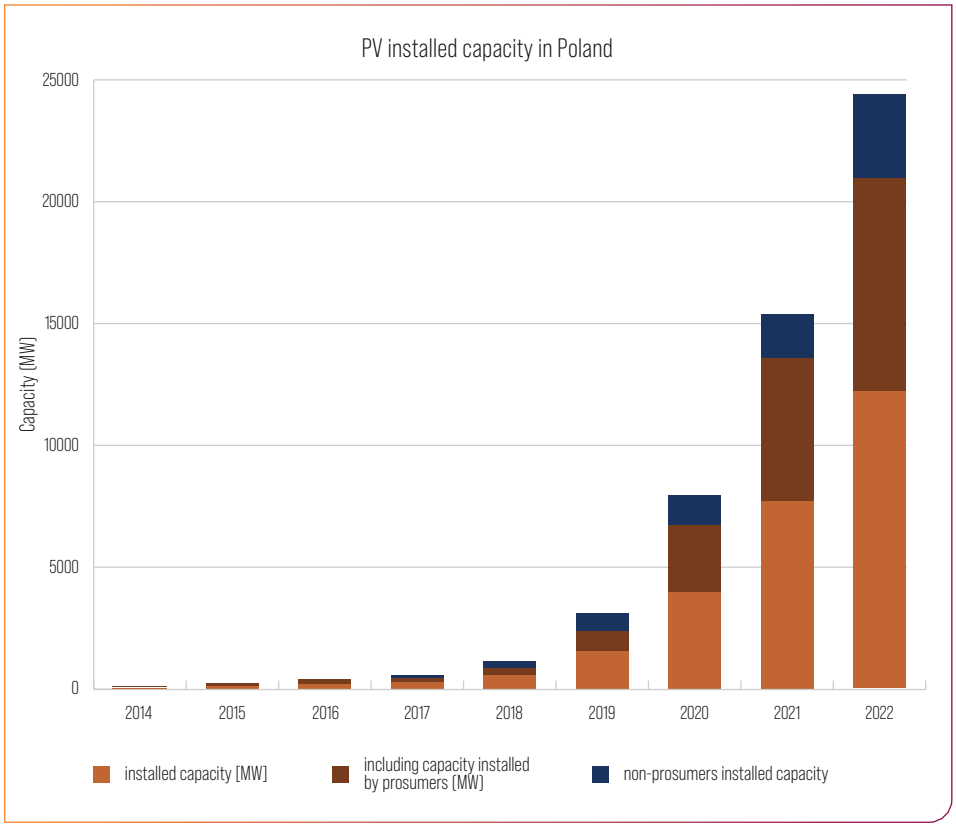
Many types of photovoltaic systems are used to generate electricity from solar energy: they range from micro systems that supply power to electronic devices in close proximity (e.g. detectors, radars, etc.), to systems mounted on the roofs of residential or commercial buildings or on the ground by private individuals and small and medium-sized enterprises, to large-scale farms. Solar energy is also increasingly used on farms.

CURRENTLY, MICRO AND SMALL SYSTEMS ACCOUNT FOR THE LARGEST SHARE OF INSTALLED PV CAPACITY.

However, this fast-growing trend is expected to lose momentum in the coming years. **On the other hand, large photovoltaic plants built by energy corporations or other large companies investing in renewable energy sources for their own needs will become increasingly important.**

FIGURE 43
INCREASE IN INSTALLED CAPACITY BASED ON REI GRAPHICS

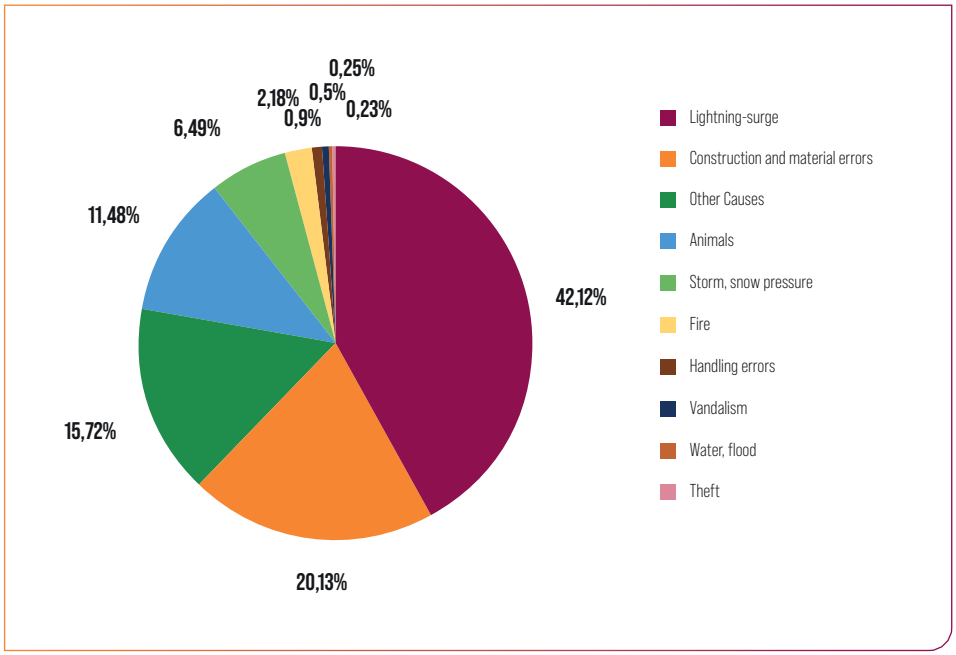




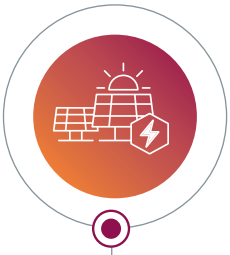
Source: EY, citing REI.

PHOTOVOLTAIC SYSTEMS ARE DESIGNED TO BE RESISTANT TO WEATHER CONDITIONS, INCLUDING HAIL. MOST DAMAGE IS CAUSED BY SURGES, FIRES, EQUIPMENT FAILURES AND MECHANICAL DAMAGE DUE TO HUMAN ACTIVITY.

FIGURE 44
PERCENTAGE DISTRIBUTION OF LOSSES IN PHOTOVOLTAIC SYSTEMS



Source: https://korpo.warta.pl/oze-w-pigulce/.



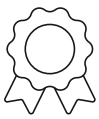
The diversity of applications of PV systems means that there are no uniform solutions of insurance products for this technology. The photovoltaic system can be insured together with the building on which it is installed, as an element of equipment, or as a separate object. It depends on the provisions of the insurance contract.

Insurance for solar farms covers not only the panels, but also transformers, transmission lines, fire and surge protection, the structures on which the panels are mounted, inverters and all other components of the installation that are included in the sum insured.

Poor installation of the system on the roof of a building, the lack (or improper) surge protection measures significantly increases the risk of fire. When a fire breaks out in buildings on which a PV system is installed, the result is often total loss. Even if the system is disconnected from the power grid, the photovoltaic system continues to produce electricity. Conducting firefighting operations in such conditions may lead to death or damage to the health of firefighters.

How the sum insured is determined depends on whether the plant is insured as a separate object or together with the building or other technical installations. In the first case, a separate sum insured is specified in the policy, while in the second case the value of the plant is included in the total sum for the building or technical equipment.

When assessing the insurance risk for large photovoltaic plants, insurance companies take into account, among other things, the location, the date of commissioning of the plant (number of years in operation), its capacity and surface area, and the manufacturer of the main components. From a risk perspective, it is relevant whether the equipment was installed on the farm brand new or whether it was previously used at another location. The location of the plant - roof, façade or ground - and the type of mounting (directly on the ground or whether trackers are used) are also examined.



How a photovoltaic system is maintained is important for its safe use. Therefore, when insuring the operational phase of a PV park, insurance companies check the maintenance contracts that the customer has concluded for the maintenance of the plant, including the scope of activities and the frequency of maintenance for which the contract is valid.

PROSPECTS FOR THE DEVELOPMENT OF NUCLEAR ENERGY IN POLAND

POLAND IS PLANNING TO BUILD A LARGE NUCLEAR POWER PLANT. ACCORDING TO PEP 2040 FORECASTS, THE FIRST PLANT OF THIS TYPE WILL BE COMMISSIONED IN 2033, AND **THE INSTALLED CAPACITY IN THIS TECHNOLOGY WILL GROW BY 1-1.6 GW EVERY 2-3 YEARS. PLANS ARE TO BUILD 6 UNITS WITH A TOTAL CAPACITY OF 6-9 GW.** IN ADDITION TO THE PEP 2040 PLANS, SMR PROJECTS ARE EMERGING.

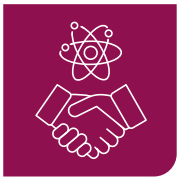
Preparations for the construction of the first nuclear power plant began as early as the 1970s. The construction of the nuclear power plant (NPP) in Żarnowiec began a decade later. In September 1990, the Council of Ministers decided not to build the NPP due to the financial problems of the project, oversupply on the national electricity market and public concern about the Chernobyl accident.

DISCUSSIONS ABOUT POLISH NUCLEAR ENERGY STARTED AGAIN IN 2005-2006.

IT WAS ONLY WITH THE RESOLUTION OF THE COUNCIL OF MINISTERS IN 2009 THAT WORK BEGAN ON THE KEY DOCUMENT FOR THE DEVELOPMENT OF NUCLEAR POWER – THE POLISH NUCLEAR POWER PROGRAMME ("PPEJ").

The programme was adopted in 2014. In December 2018, the draft Energy Policy 2040 was published, which provides for the construction of nuclear power plants. **A noticeable acceleration of the work took place in 2020, when the Nuclear Energy Programme and the resulting concept for the sale of 100% of shares in Polska Elektrownia Jądrowa (PEJ – Polish Nuclear Power Plant) were updated.** PEJ is a company that has been performing tasks related to the development of nuclear energy in Poland since 2014. It was sold to the State Treasury by PGE, Enea, KGHM and Tauron (the transaction was completed in 2021).

IN EARLY 2023, THE TECHNOLOGY (WESTINGHOUSE AP 1000) WAS SELECTED FOR THE FIRST NUCLEAR POWER PLANT PLANNED UNDER THE PPEJ. THE EXPECTED DATE OF COMMISSIONING OF THE FIRST POLISH NUCLEAR REACTOR, DESIGNED FOR ELECTRICITY GENERATION, IS 2033[5].



In parallel, Polska Grupa Energetyczna (PGE) and ZE PAK, together with Korea Hydro & Nuclear Power Co, signed a memorandum of understanding on cooperation on the Pątnów Polish-Korean strategic nuclear power plant project in Seoul on 30 October 2022, while ZE PAK and PGE signed a memorandum of association for a joint stock company on 13 April 2023. **A decision on the location and subsequent construction of the third nuclear power plant and the second to be built as part of a government programme is expected to be made in autumn 2023, according to media reports.**

SMR (SMALL MODULAR REACTOR)

PARALLEL TO THE ISSUE OF LARGE-SCALE NUCLEAR POWER, INTEREST IN INITIATIVES RELATED TO SMRS HAS ALSO GROWN IN POLAND IN RECENT YEARS.

The largest companies from the energy sector, the fuel sector and the industry are among the main stakeholders of the SMR project.

The use of SMR by industrial companies raises the hope of securing a stable supply of electricity and the possibility of reducing energy costs for their own consumption, which is particularly important in view of rising prices for energy-intensive companies. In the power sector, the use of SMRs would enable the gradual decarbonisation of production facilities and the reduction of emissions while complementing Poland's growing RES sources. In the district heating sector, on the other hand, SMRs offer the possibility to use heat generated in production (cogeneration).

THE ALLEGED ADVANTAGE OF MODULAR TECHNOLOGY OVER TRADITIONAL REACTORS IS THAT SMRS CAN BE BUILT FASTER AND CHEAPER. THE PREREQUISITE FOR THIS IS AN APPROPRIATE REGULATORY ENVIRONMENT FOR THE NUCLEAR SECTOR AND THE ACTUAL IMPLEMENTATION OF A SUFFICIENT NUMBER OF SMR PROJECTS THAT ENABLE A REDUCTION IN INVESTMENT COSTS PER UNIT DUE TO ECONOMIES OF SCALE.

[5] Program Polskiej Energetyki Jądrowej, 2022.

The insurance market in Poland is working to ensure that nuclear power can be insured.

Depending on the country, nuclear liability is prescribed at different levels. In Poland, it is 300,000,000 SDR (approx. 1.8 billion PLN – as of July 2022). This is the amount prescribed by the Vienna Convention on Civil Liability for Nuclear Damage, which is also enshrined in the Atomic Energy Act.

In the insurance of nuclear power plants, it is common practice worldwide to set up special pools in which insurance providers, governments and private companies from the nuclear power industry offer both power plant and liability insurance. The first such initiative was that of the Nuclear Risk Insurers (NRI) in the UK in 1956. Today, similar systems exist in France (Assuratome), Germany (Deutsche Kernreaktor – Versicherunggemeinschaft, D.K.V.G.), the USA (American Nuclear Insurers, A.N.I.), Spain (Espannuclear – Aseguradores de Riesgos Nucleares a.i.e) and Nordic countries (Nordic Nuclear Insurers, N.N.I.). Pools has also been established in the Netherlands, Belgium, Czechia, Slovakia, Bulgaria, Romania, South Korea, South Africa, Canada, Japan, China and Hungary. The pools also insure each other, thus spreading the risk.

As a rule of thumb, the assessment of insurance risks begins in the planning phase of nuclear facilities and the associated infrastructure. Starting the insurance discussion too late can lead to serious problems with coverage.

BUILDING THE HYDROGEN SECTOR

In November 2021, the Polish government adopted the *Hydrogen Strategy to 2030 with an outlook to 2040*. The document is part of the global, European and national activities aimed at building a low-carbon economy.

The **The Polish Hydrogen Strategy (Polska Strategia Wodorowa, PSW) is a strategic document that sets the main goals for the development of the hydrogen economy in Poland and the directions of the activities necessary to achieve them.** The document is part of the global, European and national activities aimed at building a low-carbon economy.

THE VISION AND OVERALL GOAL OF THE PSW IS TO CREATE A POLISH BRANCH OF THE HYDROGEN ECONOMY AND PROMOTE ITS DEVELOPMENT IN ORDER TO ACHIEVE CLIMATE NEUTRALITY AND MAINTAIN THE COMPETITIVENESS OF THE POLISH ECONOMY.

The implementation of the activities mentioned in the PSW will support the development of individual regions of Poland by, among other things, creating "hydrogen valleys" there that will enable the development of a value chain related to the hydrogen economy, such as: production, transport, storage and end use of hydrogen in industry. **These valleys will host, among others, R&D&I and investment projects that contribute to cooperation between local, national and foreign stakeholders.**

The development of a hydrogen industry is linked to the creation of a completely new infrastructure. This includes hydrogen production facilities based on water electrolysis, hydrogen storage, transmission infrastructure and facilities to use the energy generated by hydrogen combustion. Existing construction, property, liability and comprehensive/hull insurance products can be used to insure projects related to the creation of the infrastructure. This includes infrastructure and hydrogen-powered vehicles.

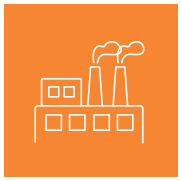
The safety of technological solutions will be crucial. For example, if hydrogen-powered vehicles can use underground garages in residential or commercial/office buildings, special installations may be required.

PHASING OUT THE COAL SECTOR

FROM A FINANCIAL POINT OF VIEW, THE PRODUCTION OF ENERGY FROM COAL IS CONSIDERED POTENTIALLY RISKY IN THE LONG TERM.

This view is also relevant for the insurance sector, which is involved in underwriting coal assets and mining activities.

FIGURE 45
THE DISAPPEARING CARBON SEGMENT



The fossil fuel-based energy sector is no longer considered viable in the long term – both for economic and image (environmental) reasons.

In Europe, the largest insurance groups, such as Swiss Re, Zurich and Allianz, declare in their strategies significant restrictions on investment and insurance risk-taking related to coal energy; in particular, insurers' participation in coal mines is declining.

THE QUESTION OF THE POLISH LEGACY OF COAL TECHNOLOGIES AND ENERGY SECURITY – NABE

Despite the increase in electricity from renewable energy sources projected in PEP 2040 (a total of about 27 GW6 in 2040) and the planned expansion of nuclear energy, coal is still necessary to ensure Poland's energy security. According to forecasts, the share of coal in electricity generation will be between 11 and 28% in 2040[7]. In the coming years, therefore, state-owned energy companies will be forced to continue to maintain carbon-intensive coal-fired plants, which, given the need to bring them into line with ever stricter environmental standards and to buy greenhouse gas emission certificates, will have a significant impact on the price of the electricity generated. It will not be competitive compared to the cheaper equivalent from RES systems, which also takes precedence over influencing the grid. **As a result, a scenario is likely in which energy companies experience declining revenues from electricity sales and attempts to obtain financing for new investments will fail due to the resistance of financial institutions to work with companies with a high carbon footprint.**

THE ANSWER TO THE ABOVE CHALLENGES IS THE ESTABLISHMENT OF THE NATIONAL AGENCY FOR ENERGY SECURITY (NABE), WHICH IS TO TAKE OVER MORE THAN 70 COAL BLOCKS CURRENTLY OWNED BY PGE POLSKA GRUPA ENERGETYCZNA S.A., ENEA S.A., TAURON POLSKA ENERGIA S.A. AND ENERGA S.A.

[6] Transformacja sektora elektroenergetycznego w Polsce. Wydzielenie wytwórczych aktywów węglowych ze spółek z udziałem Skarbu Państwa, Warszawa, February 2022 (Ministry of State Assets).
[7] Energy Policy of Poland until 2040, Warszawa, 2021 (Ministry of Climate).

Coal assets will be concentrated in PGE Górnictwo i Energetyka Konwencjonalna S.A. (PGE GiEK), which will later be transformed into NABE. The bundling of conventional resources in a company that is 100% controlled by the state ensures that the generation assets that are critical to the proper operation of the National Energy System (KSE) are maintained and relieves the burden on energy companies, which can focus on investing in low and zero carbon assets.

THE ESSENTIAL TASK OF NABE IS TO PRESERVE THE KEY ASSETS UNTIL IT IS POSSIBLE TO REPLACE IT WITH CLEAN SOURCES OUTSIDE NABE – THEN COAL CAPACITY WILL GRADUALLY BE EXTINGUISHED.

The decommissioning of individual coal-fired power plant units operating in the KSE will also depend on current and future market conditions, the profitability of production, the needs of the system and the technical capacity of the individual power plant units.

CHANGES IN THE CAPACITY MARKET

ONE FACTOR IN EU ENERGY AND CLIMATE POLICY THAT AFFECTS THE PROFITABILITY OF FOSSIL FUELS IS THE CAPACITY MARKET.

The aim of the capacity market is to create a mechanism by which controllable units are remunerated for their mere availability for use during periods of low RES generation.

From 2025, only plants that emit less than 550 g CO_2/kWh can participate in the capacity market. As a result, coal-fired power plants will no longer be able to provide standby power on their own, which will significantly reduce their profitability.

The economic and social changes and the situation in the western insurance markets may lead to an increase in risk for Polish insurers who continue to operate in the coal sector.

It can be difficult for insurance companies to reinsure risks, especially when insuring coal mines.

Another important consequence of the continued use of ageing coal plants in Poland could be the growing risk of power supply shortages and the willingness of companies to insure themselves against such events.

Despite the phase-out of coal-fired power generation by the end of its useful life, the plants must be kept in a reasonable technical condition, which requires expenditure on repairs, maintenance and innovations to reduce operating costs and environmental impact.

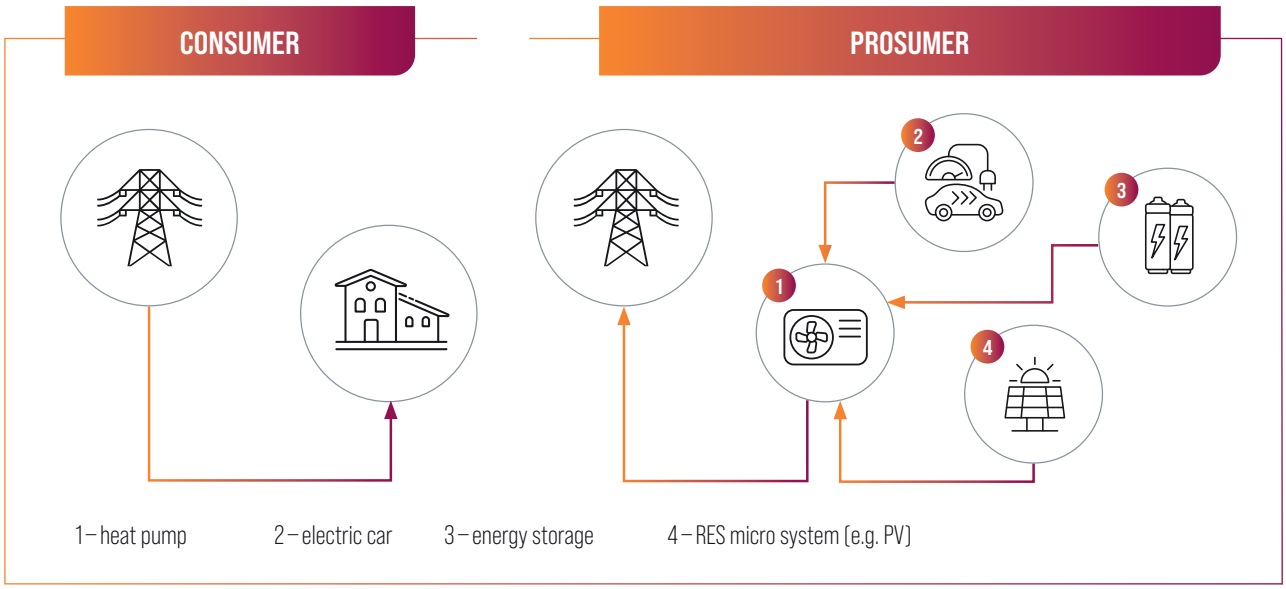
Conventional energy insurance products can cover risks such as liability for pollution incidents, business interruption and CO_2 transmission liability.

FUNDAMENTAL TRANSFORMATION OF THE ENERGY SYSTEM: DECENTRALISATION AND DIGITALISATION

THE TRANSFORMATION OF THE POWER GENERATION SECTOR IS NOT ONLY TAKING PLACE AT THE TECHNOLOGICAL LEVEL. **AN IMPORTANT DIMENSION OF THIS TRANSFORMATION ARE ALSO CHANGES IN THE ORGANISATIONAL FORMS OF ENERGY PRODUCTION AND THE RESULTING LEGAL CHANGES, NEW BUSINESS MODELS AND SOCIAL PHENOMENA.**

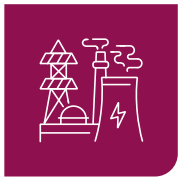
An example of the decentralisation, decarbonisation and digitalisation of the sector is the development of so-called prosumerism, i.e. the generation of electricity and heat directly at the consumer, especially in households, as mentioned above. **Another expression of these changes is the development of long-term contracts for the direct purchase or sale of electricity between companies, i.e. PPAs (Power Purchase Agreements).**

PROSUMERS OF ELECTRICITY IN HOUSEHOLDS



THE HISTORICAL ROLE OF THE CONSUMER WAS LIMITED TO THE PASSIVE CONSUMPTION OF ELECTRICITY FROM THE GRID, WITHOUT ACTIVE CONTROL OVER THE TIME OF CONSUMPTION AND THE AMOUNT CONSUMED, AND WITHOUT ANY PRODUCTION OR STORAGE CAPACITY OF THEIR OWN.

The current changes mean that existing consumers are also starting to produce energy, e.g. by installing photovoltaic (PV) panels. What happens is that PV system owners export energy to the grid, which is then bought back by the electricity suppliers and used for other consumers. The owners of PV systems, the so-called prosumers, are starting to pay more attention to the hours in which they produce and consume energy in order to optimise the economic effect of their system. To this end, prosumers use, among other things, smart metres that enable real-time monitoring of energy consumption, analysis of historical consumption profiles and thus better energy management.



However, these changes still require significant action on the part of energy companies in Poland. On average, 17.5%[8] of the country's energy consumers have smart metres installed, while the European average is around 53%[9].

[8] https://wysokienapiecie.pl/66668-inteligentne-liczniki-lider-wyprzedza-peleton-o-kilka-dlugosci/
[9] Smart Metering in Europe 16th edition, 2021 (Berg Insigh).

The deployment of smart metres stems from the need to implement the EU Directive on common rules for the internal energy market (2019/944)[10].

According to the provisions of the Energy Act, amended in July 2021, the distribution system operator **must install smart metres for at least 80% of final consumers, including not less than 80% households, by 31 December 2028**[11].

In addition, a national system IT is currently being set up that will allow the introduction of dynamic tariffs, where the energy fee paid by the end consumer is directly linked to the current prices on the wholesale energy market. Currently, the regulations on dynamic tariffs in Poland are in the drafting phase[12].

ENERGY STORAGE (INCLUDING ELECTRIC CARS) WILL PLAY A KEY ROLE IN THE ABILITY TO ACTIVELY MANAGE THE ENERGY CONSUMPTION PROFILE.

Observing global trends, one can assume that these technologies will also **experience significant development in Poland in the coming years.** The ongoing electrification of households and other global economic and societal trends (increasing energy efficiency, rising fossil fuel prices, growing energy awareness) also exemplify the intensive development of the heat pump sector, which is particularly noticeable among prosumers.

These phenomena lead to a significant increase in the value of household assets potentially covered by insurance offering.

[10] Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU.
[11] The process is to take place in accordance with the schedule presented in the Act, which establishes cut-off dates of 31.12.2023, 31.12.2025 and 31.12.2027 for the installation of smart metres at energy consumption points accounting for 15, 35 and 65% of the total number of PSAs at the above end-users, respectively.
[12] https://www.gov.pl/web/klimat/umowa-z-cena-dynamiczna---tansza-energia-dla-aktywnych-odbiorcow

The growing trend towards prosumerism leads to the development of a large number of expensive and high-tech goods on the household side. This phenomenon creates an important market for insurers seeking to cover these assets in the form of damage protection, maintenance, economic performance guarantees and other insurance products.

MODELS FOR THE DEVELOPMENT OF ENERGY SOURCES FOR ENTERPRISES

INDUSTRY AND ENTERPRISES IN POLAND ARE UNDER CONSIDERABLE PRESSURE TO REDUCE THE CARBON FOOTPRINT OF THE PRODUCTS AND SERVICES THEY OFFER. THIS IS DUE TO POLAND'S ENERGY MIX, WHICH MAKES THE ENERGY FROM THE SYSTEM VERY EARTHBOUND.

On the other hand, rising prices for carbon dioxide emission certificates mean that electricity from the system in Poland is becoming more and more expensive. Industry, especially energy-intensive consumers, is particularly sensitive to rising energy prices, which account for a significant part of energy costs.

A SOLUTION TO THIS PROBLEM, ENABLING THE PURCHASE OF GREEN ENERGY FOR BUSINESS PURPOSES, IS THE GROWING POPULARITY OF THE PPA (POWER PURCHASE AGREEMENT).

Under a PPA, the energy producer and the energy recipient agree on a long-term fixed (or, for example, indexed by inflation) price for the purchase or sale of energy. This mechanism allows enterprises to obtain energy from RES without having to build physical infrastructure and without having to go through complex investment processes. For the recipient, the completion of the PPA is a guarantee that the bank will fund the investment and the recipient receives the expected return on the invested capital.

INDUSTRY'S RESPONSE TO CHANGES IN THE ENERGY SECTOR

- Construction of own generation sources – RES and, in the future, potentially small modular reactors (SMRs).
- The long-term contract for the purchase of renewable energy **at a fixed price (PPA).**
- Measures to improve energy **efficiency (modernisation** work, process automation, computerisation).

There are different types of PPAs (e.g. on-site model and off-site model). The individual models differ in terms of the location of the generation assets in relation to energy consumption (on-site vs. off-site), the scope of the contract (physical PPA or financial PPA) and the legal status of the assets (asset leasing, takeover, direct line)[13].

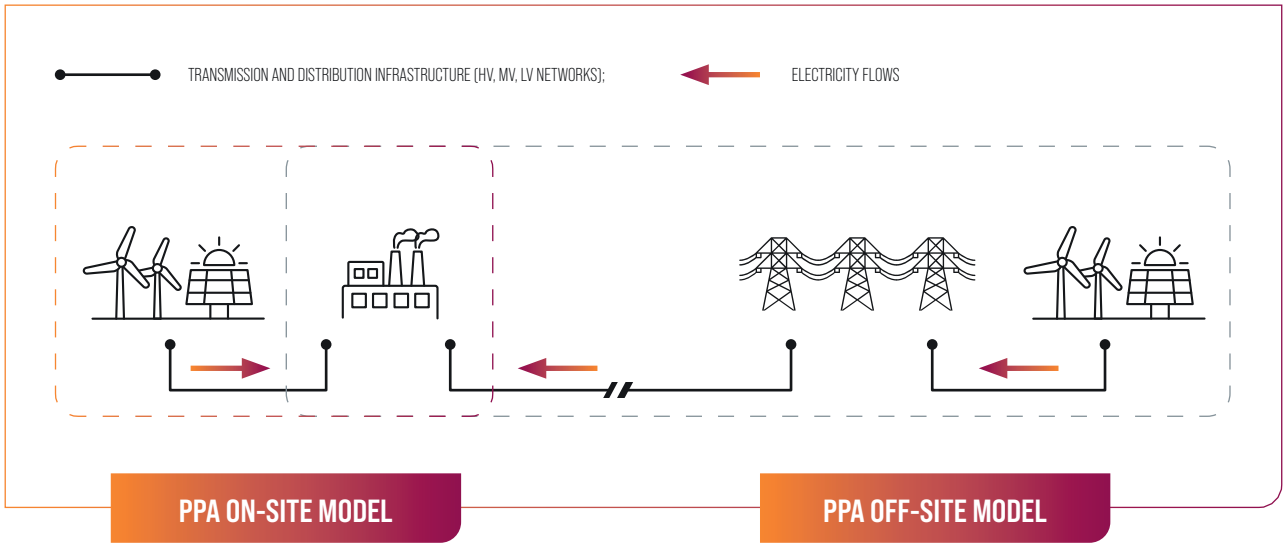


FIGURE 46
PPA ON-SITE AND OFF-SITE MODELS

[13] More detailed information on PPA models can be found at http://resourcepoland.pl/Przewodnik_po_cPPAs.pdf.

1 **On-site models are associated with a specific property, e.g. a production site. Due to their** features, they can be used on a larger scale in energy-intensive industries, e.g. manufacturing activities. Emerging sources under the on-site model are connected directly to the recipient's facility. They can be implemented in the following variants:

1.1 The energy consumer owns a source of electricity generation on his property (local self-production).

1.2 Lease – the recipient leases a new source on his property. Local PPA (on-site PPA) – the **recipient enters into a long-term contract with the producer to purchase energy at a fixed price** from the source on the recipient's property.

1.3 PPA with a direct line – the source is located on a neighbouring or nearby property of the recipient and a PPA is concluded for the purchase/sale of energy.

2 In off-site models, the recipient and the generation facility have no direct connection. Off-site **models do not have to be linked to a specific property, which is why they are sometimes used by** companies from many different industries. There are the following types of off-site model:

2.1 **Physical PPA – a long-term contract to buy and sell energy at a fixed price. This requires the** conclusion of additional contracts for balancing and transfer of energy.

2.2 Financial PPA – a contract for difference for the purchase/sale of energy that is linked to the **market price, typically on an energy exchange. It guarantees both parties a long-term fixed** purchase and sale price for energy and does not require any additional agreements arising from the principles of the functioning of the energy system.

Industry may be interested in insuring its own sources or insuring the expected amount of energy and the associated financial benefits.

Insurance guarantees (bonds) can be a product securing PPAs.

FIGURE 47
PPA VOLUMES CONTRACTED IN POLAND [MW][14]

[14] Based on market data and EY analyses.

INSURANCE PRODUCTS FOR THE ENERGY SECTOR IN THE ERA OF TRANSFORMATION

INSURANCE PROGRAMMES ARE PREPARED FOR INDIVIDUAL INVESTMENT PROJECTS AS SOON AS THE PLANNING AND CONCEPTUAL WORK BEGINS.

ERRORS MADE IN THE INITIAL PHASE CAN LEAD TO LOSSES AND CLAIMS ARISING IN THE OPERATIONAL PHASE.

The process of implementing a (construction) project involves many risks. A loss may consist in damage to the stucture built. They may also occur during the transport of building materials and equipment from the place of their manufacture to the construction site, whether due to a traffic disaster or adverse weather phenomena. Construction machinery can also be destroyed or damaged during the implementation of the project.

Companies carrying out construction work can make errors during construction or installation works that can lead to subsequent destruction, damage or failures in power generation.

THIS IN TURN COULD LEAD TO CLAIMS IN THE MILLIONS IN THE FUTURE.

A DELAY IN THE INVESTMENT PROCESS MAY MEAN THAT THE POWER GENERATION PLANT CANNOT BE COMMISSIONED AS PLANNED.

The project owner usually covers the costs of building new energy facilities with a bank loan or funds from issuing debentures.

ANY DELAY FROM THE ASSUMED SCHEDULE MEANS LOSSES AND POSSIBLE PROBLEMS WITH LIQUIDITY AND DEBT SERVICING.

Damage can also occur during the operational phase of the energy facility due to a natural or man-made catastrophe. Failures of machinery and equipment are common damages that occur in the energy sector. Repair costs can be high, as the disassembly, purchase and transport of a new appliance or machine, as well as the reassembly, usually involve very high costs.

OTHER RISKS IN THE OPERATION PHASE:

Errors can also be made during maintenance or overhaul work, which can cause further damage during the operation of a facility.

Operators of energy generation plants are exposed to the risk of non-payment by electricity consumers.

The processes of power generation and distribution are controlled by IT systems. A system failure or a hacker attack can paralyse the company's business.

The interruption of power plant operations due to the failure or destruction of equipment necessary for power generation or transmission causes high losses. As with delays in the investment phase, business interruptions can have a negative impact on the enterprise's financial situation.

The insurance products are used by investors and operators of power generation plants as well as their contractors, service providers and their subcontractors. All these companies benefit from property insurance, liability insurance, cyber insurance, insurance against loss of profit and security in the form of insurance bonds.

TYPES OF INSURANCE PRODUCTS FOR THE ENERGY SECTOR

UNDER CONSTRUCTION

- Construction and assembly insurance (CAR and EAR)
- Contractor's Plant & Machinery Insurance
- Professional liability of planners, engineers and lawyers
- Contractor's liability
- Proper performance of a contract bond
- Rectification of defects and faults bond
- Financial security for the development of the seaside property in accordance with the administrative decision
- Security related to the connection to the electricity grid
- Advance payment bond
- Forwarder's liability and carrier's liability insurance
- Trade credit insurance
- Insurance of the transport of machinery, equipment and construction materials (cargo)
- Loan protection insurance
- Insurance of the project owners future lost profit due to damage or delay in the construction process (ALOP)
- Personal accident insurance for workers on construction sites
- Legal expenses insurance

IN OPERATION

- Insurance of power generation plants and equipment against fire and other fortuitous events and failures
- Insurance of the property of companies carrying out maintenance and repair work and of other suppliers and service providers
- Trade credit insurance
- Cyber insurance
- Insurance of machinery and electrical breakdown
- Proper performence bond
  Maintenance bond
  Advance payment bond
- Business Interruption and contingent business interruption
- Insurance of the transport of machinery, equipment, fuel, waste (cargo)
- Energy company's liability insurance
- Liability insurance for companies carrying out maintenance and repair work and other subcontractors
- Professional liability of planners, engineers and lawyers

NOTES

This report was prepared by the Polish Chamber of Insurance (PIU) in collaboration with EY. The report contains an analysis of the climate environment and the threats posed by destructive weather phenomena and raises the question of how climate risk should be managed and whether the role of insurance in the energy transition is being adequately fulfilled. At the same time, we would like to point out that the data contained in the report comes from reliable sources. Neither PIU nor EY guarantee the exhaustive accuracy and completeness of the information presented and the conclusions drawn from it. Readers should not rely on the content of the report without making an independent assessment of its accuracy and completeness.

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