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Global damage from extreme weather is rising – 21% of German enterprises already affected by the negative consequences of climate change

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Global warming is advancing. In 2024, the global average temperature was already 1.6°C above the pre-industrial level. If the current warming trend of 0.2°C per decade continues, the 1.5-degree threshold set in the Paris Agreement on climate change is likely to be permanently exceeded in the 2030s. The United Nations Environment Programme expects warming of 2.8°C by 2100 if current climate policies continue. An orderly adaptation to such an increase is considered extremely difficult. **In Germany, the average temperature has already risen by around 2.5°C since 1881.** The number of hot days with at least 30°C has quadrupled since the 1950s from around three to about twelve per year.

The massive consequences of climate change are already visible today: Extreme weather events have increased and are causing high economic losses. Worldwide they added up to over USD 3.8 trillion between 2000 and 2024 and more than doubled over that period. In Germany, damage of EUR 180 billion occurred between 1980 and 2023. Besides the global South, key trading partners of Germany such as China, the US, Italy and Spain are currently the most affected by extreme weather.

German enterprises are already feeling the effects of climate change, not least because of global trade linkages. According to the KfW Climate Barometer, 21% of all firms report negative impacts, rising to 74% among large enterprises and 31% among energy-intensive enterprises. In addition to direct material damage, the main impact stems from disruptions to energy and transport infrastructure and global supply chains. Analyses indicate that unchecked climate change also poses a substantial risk to Germany's future economic prosperity.

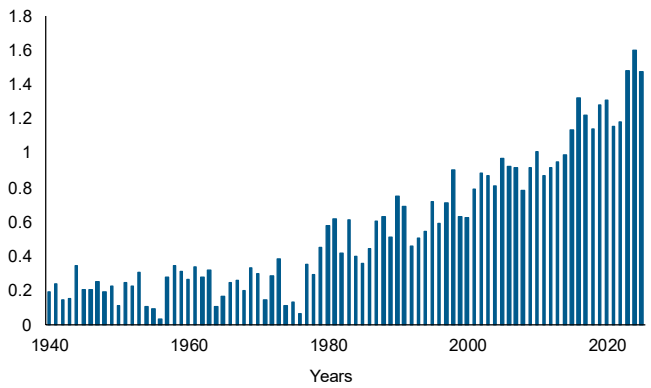
Ambitious international climate action and early adaptation by the state and enterprises are essential, for example better flood and heat protection, climate-resilient agriculture and more green spaces in cities. Firms can protect themselves against climate-related risks through structural protection, natural disaster insurance and higher inventory levels.

There are no signs of an all-clear

In recent decades, the global warming trend has accelerated (Figure 1). The past eleven years rank among the warmest since temperature records began. In 2024 the global average temperature exceeded the 1.5°C threshold of the Paris Agreement on climate change for the first time, at 1.6°C above the pre-industrial level. The 1.5°C threshold is a benchmark set by the international community to limit the risks and impacts of climate change (see also Box 1). If the current warming trend of 0.2°C per decade continues, Copernicus, the EU's Earth observation programme, projects that the 1.5°C threshold will probably be permanently crossed as early as the 2030s[1]. At the same time, there is mounting evidence that the warming trend has accelerated and that the 1.5°C threshold will be exceeded even earlier.[2]

Figure 1: Global warming is advancing

Deviation of global air temperature from the average of the years 1850 to 1900, in °C.



Note: The zero line corresponds to the global average air temperature of the years 1850 to 1900.

Source: Copernicus Climate Change Service (2026).

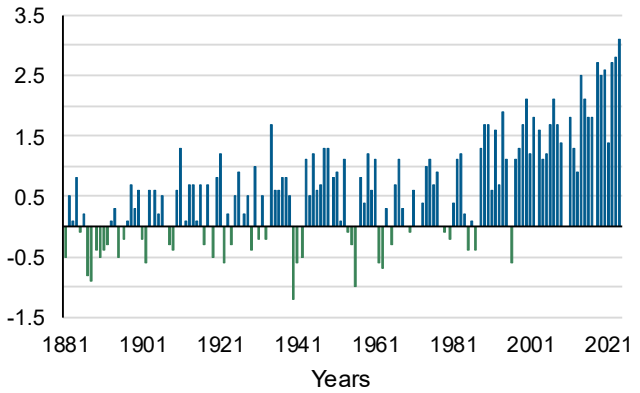
Given current greenhouse gas emission trends, it is far from certain that the 2-degree limit set out in the Paris Climate Agreement will be met. Under a continuation of current global policies to the end of this century, the United Nations Environment Programme projects a warming of 2.8°C above the pre-industrial level. Even if all emission reduction commitments

(NDCs) submitted under the Paris Agreement were fully implemented, the global temperature is still projected to rise by 2.3 to 2.5°C.[3] Adapting to the impacts of climate change becomes virtually impossible if global warming exceeds 2°C.[4]

Climate change is already evident in Germany. Since the 1960s, each decade has been warmer than the previous one. Recent years are among the warmest since the time series began (Figure 2). Since systematic weather records were introduced in 1881, the average temperature in Germany has already risen by around 2.5°C.[5] The number of hot days with temperatures of at least 30°C has quadrupled since the 1950s from about three days per year to now twelve days per year.[6]

Figure 2: Warming trend is also accelerating in Germany

Positive and negative deviations of the average annual temperature in Germany from the long-term mean 1881–1910 to the year 2024, in °C.



Note: The zero line corresponds to the average air temperature in Germany of the years 1881 to 1910: 7.8°C.

Source: Deutscher Wetterdienst (2025).

Box 1: Paris Agreement

To limit the foreseeable severe consequences of global climate change, the international community agreed on common objectives at the UN Climate Conference in Paris in 2015. Accordingly, global warming must be limited to well below 2°C above pre-industrial levels. Additional efforts should be made to limit this increase to 1.5°C. Scientific findings of the Intergovernmental Panel on Climate Change (IPCC) show that warming beyond 1.5°C can have severe and potentially irreversible impacts on the climate. Even with warming of 1.5°C, the expected negative impacts of global climate change are substantial. These include, for example, more frequent and intense extreme weather events and the threat posed to island states by rising sea levels. At 2°C of warming and beyond, very likely irreversible tipping points will be reached that could destabilise the climate system as we know it and trigger lasting changes. For instance, the glaciers at the North and South Poles could melt.[7]

Exceeding the 1.5°C threshold for the first time in 2024 does not mean that the Paris Agreement target has already been missed, as it is assessed based on longer-term averages. To limit global warming to 1.5°C, however, the IPCC's Sixth Assessment Report states that global CO_2 emissions must fall by 48% compared with 2019 levels by 2030. In addition, near-net-zero carbon dioxide emissions must be achieved across all regions and sectors by 2050.[8] Against the backdrop of global CO_2 emissions reaching a new peak in 2024[9], keeping warming to 1.5°C now appears unlikely. Global climate action to date has been insufficient to put worldwide emissions on a sustained downward trajectory. Limiting global warming to 2°C would require reducing global CO_2 emissions by 22% by 2030 compared with 2019 levels and by 73% by 2050.[10]

The consequences of climate change are long since visible worldwide: Extreme weather events such as heat, drought, storms and heavy rainfall are increasing, as are the melting of land and sea ice and sea-level rise. There is broad scientific consensus that anthropogenic climate change increases the frequency and intensity of numerous extreme weather events.[11] Event attribution research is contributing increasingly to determining the specific influence of climate change on individual extreme weather episodes.[12] There is also consensus that with each tenth of a degree of additional warming, the risks posed by global climate change to human health, ecosystems and economic prosperity rise.[13]

This analysis provides an overview of the evolution of economic damage caused by extreme weather events. It also shows which countries are currently the most burdened by extreme weather and which regions have particularly high material damage potential in the event of unchecked global climate change. New evaluations from the KfW Climate Barometer also shed light on the extent to which German enterprises are already affected by the negative consequences of climate change (see also Box 2).

High economic damage from extreme weather events already today – and they are growing quickly

Extreme weather events are already causing substantial economic damage. The largest losses are due to storms and floods.

- **Global:** According to the international disaster database EM-DAT[14] climate-related disasters caused worldwide economic damage of over USD 3.8 trillion (in 2023 prices) in the period from 2000 to 2024, more than half of which were attributable to storms (Figure 3). Just over a quarter of the damage was caused by floods. The cost of damage more than doubled in the past two decades: the cost of climate-related damage rose from a total of around USD 450 billion in the period from 2000 to 2004 to more than USD 1 trillion between 2020 and 2024.[15] This trend is in line with scientific projections of increasing frequency and intensity of extreme weather events due to global warming. Initial loss statistics for 2025 show worldwide asset damage from natural catastrophes of USD 224 billion. By far the costliest natural disaster of all time was the wildfires in the Greater Los Angeles area in January 2025. A dangerous combination of persistent drought and strong winter winds created optimal conditions for the fires. The total damage amounted to USD 53 billion.[16]
- **Europe:** The European Environment Agency (EEA) estimates that weather- and climate-related extreme events caused asset damage of EUR 738 billion (price-adjusted to 2023) in the European Union between 1980 and 2023. Over EUR 162 billion of that –

corresponding to 22% – occurred in the period from 2021 to 2023 alone. Of the total damage, 44% were caused by floods, 29% by storms, lightning and hail, 19% by heatwaves and the remaining 8% by droughts, wildfires and cold spells. Annual damage varies greatly but a statistical evaluation of a 30-year moving average shows a clear increase in economic losses over time. Between 2009 and 2023, annual asset damage rose by a total of 53%, corresponding to an average annual increase of 2.9%.[17]

- **Germany:** The European Environment Agency puts asset damage caused by extreme weather events in Germany in the period from 1980 to 2023 at around EUR 180 billion.[18] A study commissioned by the Federal Ministry for Economic Affairs estimates extreme-weather-related damage between 2000 and 2021 at least EUR 145 billion (price-adjusted to 2021). Nearly half of that is due to flood and torrential rain events, 29% to heat and drought and 22% to storm, hail and snow.[19] Flash floods and river floods alone in July 2021 in North Rhine-Westphalia and Rhineland-Palatinate caused more than EUR 40 billion, over 25% of the recorded total damage. The distinctive feature of this study is that it considers both direct and indirect extreme-weather-related damage. In addition to direct losses of around EUR 115 billion – for example the destruction of infrastructure and buildings or insured losses – it includes, for the first time, indirect damage along the value chain in the loss statistics. This indirect damage amounts to around EUR 30 billion, for example through more expensive intermediate goods or missed deliveries.

The above loss statistics should be interpreted with caution, as they cover only a portion of the total damage caused by extreme weather events. The impacts and consequences of such events are diverse and complex, so not all damage can be fully captured or monetised.[20] This applies particularly to heat and drought events, as currently only few actors are insured against drought-related damage (such as crop failures) and heat-related damage have so far been inadequately studied. Moreover, indirect consequences of climate change are not yet considered in economic damage assessments. These include long-term health impacts, productivity losses or loss of biodiversity through the extinction of animal and plant species. Overall, data gaps, methodological challenges in recording losses and the omission of smaller damage events mean that weather- and climate-related economic damage is underestimated.

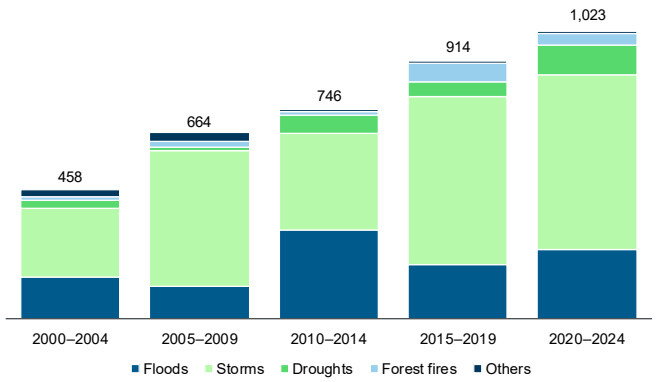
Heat is the extreme weather event with the highest mortality rate in Germany and Europe

Extreme weather events not only cause substantial damage to assets but also pose a direct threat to health and life. According to the Climate Risk Index 2025 published by Germanwatch, more than 765,000 people worldwide lost their lives in over 9,400 extreme weather events between 1993 and 2022. Most deaths were attributable to storms (35%), heatwaves (30%) and floods (27%).[21] The European Environment Agency estimates the number of deaths caused by weather- and climate-related extremes in the European Union between 1980 and 2023 at around 242,000, 95% of which were due to heatwaves.[22]

The deadliest extreme weather event in Germany is heat: 99% of the approximately 30,800 extreme-weather-related deaths recorded in the period from 2000 to 2021 were due to heat events.[23] In the years 2022 to 2024, roughly 10,500 heat-related deaths were added.[24] Heatwaves regularly lead to excess mortality in Germany. Those particularly affected are persons aged over 75 with pre-existing conditions such as dementia, cardiovascular or pulmonary diseases. According to an analysis by the Robert Koch Institute, even isolated hot days pose a heat burden which, if night-time cooling fails to occur, can lead to increased mortality.[25]

Figure 3: Worldwide damage from climate-related disasters is rising over the period 2000 to 2024

In USD billions (in 2023 prices).



Note: Only damage from natural disasters directly related to weather conditions or climate change are considered. The data for 2024 were extrapolated based on the average values for 2020–2023 to show the five-year trend for 2020–2024.

Source: World Economic Forum, Boston Consulting Group (2024) based on the "EM-DAT International Disaster Database" of the Centre for Research on the Epidemiology of Disasters (CRED) at the Université Catholique de Louvain, Brussels.

Alongside the global South, industrialised nations such as China, the US, Italy and Spain are among the countries currently most affected by extreme weather

The number of extreme weather events has increased worldwide in recent decades.[26] Which countries are strongly affected these days? The Climate Risk Index 2025 published by Germanwatch also provides important indications. This study compiles a country ranking of exposure to extreme weather. It is based on economic damage, deaths, injured persons and persons who lost their homes, evaluated both in absolute terms and relative to population and gross domestic product. In the long-term assessment for the period from 1993 to 2022, the most affected countries include the Caribbean Island state of Dominica, followed by China, Honduras, Myanmar, Italy, India, Greece and Spain. The US ranks 13th. Germany is in 48th place out of the 174 countries evaluated.[27]

The assessment shows that not only countries in the global South, such as states in Africa or South Asia, are heavily affected by weather- and climate-related extremes, but also industrialised nations in North America, Europe and Asia. However, countries in the global South often have fewer resources to adapt to the consequences of climate change and to mitigate

damage. This greatly increases their vulnerability and jeopardises long-term development progress.

High material damage risks for economic centres near coasts and rivers under unchecked climate change

Without decisive climate action and effective adaptation measures, damage from extreme weather events will continue to increase as climate change advances. Which countries have the greatest damage potential? Pointers to damage risks for the assets of each country are provided by the XDI Gross Domestic Climate Risk Report.[28] The study assesses more than 2,600 regions worldwide in terms of their risk of damage to the built environment from extreme weather events and climate change in 2050. It considers potential damage from floods, sea-level rise, storms, extreme heat, drought and wildfires. The underlying climate model assumes a "business-as-usual" trajectory for the concentration of greenhouse gases and results in average global warming of over 3°C by the end of this century.[29]

The results show that regions with extensive residential, industrial or commercial areas near rivers and coasts bear a high material damage risk.[30] The country ranking indicates that China, the US and India are especially exposed to asset damage in the event of unchecked global climate change (Figure 4). These three countries account for more than half of the states and provinces in the top 100 of the ranking. Major economic centres are particularly affected:

- Two of China's largest subnational economies – Jiangsu and Shandong – occupy the top two places in the global ranking. More than half of the provinces in the global top 50 are located in China.
- After China, the US accounts for the most high-risk regions within the top 100, with eighteen states. Florida is the highest-ranked US state, followed by California and Texas.
- Other important economic centres in the top 100 include Buenos Aires, São Paulo, Jakarta, Beijing, Ho Chi Minh City, Taiwan and Mumbai.

European regions are also among the top 100 with the highest damage potential: Lower Saxony in Germany (rank 56), Flanders in Belgium (rank 64), Krasnodar in Russia (rank 72) and Veneto in Italy (rank 74).

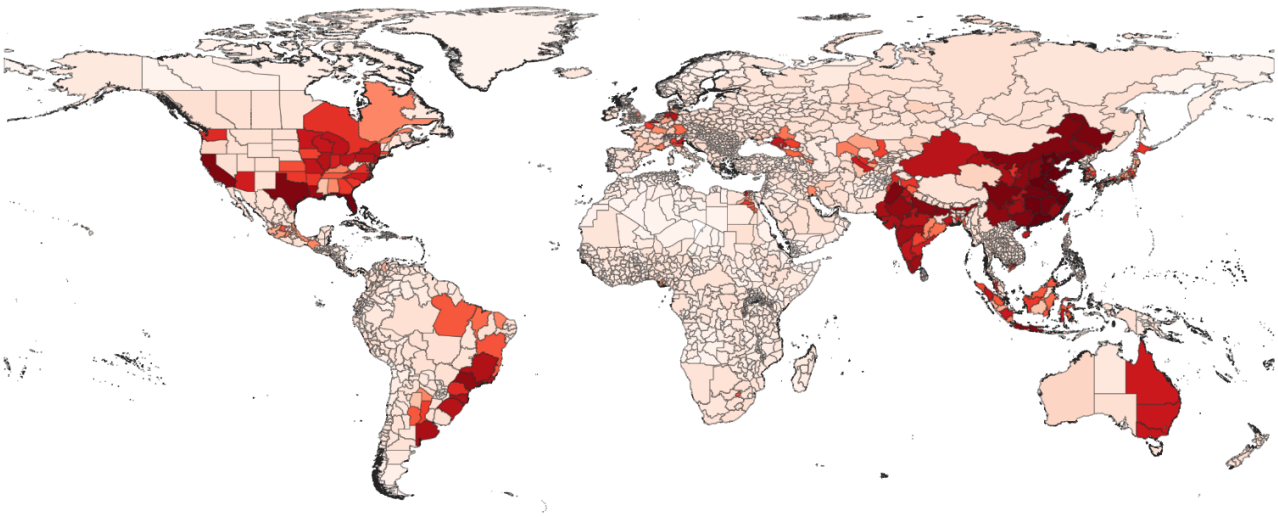
Besides local damage risks, Germany as a country highly integrated into world trade is also strongly exposed to the consequences of climate change in other world regions

The impacts of global climate change can adversely affect enterprises' business activity and a country's economic development in multiple ways. These include:

- **Damage to infrastructure and property:** Extreme weather events can repeatedly cause damage to production facilities, energy supply and transport infrastructure and buildings. The associated restoration and repair costs place a burden on public budgets, insurers and enterprises.
- **Limited insurability of assets:** Even today, climate- and weather-related risks to assets in exposed locations are in some cases not insurable, or only at very high cost. This can also complicate the financing of investment projects in these regions.
- **Reduced labour productivity:** Particularly in manual outdoor work, such as construction or agriculture and forestry, extreme heatwaves impair workers' performance.
- **Falling agricultural yields:** Climate extremes such as droughts or torrential rainfall increase the risk of large-scale crop failures, which can drive up prices on global markets.
- **Rising energy prices due to impaired energy supply:** Thermal power stations – such as coal-, nuclear-, gas- and steam-fired plants – require cooling water for electricity and heat generation, which is usually taken from rivers. High water temperatures and low water levels during periods of heat and drought often require restrictions on cooling water withdrawal and discharge, thereby reducing energy production. Hydropower plants are also affected during droughts. In addition, various industrial processes use rivers as a cooling medium.

Figure 4: High damage risks to existing assets from climate change in 2050 near coasts

Darker red = higher risk.



Source: XDI Gross Domestic Climate Risk Report (2024).

- **Disruptions in goods transport:** Extreme heat, storms and floods can damage and close roads and rail routes, while flooding or very low water levels impair inland navigation and port operations. For example, lower water levels in the Panama Canal from October 2023 to January 2024 due to drought led to a reduction in transits by more than one third. This caused disruptions to global trade, as many ships had to divert to longer and more expensive routes via the Suez Canal or around the Cape of Good Hope.[31]
- **Interruptions in global supply chains for raw materials, food and intermediate goods:** Extreme weather events in extraction, cultivation and manufacturing countries can lead to supply bottlenecks and disruptions. In an era of highly networked, just-in-time logistics, this can impose considerable financial burdens on importing enterprises. For example, flooding in Slovenia from August to October 2023 prevented Volkswagen from producing 150,000 vehicles because a key supplier was unable to deliver.[32]

The last point illustrates that, as a highly industrialised economy, Germany is strongly exposed to the indirect consequences of climate change in other parts of the world because of international trade linkages. This aspect has so far received little attention in the public debate, as such indirect damage is more difficult to attribute and quantify. Recent studies for the EU, however, suggest that, going forward, indirect damage from disrupted global trade and supply chains may far exceed the direct climate-related damage incurred within the EU.[33]

More than one in five enterprises in Germany already affected by the negative consequences of climate change

Evaluations of the KfW Climate Barometer 2025 show that 21% of all enterprises in Germany (around 800,000 enterprises) report being at least partly affected by the negative consequences of climate change (Figure 5). By contrast, two thirds of enterprises perceive no exposure. The remaining firms responded “Not sure”.

Large enterprises more likely to be affected

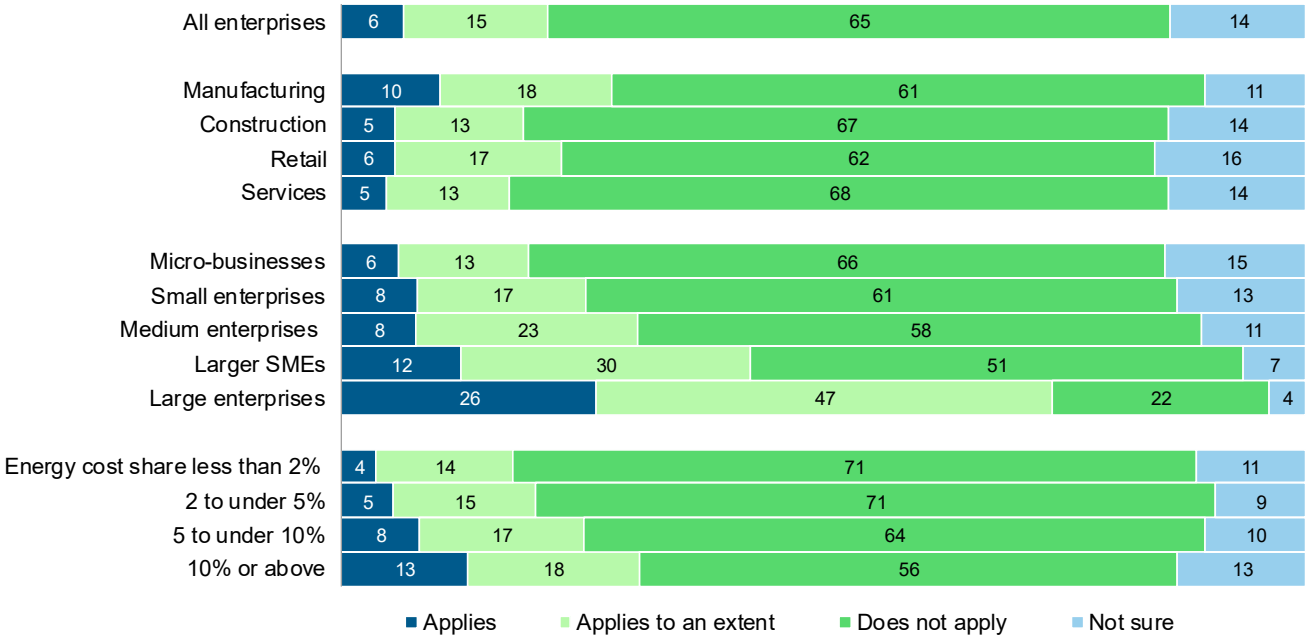
Among micro-businesses with fewer than five employees, only one in five (19%) report already experiencing the negative consequences of climate change. Among large enterprises with annual turnover of more than EUR 500m, by contrast, the figure is more than seven in ten. Almost three in four large enterprises currently regard themselves as at least partly affected by the negative consequences of climate change. Among larger SMEs with more than fifty employees (but total turnover of less than EUR 500m), 42% report experiencing negative impacts. A key reason for this size-related difference is likely to be the stronger international integration of larger enterprises. While smaller firms often operate locally – sourcing more of their inputs and generating more of their revenues regionally – larger enterprises are more closely integrated into international supply chains and sales markets and are more likely to have foreign sites.

Their stronger international orientation also makes them more vulnerable to the impacts of climate change. They are affected not only when their own sites are hit but also when trading partners are impaired by extreme weather events.

Moreover, energy-intensive enterprises are particularly vulnerable to the negative consequences of climate change. The data show that firms with an energy share of 10% or more in total costs are already more likely to feel these effects: 31% of such energy-intensive enterprises report being at least partly affected. This became apparent not least during the dry summers of 2022 and 2025, when some energy-intensive industries came under pressure. At low river levels – such as on the Rhine[34] – ships were only able to sail with reduced loads, so fewer goods and energy carriers reached their destinations.

Figure 5: Perceived exposure of enterprises to the adverse effects of climate change in 2025

Shares of enterprises in per cent.



Note: The question was as follows: "To what extent do the following statements on the topic of climate action apply to your enterprise?" The shares shown here refer to "Our enterprise is affected by the negative consequences of climate change". The response options were the four categories.

Source: KfW Climate Barometer 2025.

In addition, the output of thermal power stations and hydropower plants is constrained during periods of heat and drought by high water temperatures and low water levels. Restrictions on the use of cooling water impair industrial cooling processes.

Looking across sectors, the differences are more moderate. Around 28% of enterprises in manufacturing report being affected by the negative consequences of climate change – slightly more than in retail (23%), construction and services (18% each). Possible reasons include that manufacturing is often characterised by energy-intensive production processes and complex supply chains. These make the sector particularly vulnerable to climate impacts such as extreme weather events, which can lead to delivery difficulties, especially where there are global dependencies.

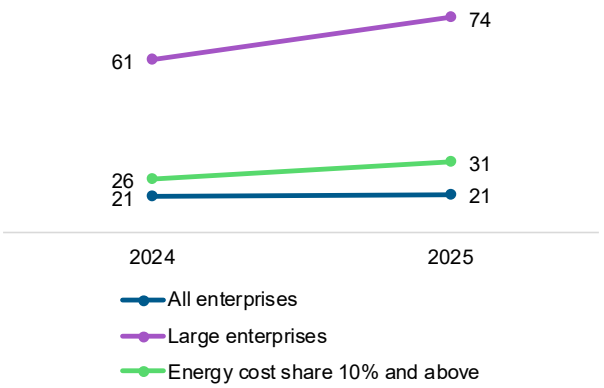
A more detailed industry breakdown shows that enterprises in energy supply and in agriculture and forestry report being affected by the negative consequences of climate change more frequently than average. The energy industry is already in transition and is discussing and implementing numerous measures to reduce greenhouse gas emissions, such as expanding wind and solar installations for power generation. Agriculture and forestry, by contrast, depend directly on weather conditions. Extreme weather events such as droughts, heavy rainfall or storms have a direct impact on crop yields and forest health.

Overall, perceived exposure remains stable over time

The share of enterprises that consider themselves affected by the negative consequences of climate change has remained at a similar level to the previous year, at just under 21% overall (Figure 6). Changes are evident, however, among large enterprises and among enterprises with a high energy cost share. In 2024, 61% of large enterprises reported being affected by the negative consequences of climate change. One year later, this figure has risen to 74%. Among enterprises whose energy cost share is 10% or more, the proportion increased from 26 to 31% over the same period.[35] Enterprises with a high energy cost share are more often medium to large and predominantly industrial. This makes this group particularly vulnerable to climate impacts such as extreme weather events which can lead to delivery difficulties, especially in the context of global supply chains.

Figure 6: Increase among large enterprises and those with high share of energy costs

Shares of enterprises indicating *applies* or *partly applies*, in per cent.



Note: The question was as follows: "To what extent do the following statements on the topic of climate action apply to your enterprise?" The shares shown here refer to "Our enterprise is affected by the negative consequences of climate change". The response options were the four categories indicated in Figure 5.

Source: KfW Climate Barometer 2024-2025.

Economy-wide damage from CO_2 emissions far exceeds the costs of abatement

New estimates suggest that the **macroeconomic consequences of climate change could be substantially more severe** than previously assumed. Even global warming of 2°C compared with the pre-industrial level and the associated increase in extreme weather events could lead to worldwide welfare losses of more than 30% by 2100.[36] This implies social costs of climate change of over USD 1,200 – around EUR 1,000[37] – per tonne of CO_2.[38] Against this backdrop, current CO_2 prices appear too low: In the EU Emissions Trading System (EU ETS), the price was around EUR 70 per tonne of CO_2 in early March 2026.

Social costs of around EUR 1,000 per tonne of CO_2 imply that even unilateral decarbonisation by large economies would likely pay for itself.[39] If the decarbonising economy is sufficiently large, as in the case of the EU, the global effects of its emission reductions are so substantial that a positive economic net effect emerges for it over time. This holds even more if a coalition of major emitters forms, for example an alliance of the EU with other large emitters such as China or India.[40]

The expected benefits of avoided climate damage, however, exceed today's abatement costs by a wide margin only if future damage is appropriately reflected in today's decision-making with an appropriate time preference rate. In practice, future costs and benefits – particularly over long time horizons – are often considered less urgent or more uncertain. Decision-makers therefore often use higher discount rates, corresponding to a higher present bias. This leads to a lower weighting of future climate damage and reduces incentives for early action on climate change.

Conclusion: Unchecked climate change poses a significant risk to future prosperity – including Germany

Extreme weather events are already causing substantial damage – including in Germany. As global warming progresses, the frequency and intensity of such extreme weather conditions will continue to increase. Risk analyses show that even highly developed industrial nations are exposed to major damage-related risks under unchecked global climate change. Regions in China, the US and India are important trading partners of Germany. These regions are particularly exposed to damage to assets from more frequent extreme weather events and the impacts of climate change.

Besides direct physical damage, climate change also entails significant **security risks** which can manifest indirectly in the form of higher costs, greater uncertainty and lower economic momentum. The *Bundesnachrichtendienst* (BND) accordingly classifies the consequences of climate change as one of the five greatest external threats to Germany – alongside an aggressive, expansionist Russia, China's geopolitical ambitions, growing cyber threats and ongoing international terrorism.[41] According to this assessment, the consequences of climate change increase the risk of large-scale crop failures. They exacerbate conflicts over land, water and food, which can in turn trigger migration. Moreover, climate change intensifies conflicts particularly in states with low incomes and high population growth and facilitates recruitment to militant groups. This indirectly threatens the security of Germany and Europe as well. Such security tensions typically spill over into the real economy – for example via disrupted supply chains and rising risk premia.

Consistent and **ambitious international climate policy** therefore serves not only to protect human health and the stability of ecosystems but also provides an important means of safeguarding future economic prosperity. Swift action is important because CO_2 has a long atmospheric residence time and accumulates over centuries. In other words, delays in emission reductions lead to a lasting increase in greenhouse gas concentrations in the atmosphere and to ongoing warming, the consequences of which are long-term and partly irreversible.

As **further temperature increases** are **not** completely **avoidable** even with intensified mitigation measures, the risks described will continue to increase. To limit the economic and social costs, **early adaptation measures** to climate change are **indispensable** in Germany as well. These include, for example, expanding flood protection systems, modernising sewerage systems, climate-resilient adaptation in agriculture and creating additional green spaces in cities to reduce heat islands. Enterprises can prepare for the impacts of climate change by protecting their plants and buildings from flooding due to cloudbursts, shielding them from heat through appropriate shading measures, or taking out additional insurance against natural disasters. Moreover, higher inventory levels can help cushion supply chain disruptions caused by extreme weather events. All these measures involve costs and require investment. Adaptation to the consequences of climate change does not come free of charge.

Box 2: The KfW Climate Barometer

The KfW Climate Barometer is currently the only representative database on the investment behaviour of all German enterprises related to climate action. The enterprise survey is designed as an annual repeated survey and provides insights into enterprises' attitudes and activities in relation to topics of climate action and the energy transition. The present analysis is based primarily on data from the fourth wave (survey period February to June 2025). A total of around 13,300 enterprises participated.

Within the KfW Climate Barometer, five enterprise size classes are distinguished. These are defined as follows: micro-businesses have fewer than five employees. Small enterprises have five to nine employees. Medium-sized enterprises are defined as having ten to forty-nine employees. With fifty or more employees they are classified as larger SMEs – provided they have annual turnover of no more than EUR 500m. This turnover threshold applies in the same way to all smaller size classes. Large enterprises are thus defined as enterprises with annual turnover of more than EUR 500m; the number of employees is irrelevant. For the sake of clarity, this analysis refers exclusively to these terms.

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1 Cf. Copernicus Climate Change Service (2025): Global Climate Highlights 2024, retrieved on 06.03.2026

2 Cf. Foster and Rahmstorf (2026): Global Warming Has Accelerated Significantly, Geophysical Research Letters, retrieved on 09.03.2026.

3 Cf. United Nations Environment Programme (2025): Emissions Gap Report 2025: Off Target - Continued Collective inaction puts Global Temperature Goal at Risk, retrieved on 06.03.2026.

[4] Cf. Tagesspiegel Background (02.11.2022), Folgen des Klimawandels: „Es erfüllt sich, wovor wir seit Jahrzehnten gewarnt haben", Interview with Stefan Rahmstorf (PIK), issue of 02.11.2022, retrieved on 06.03.2026 (*"What we have been warning about for decades is now becoming a reality"* – in German only).

[5] LOESS trend of the area-mean value.

[6] Cf. Deutscher Wetterdienst (2025): Was wir über das Extremwetter in Deutschland wissen, retrieved on 06.03.2026 (*"What we know about extreme weather in Germany"* – in German only).

[7] Cf. Umweltbundesamt (2025): Das 1,5-Grad-Ziel nach dem Übereinkommen von Paris, retrieved on 12.06.2025 ("The 1.5°C target following the agreement in Paris" – in German only).

[8] Cf. IPCC (2023): Synthesis Report of the IPCC Sixth Assessment Report (AR6). Summary for Policymakers. In: *Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, retrieved on 06.03.2026.

[9] Cf. Global Carbon Project (2024): Briefing on key messages Global Carbon Budget 2024.

[10] Cf. IPCC (2023): Synthesis Report of the IPCC Sixth Assessment Report (AR6). Summary for Policymakers. In: *Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, retrieved on 06.03.2026.

[11] Cf. ibid.

[12] Cf. Germanwatch (2025): Climate Risk Index 2025. Who suffers most from extreme weather events? retrieved on 06.03.2026.

[13] Cf. IPCC (2023): Synthesis Report of the IPCC Sixth Assessment Report (AR6). Summary for Policymakers. In: *Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, retrieved on 06.03.2026.

[14] An event is included in the database if at least one of the following criteria is met: (1) at least ten fatalities occurred, (2) at least 100 people were affected, (3) a disaster emergency was declared, (4) an international appeal for assistance was issued.

[15] Cf. World Economic Forum, Boston Consulting Group (2024): The cost of inaction: A CEO guide to navigating climate risk, retrieved on 12.06.2025.

[16] Cf. Munich RE (2026): Climate change presses on: Devastating wildfires and intense thunderstorms exacerbate losses for insurers, retrieved on 30.01.2026.

[17] Cf. European Environment Agency (2024): Economic losses from weather- and climate-related extremes in Europe | Indicators, retrieved on 14.07.2025.

[18] Cf. ibid.

[19] Cf. Jan Trenczek et al. (2022): Übersicht vergangener Extremwetterschäden in Deutschland, retrieved on 12.06.2025. Study commissioned by the Bundesministerium für Wirtschaft und Klimaschutz (*"Overview of past extreme weather damage in Germany"* – in German only).

[20] Cf. BMWK (2023): Was uns die Folgen des Klimawandels kosten – Merkblatt #03: Schäden von Wetterextremen, retrieved on 06.03.2026 ("*What the effects of climate change are costing us – Factsheet #03: Damage from extreme weather*" – in German only).

[21] Cf. Germanwatch (2025): Climate Risk Index 2025. Who suffers most from extreme weather events? retrieved on 06.03.2026.

[22] Cf. European Environment Agency (EEA, 2024): Economic losses from weather- and climate-related extremes in Europe, https://www.eea.europa.eu/en/analysis/indicators/economic-losses-from-climate-related?activeAccordion=ecdb3bcf-bbe9-4978-b5cf-0b136399d9f8, retrieved on 14.07.2025.

[23] Cf. Jan Trenczek et al. (2022): Übersicht vergangener Extremwetterschäden in Deutschland, retrieved on 12.06.2025. Studie im Auftrag des Bundesministeriums für Wirtschaft und Klimaschutz (*"Overview of past extreme weather damage in Germany"* – in German only).

[24] Cf. Robert Koch Institute (2025): Hitzebedingte Mortalität in Deutschland 2023 und 2024, Epidemiologisches Bulletin 19/2025, retrieved on 06.03.2026 (*"Heat-related mortality in Germany 2023 and 2024", "Epidemiological Bulletin 19/2025",* in German only).

[25] Cf. Umweltbundesamt (2025): Heat-related deaths: seniors are at a higher risk. Older people with pre-existing conditions particularly affected. Press release of 03.06.2025.

[26] Cf. World Meteorological Organization (2021): WMO atlas of mortality and economic losses from weather, climate and water extremes (1970-2019), retrieved on 06.03.2026.

[27] Cf. Germanwatch (2025): Climate Risk Index 2025. Who suffers most from extreme weather events? retrieved on 06.03.2026.

[28] Cf. XDI (2024): 2024 XDI Gross Domestic Climate Risk Report, retrieved on 06.03.2026.

[29] The Intergovernmental Panel on Climate Change (IPCC) climate scenario "Representative Concentration Pathway (RCP) 8.5" was used. This scenario is frequently employed by banks, supervisory authorities and other bodies to assess physical climate risks.

[30] Based on an extensive dataset on buildings and infrastructure in the respective regions, supplemented by local weather and environmental data as well as historical damage costs, annual damage ratios are calculated for each region – defined as potential damage costs relative to the total value of assets. The ranking of regional damage risk is essentially based on the projected increase in these annual damage ratios up to 2050.

[31] Cf. UNCCD (2025): Drought hotspots around the world 2023-2025, retrieved on 06.03.2026.

[32] Cf. Automobilwoche (2023): VW baut wegen Slowenien-Hochwasser 150.000 Autos weniger, retrieved on 25.07.2025 (*"VW building 150,000 fewer cars due to floods in Slovenia"* – in German only).

[33] Cf. inter alia, Fahr, S. et al. (2024): The globalization of climate change: amplification of climate-related physical risks through input-output linkages, ECB Working Paper Series No 2942, European Central Bank; European Scientific Advisory Board on Climate Change (2025): Scientific advice for amending the European Climate Law - Setting climate goals to strengthen EU strategic priorities, retrieved on 06.03.2026.

[34] Cf. Die Zeit (2025): Hitzewelle in Westeuropa: Niedrige Pegelstände am Rhein beeinflussen Frachtverkehr, retrieved on 06.02.2026 ("*Heat wave in Western Europe: Low water levels on the Rhine are affecting freight traffic*" – in German only).

[35] As early as 2022, 15% of enterprises in Germany stated that they were currently affected by the adverse consequences of climate change. 26% stated that they were prospectively affected. Because the phrasing of the question and the response categories available then and now differ, the results are not directly comparable. However, what is evident then as now is that larger enterprises are more likely to state that they are affected by climate change. The same tends to hold for those with high shares of energy costs. Cf. Brüggemann, A. and E. Grewenig (2023): Globale Erderwärmung schreitet voran: 41% der deutschen Unternehmen aktuell oder perspektivisch vom Klimawandel betroffen, Fokus Volkswirtschaft Nr. 430, KfW Research. Back then, the specific question was: "Do you see your enterprise as being affected by the adverse consequences of climate change, for example through an increase in extreme weather events such as heatwaves, flooding or storms?" The three response categories available were "Yes, already affected by the adverse consequences of climate change today", "Yes, prospectively affected" and "No, not affected".

[36] Previous studies on the macroeconomic consequences of climate change examined increases in average temperature in different countries. In comparison, Bilal and Känzig (2026) explicitly take into account the increase in global average temperature because it correlates more strongly with extreme climate events such as heat, drought, storms and heavy rainfall. Cf. Bilal and Känzig (2026): The Macroeconomic Impact of Climate Change: Global Versus Local Temperature, forthcoming in the *Quarterly Journal of Economics*. Freely accessible as Working Paper, retrieved on 25.02.2026.

[37] The conversion is based on the exchange rate as at 25 February 2026, when EUR 1 corresponded to approximately USD 1.18.

[38] The uncertainty around the estimates, however, is not negligible. Bilal and Känzig (2026) cannot fully rule out that climate damage could be substantially lower – but it is equally possible that it will be even higher. This could be the case because the study does not account for a potential positive pull effect of decarbonisation that may arise from actors who are early investors in climate-friendly technologies. Early decarbonising actors could also subsequently benefit from technological leadership. Cf. Bilal and Känzig (2026): The Macroeconomic Impact of Climate Change: Global Versus Local Temperature, forthcoming in the *Quarterly Journal of Economics*. Freely accessible as Working Paper, retrieved on 25.02.2026.

[39] Cf. Bilal and Känzig (2025): Does Unilateral Decarbonization Pay for Itself? *AEA Papers and Proceedings*. Freely accessible as a Working Paper, retrieved on 25.02.2026.

[40] Cf. Edenhofer et al. (2025): Stable Investments in Times of Instability: Bridging Interests to Revive International Climate Diplomacy, retrieved on 12.03.2026.

[41] Cf. BND et al. (2025): Nationale Interdisziplinäre Klimarisiko-Einschätzung, retrieved on 06.03.2026 (*"National interdisciplinary climate risk assessment"* – in German only).