Grantham Research Institute on Climate Change and the Environment

LSE Global School of Sustainability

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Policy brief
Economic opportunities from investing in climate resilience in the UK

Findings from Part A of PROSPER 2026

Summary

- **The United Kingdom is experiencing significant economic impacts from climate change, and these will increase in future decades.** Without comprehensive and well-funded adaptation strategies, risks will grow, including from agriculture losses, flooding, and impacts on health and productivity.
- **This brief summarises findings from Part A of the PROSPER (Physical-risk & Resilience Outcomes for Spending, Planning & Economic Returns) research project.** This first part of the project is designed to inform fiscal decision-makers on potential targets for adaptation funding.
- **Projected annual economic damage under a High Warming climate scenario (relative to a baseline of pre-industrial climate conditions) could increase to 4% of the UK's gross domestic product (GDP) by 2050 and 6% by 2075,** expressed in GDP-equivalent welfare terms.
- **This projection includes the potential for climate-change-driven global economic disruption,** which represents the largest proportion of projected economic damage; however, domestic risks to the UK economy linked to climate change are also prominent.
- **By the 2050s, extreme events linked to climate change could result in large-scale disruptions across the UK economy.** Estimates suggest there is a 1-in-200-year risk of one or more of the following in a single year: agricultural losses exceeding £10 billion, flood damages exceeding £60 billion, labour productivity losses exceeding £70 billion and heat-related excess mortality exceeding 21,000 deaths.
- **Projected domestic risks could be reduced by nearly 30% with strategic investments in climate-adaptation measures such as flood defences and more climate-resilient infrastructure** starting at the levels outlined in the UK's third National Adaptation Programme (NAP3) and related government strategies, and increasing proportionately over time in relation to rising risk.
- **While adaptation measures bring major benefits, strengthened global efforts to mitigate climate change remain critical.** Projections suggest that avoiding a High Warming climate scenario will halve domestic economic risks in the UK, highlighting the importance of pursuing strong international action on climate change.

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Policy briefs provide analysis on topical issues, presenting specific recommendations to inform ongoing policy debates. Drawing on the Grantham Research Institute's expertise, they summarise either our research findings or the state of knowledge about a particular issue.

This policy brief has been written by **James Rising**, **Paul Watkiss**, **Nicola Ranger** and **Yoselin Oropeza Abregú**.

Background

The UK is already feeling the impacts of climate change. Heat waves are expected to become more frequent and severe as the climate warms, with robust evidence for the negative consequences on human health (Ige-Elegbede et al., 2024). Comprehensive, strategic and well-funded adaptation is needed to address the challenges of the coming decades and to achieve a well-adapted UK (Climate Change Committee [CCC], 2026a).

The PROSPER project aims to provide actionable insights and data that can help inform fiscal decision-makers on the physical risks of climate change and the potential effectiveness and economic benefits of adaptation. The project's work is built around four core practices:

- **Synthesising the available evidence:** PROSPER engages with experts in climate, infrastructure and the economy, and brings together multiple lines of evidence on risks and adaptation from the CCC's third and fourth Independent Assessments of UK Climate Risk (CCRA3-IA and CCRA4-IA) as well as other sources, into a consistent framework.
- **Policy-relevant scenarios and storylines:** Workshops and the PROSPER advisory group bring together multiple government departments to construct common scenarios and specific storylines to explore the questions facing decision-makers.
- **Fiscal, financial and economic outcomes:** Our findings quantify projected monetary and welfare losses related to climate change, to compare those with the costs of investing in adaptation.
- **Interactive decision-support tools:** PROSPER is building new tools and datasets designed to help decision-makers to navigate the risks associated with climate change and the many options available to proactively address these risks.

This policy brief presents initial results for the UK from Part A of PROSPER, capturing economic risks and adaptation opportunities in **agriculture, flood and coastal management, health, and labour productivity**. We also estimate UK-wide risks from **trade spillovers, catastrophic economic risks and other expert-assessed channels**. A forthcoming companion policy brief (Oropeza Abregú et al., 2026) provides fiscal and monetary outcomes across new UK and international storylines.

Reading this policy brief

We describe the climate scenarios used for PROSPER in Box 1 below. The brief follows a template which is then repeated for each of the main risk channels, including a map of projected risks across the UK in 2050 and a summary table of impacts. The descriptions for each risk channel reflect the current state of knowledge on economic impacts for the UK and the benefits of adaptation. Damages are reported as the expected annual damages for two climate scenarios, 'Medium Warming' and 'High Warming'. For the 2030s and 2050s, we also describe the damages associated with extreme value or 'tail' events: 1-in-200-year events in each decade (see Box 2). The baseline risk estimates do not include adaptation, but we also show the benefits of adaptation investment at the level laid out in proposed and announced adaptation policies. This adaptation funding is applied strategically across the limited set of adaptation solutions studied here.

"This project aims to provide actionable insights and data that can help inform fiscal decision-makers on the physical risks of climate change and the potential effectiveness and economic benefits of adaptation."

Box 1. Climate scenarios

PROSPER explores risks across two climate scenarios: a 'Medium Warming climate' scenario and a 'High Warming climate' scenario.

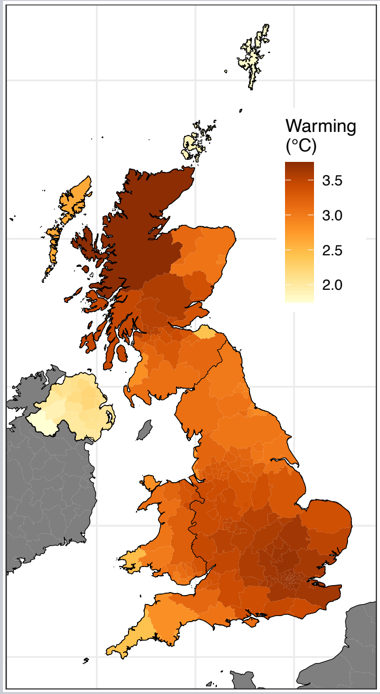
Under the **Medium Warming scenario**, greenhouse gases peak in the next 20 years, followed by a gradual decline. Temperatures continue to rise through the century, and with the added influence of climate feedbacks, such as sea-ice melt and forest die-back (Dietz et al., 2021), global warming reaches 2.4°C in the 2050s and 2.7 °C in 2075 compared with pre-industrial levels. This scenario is consistent with current policies and a future where global cooperation to mitigate climate change continues to encounter challenges, even as some countries achieve their climate goals.

Under the **High Warming scenario**, global warming reaches 2.6°C above pre-industrial levels in the 2050s and 3.3°C in 2075. This is slightly above the CCRA4-IA's High Warming scenario due to the added effects of global tipping points.

Temperature increases in the UK are projected to be more rapid than the global average, reaching an increase of 2.5°C in the 2050s under the Medium Warming scenario and 2.9°C in the 2050s under the High Warming scenario. Based on historical variability, individual years in the 2050s could reach 4.1°C above pre-industrial averages. Local sea-levels would increase by 100–200mm by 2050 and 250– 400mm by 2075 compared with the 1985–2005 average.

UK-wide and regional temperatures relative to pre-industrial levels are calculated using observed changes since 1940–1960, plus the UK-wide warming from pre-industrial levels to 1940–1960 from the MetOffice. The figures in Table 1 are population-weighted, which takes account of the temperature changes to which the population is exposed. This differs from the usual area-weighted measure of warming. For comparison, the area-weighted warming of the UK in 2025 was 2.1°C compared with the pre-industrial baseline.

Figure 1. Expected warming under a High Warming scenario in 2050



Note: *These results are mapped at the second administrative level of disaggregation (source: Natural Earth).*

Table 1. Projected UK-wide warming under Medium, High and tail event scenarios, 2025-2075 (population-weighted)

Year	Medium (3°C)	High (4°C)	Tail Event
2025	2.1°C	2.1°C	
2030s	2.5°C	2.5°C	3.7°C
2050s	3°C	3.4°C	4.6°C
2075	3.5°C	4.2°C	

Box 2. What is a tail event?

We define a tail event as a 1-in-200-year event, such as a 1-in-200-year flood (also referred to as a 200-year return period). It reflects the size of an event (e.g. in terms of economic damages) that is expected to be exceeded only with a 0.5% chance in a given year.

In PROSPER, we include both traditional variability and uncertainty in the damage relationships when estimating the size of the 1-in-200-year event: that is, this represents both an extreme in the outcome and an extreme in how vulnerable the economy is to a hazard.

Note that we study how the severity of the 1-in-200 event increases in future decades due to climate change, rather than reporting how a historical 1-in-200 year event becomes more likely.

"Temperature increases in the UK are projected to be more rapid than the global average."

Projected impacts

Agricultural yield losses

Agriculture could experience reductions in productivity in many regions, though there could be benefits in some areas. Higher temperatures reduce yields for most crops, with total calorie production expected to decline by 4.4% per degree Celsius of warming (Hultgren et al., 2025). If the Atlantic Meridional Overturning Circulation (AMOC) weakens significantly, it could result in widespread dry conditions in the UK, leaving much currently cultivated land unsuitable for farming (Ritchie et al., 2020).

In PROSPER, we conducted a meta-analysis using the WOFOST, EPIC and Ritchie et al. (2020) models to create projections. Under the High Warming scenario, weakening of the AMOC results in large losses of agricultural production across the East of England, partially offset by gains in some parts of Wales and the South-West. By the 2050s, the 1-in-200-year agricultural loss event exceeds damages worth £10 billion per year.

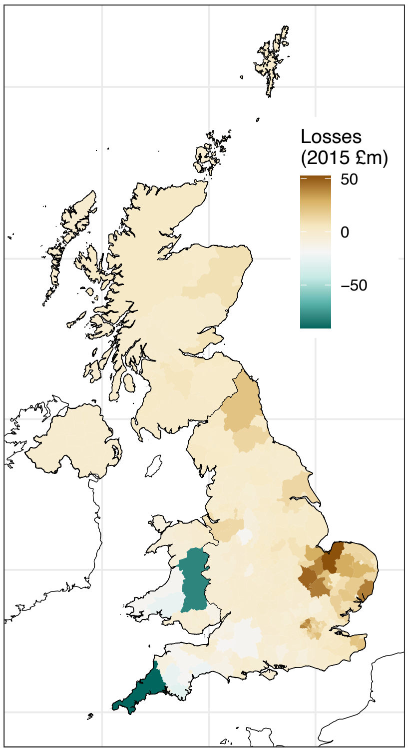
We have studied the potential of improving soil management as a form of climate adaptation for wheat, barley and potatoes, examining a set of climate-smart agriculture options (data from Moran et al., 2013). The largest benefits are achieved through addressing soil compaction. Benefits are also linked to cover crops, spring cultivation and shallow ploughing. At the low investment level of £110 million per year (in line with current commitments; see CCC, 2026b), enough climate risk can be reduced in the 2030s for net benefits to emerge. Importantly, however, this adaptation benefit is based on general climate-change-related risks to agriculture. We find that the greatest risk derives from AMOC-related drying.

"If the Atlantic Meridional Overturning Circulation weakens significantly, it could result in widespread dry conditions in the UK, leaving much currently cultivated land unsuitable for farming."

Table 2. Projected UK-wide annual losses (2015 £m) in relation to agriculture under Medium, High and tail event scenarios, 2025-2075

Year	Medium (3°C)	High (4°C)	Tail Event
Baseline risks			
2025	-100	-70	
2030s	100	300	7,000
2050s	600	1,000	10,000
2075	1,000	2,000	
Modelled adaptation investment			
2030s	-330	-300	2,500
2050s	-83	160	5,500
2075	340	1,100	

Figure 2. Expected annual losses in relation to agriculture under a High Warming scenario in 2050



Note: *These results are mapped at the third administrative level of disaggregation (source: GADM).*

All–source flooding

The largest domestic risks to the UK from climate change are linked to combined river, surface water and coastal flooding, exacerbated by sea-level rise and storm surges (CCC, 2021). Around 6.3 million properties – homes and businesses – in England are in areas at risk of flooding. With climate change, this could increase to around 8 million properties by 2050. This means that one in four properties in England will be in areas at risk of flooding from rivers, the sea or surface water by that date (Environment Agency, 2025). Similar increases are projected for Scotland, Wales and Northern Ireland.

Our meta-analysis of flood impacts, which relies on Sayers et al. (2021), and the LISFLOOD, GLOFRIS and OS-DaMage models, finds flooding risks are widely distributed across the UK, with pockets of particularly high expected losses in England and Scotland. Expected annual damages linked to flooding (including direct and indirect damages) increase from £3 billion per year today to £5 billion by 2050 and £7 billion by 2075, under a High Warming scenario. However, economic damages linked to extreme events are 10 times this level with tail events reaching £60 billion as soon as the 2030s.

Adaptation can reduce these losses significantly. Spending £1.5 to £2 billion per year (consistent with the CCC's *A Well-Adapted UK*) is expected to reduce both annual and extreme risks by 40% (estimated range of 25–55%).

We also study coastal inundation and storm surge risks associated with sea-level rise, a subset of all-source flooding. Coastal inundation from sea-level rise results in population displacement, capital loss and wetland destruction, while the combination of storms and higher sea-levels results in large damages under extreme tail events. We estimate that an extreme event in the 2030s will cause £37 billion in annual damages. This could reach £67 billion in the 2050s.

Table 3. Projected UK-wide all-source flooding losses (2015 £m) under Medium, High and tail event scenarios, 2025-2075

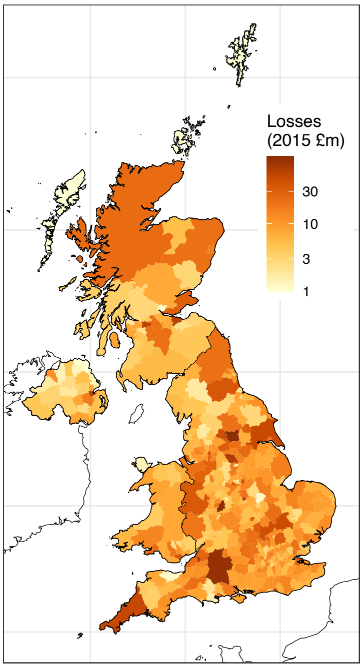
Year	Medium (3°C)	High (4°C)	Tail Event
Baseline risks			
2025	2,700	2,900	
2030s	3,100	3,600	61,000
2050s	3,900	5,100	64,000
2075	4,600	7,200	
Modelled adaptation investment			
2030s	1,200	1,400	24,000
2050s	1,600	2,000	26,000
2075	1,800	2,800	

Table 4. Projected UK-wide coastal flooding losses (2015 £m) under Medium, High and tail event scenarios, 2025-2075

Year	Medium (3°C)	High (4°C)	Tail Event
Baseline risks			
2025	6,700	6,700	
2030s	8,400	8,600	37,000
2050s	13,000	14,000	67,000
2075	20,000	24,000	
Modelled adaptation investment			
2030s	2,600	2,700	12,000
2050s	3,700	4,100	18,000
2075	5,800	7,200	

"We estimate that an extreme flooding event in the 2030s will cause £37 billion in annual damages. This could reach £67 billion in the 2050s."

Figure 3. Expected annual losses in relation to all-source flooding under a High Warming scenario in 2050



Note: *These results are mapped at the third administrative level of disaggregation (source: GADM).*

Heat-related mortality

As summer heat waves have grown more intense in recent years, heat-related mortality in the UK has climbed. The UK Health Security Agency reports between approximately 1,500 and 3,000 heat-associated deaths each year, with 2,985 such fatalities during 2022 when temperatures exceeded 40°C in July (Health Security Agency, 2022). At the same time, warmer temperatures across the UK are expected to bring some benefits, with some cooler regions experiencing reduced cold-related mortality due to warmer winters (Carleton et al., 2022).

Our analysis in this area is based on Bressler (2021) and the PESETA IV study and finds a pattern consistent with both. In the north of Scotland and parts of Northern Ireland, the reduction in deaths due to warmer winters is expected to exceed any increase in summer deaths. Across England and Wales, however, warming summers result in excess mortality, with the greatest losses in southern England.

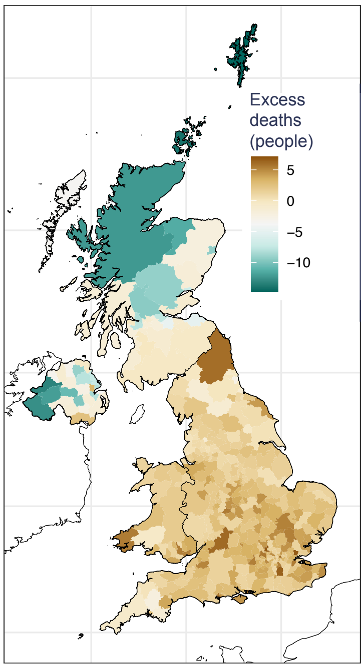
Our analysis projects only the net effect of these changes, but future work will distinguish between the distinct risks of heat and cold-related mortality, the different adaptation options for them, and the heightened risk from cold snaps observed in recent years (Health Security Agency, 2026). We project that net death rates today are lower across the UK than they would have been under pre-industrial temperatures. By the 2050s, however, summer excess deaths in the average year will exceed winter reductions in mortality. Extreme events would result in high mortality, with 1-in-200-year excess mortality exceeding 10,000 people in the 2030s and 20,000 people in the 2050s. These may be significant underestimates, since the Health Security Agency (2023) projects 10,000 expected annual excess deaths by the 2050s. Using £2 million as the 'Value of a Prevented Fatality' (see Health and Safety Executive, 2020), if the increased mortality risk produced 10,000 excess deaths, this would represent £20 billion in welfare losses. However, a mortality valuation that relied on the value of a life year (VOLY) would be expected to reduce this estimate significantly, since older populations are most at risk.

"Across England and Wales, warming summers result in excess mortality, with the greatest losses in southern England."

Table 5. Projected UK-wide annual excess deaths linked to heat-related mortality under Medium, High and tail event scenarios, 2025-2075

Year	Medium (3°C)	High (4°C)	Tail Event
Baseline risks			
2025	-550	-590	
2030s	290	-140	11,000
2050s	220	830	21,000
2075	720	2,000	
Modelled adaptation investment			
2030s	-260	-130	10,000
2050s	200	740	19,000
2075	650	1,800	

Figure 4. Expected annual excess deaths linked to heat-related mortality under a High Warming scenario in 2050



Note: *These results are mapped at the third administrative level of disaggregation (source: GADM).*

We assess the potential of blinds and air conditioning as adaptation measures, finding that each reduces mortality risks. However, the scale of investment needed is considerable. The Assessing Climate Change in Europe (ACCREU) project estimated around £1.3 billion per year in private investment to provide these measures. However, we find that this only reduces mortality risk by 10%. The CCC proposes adaptation packages ranging from £18 billion to £2.2 trillion (CCC, 2026c).

Labour productivity

The productive capacity of both indoor and outdoor workers can be impacted by rising temperatures (Rode et al., 2022). Outdoor occupations in construction, forestry and agriculture are particularly exposed. As summer heatwaves become more prevalent and extreme, workers will be affected and total productivity will decline. In severe cases, workers can experience health impacts. Indoor workers can also be affected by heat, although the impacts can be significantly reduced with effective air conditioning and other cooling methods.

Based on work performed under PESETA III and COACCH, we find that the largest losses in net productivity occur in southern England, where temperatures are highest. However, large decreases in labour productivity are found in any counties where there are large cities. The scale of these impacts is similar for both the Medium- and High Warming climate scenarios, because of high estimated heat-related productivity losses today, resulting in annual damages of around £20 billion per year by the 2030s. Tail events can result in more than £60 billion in losses.

"We find the largest losses in productivity occur in southern England. However, large decreases in labour productivity are found in any counties where there are large cities."

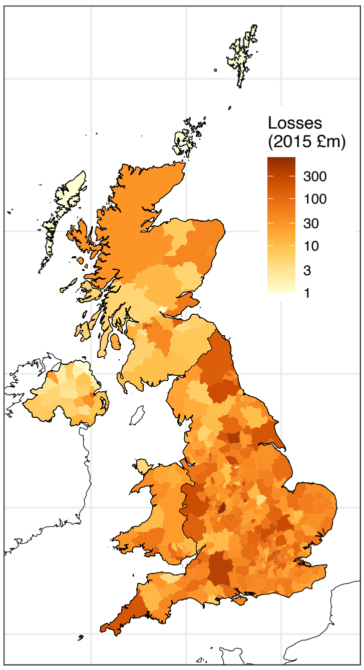
Table 6. Projected UK-wide labour productivity losses (2015 £m) under Medium, High and tail event scenarios, 2025-2075

Year	Medium (3°C)	High (4°C)	Tail Event
Baseline risks			
2025	17,000	17,000	
2030s	19,000	19,000	64,000
2050s	21,000	22,000	73,000
2075	21,000	23,000	
Modelled adaptation investment			
2030s	17,000	17,000	58,000
2050s	19,000	20,000	66,000
2075	19,000	21,000	

Table 7. Projected UK-wide labour productivity losses in hours per person under Medium, High and tail event scenarios, 2025-2075

Year	Medium (3°C)	High (4°C)	Tail Event
Baseline risks			
2025	-0.33	-0.33	
2030s	-0.3	-0.29	0.51
2050s	-0.24	-0.22	0.57
2075	-0.22	-0.15	
Modelled adaptation investment			
2030s	-0.26	-0.26	0.44
2050s	-0.21	-0.19	0.5
2075	-0.19	-0.13	

Figure 5. Expected annual losses in relation to labour productivity under a High Warming scenario in 2050



Note: *These results are mapped at the third administrative level of disaggregation (source: GADM).*

We also quantify these labour productivity impacts in terms of hours per person per year, as an aggregate of increases and decreases in productivity over the year. These models suggest that the UK currently has slightly higher net productivity than under preindustrial temperatures, due to more productive winters. These gains are offset by losses during summers, with the total benefit cut in half by 2075 (from 0.3 hours per person per year gained in 2030 to 0.15 hours per person per year gained in 2075). While these results are based on different analyses than the labour productivity results, they may suggest that productivity falls, even as labour supply increases.

We consider a range of solutions to help workers to adapt to higher temperatures including heat alerts, air conditioning, blinds, improved ventilation and behavioural change, drawing on Robinson et al. (2025). These adaptation measures rapidly pay for themselves, with estimated benefits around 10 times the costs. In this projection, we applied £100 million per year in public adaptation support, but this would likely be a significant underinvestment given the scale of potential benefits linked to adaptation solutions.

Trade spillovers

Compared with many countries across the globe, the UK benefits from a more temperate climate currently and has greater capacity to adapt to climate change. However, the UK depends on trade with hotter and poorer countries. Impacts elsewhere in the world related to climate change, cascading back along supply chains and other pathways, are projected to reduce the UK's annual GDP by 0.2–0.4% (Rising et al., 2026). While potential adaptation mechanisms exist for these risks, such as reserve stocks, diversification, insurance and hedged contracts, we do not model these under PROSPER.

"By the end of the 2050s, under the High Warming scenario, there is a 1-in-20 chance that climate change will have triggered a partial collapse in the global economy."

Table 8. Projected UK-wide losses (% GDP) under Medium, High and tail event scenarios due to trade spillovers, 2025-2075

Year	Medium (3°C)	High (4°C)	Tail Event
Baseline risks			
2025	0.21%	0.19%	
2030s	0.28%	0.3%	1.1%
2050s	0.29%	0.37%	1.4%
2075	0.32%	0.36%	

Catastrophic economic risks

Catastrophic economic risks represent the potential for disruption to the global economy through economic tipping points. Evidence suggests that the global economic system faces greater risks than any region considered in isolation (Bilal and Känzig, 2024; Howard and Sterner, 2025). While these risks are negligible today, they could grow rapidly over the century. By the end of the 2050s, under the High Warming scenario, there is a 1-in-20 chance that climate change will have triggered a partial collapse in the global economy (equivalent to losing 25% of global GDP) at some point in the intervening years.

Table 9. Projected UK-wide losses (% GDP) under Medium, High and tail event scenarios due to catastrophic economic risks, 2025-2075

Year	Medium (3°C)	High (4°C)	Tail Event
Baseline risks			
2025	0%	0%	
2030s	0.43%	0.38%	0%
2050s	1%	1.3%	22%
2075	1.6%	2.5%	

Expert-assessed risks

The current coverage of risks in PROSPER is incomplete and misses many documented risks. For example, the CCRA4-IA identifies 43 risks and opportunities linked to climate change, including risks such as water and drought-related effects, other health impacts, losses to biodiversity and ecosystem services, and risks to infrastructure, including energy systems. We use expert elicitation estimates, quantified and translated into an 'expert-assessed risks damage function', to project these risks. Damages are equivalent to more than 1% of annual GDP by the 2030s, with extreme tail events reducing welfare by the equivalent of more than 5% of GDP.

"Our estimates show that adaptation investment provides large and quantifiable macroeconomic benefits to the UK."

Table 10. Projected UK-wide losses (% GDP) under Medium, High and and tail event scenarios due to expert-assessed risks, 2025-2075

Year	Medium (3°C)	High (4°C)	Tail Event
Baseline risks			
2025	0.9%	0.9%	
2030s	1.1%	1.1%	5.5%
2050s	1.2%	1.3%	6.3%
2075	1.3%	1.5%	

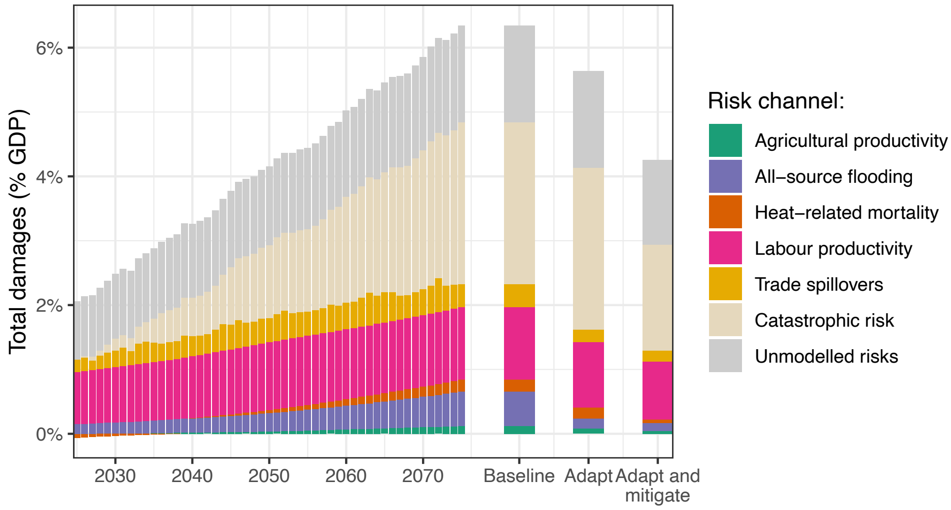
Policy implications

We estimate that, when combined, UK-wide damages related to climate change will grow from 2% in GDP-equivalent welfare terms today to 3.7% in 2050 and 4.8% in 2075 under the Medium Warming scenario. Under the High Warming scenario, we estimate that combined UK-wide damages related to climate change will grow to more than 4.2% in 2050 and 6.3% in 2075. This is similar to estimates in the CCC's *A Well-Adapted UK* (2026a). However, our estimates are somewhat lower than those in Rising et al. (2026), which finds 5.3% GDP-equivalent losses in 2050, primarily because that paper includes risks to the energy sector, livestock and fisheries, and uses an alternative representation of catastrophic economic risks.

Our estimates show that adaptation investment provides large and quantifiable macroeconomic benefits to the UK. Across the domestic risks modelled above, the levels of adaptation investment described in each category reduce damages by around 30%. However, the potential benefits of increased adaptation investment are even greater. In an illustrative set of scenarios – covering only a limited subset of risks and adaptation options

– the largest net benefits occured under a 50% increase in annual flood protection, a tripling of agricultural adaptation and substantial expansion of measures supporting labour productivity.

Figure 6. Total expected annual damages by risk channel in the UK (% GDP) (2025-2075 and comparing 'baseline', 'adapt', and 'adapt and mitigate' scenarios)



Left: Damages by year under the High Warming scenario, excluding tail events and additional adaptation.
Right: Projected adaptation and Medium Warming mitigation scenarios in 2075. The 'baseline' bar corresponds to the last year of the time series; the 'adapt' bar corresponds to the level of adaptation investment specified in this brief; and the 'adapt and mitigate' bar also includes shifting from the High Warming to Medium Warming climate scenario.

"Adaptation and mitigation are both needed to reduce risks from climate change in the UK."

Figure 6 shows that adaptation and mitigation are both needed to reduce risks from climate change in the UK (see 'adapt and mitigate' bar on the right). Mitigation that shifts the climate from a High Warming scenario to the Medium Warming scenario further reduces these modelled domestic risks by 20%. Mitigation also reduces expert-assessed risks and catastrophic economic risks originating from other countries by about 30%. Given the low costs and high benefits of stronger mitigation action, to achieve warming at levels below 2°C in 2100, a clear economic argument exists for strong mitigation action.

Looking ahead

The results described in this policy brief and a forthcoming companion brief (Oropeza Abregú et al., 2026) estimate a limited group of risks and adaptation solutions linked to climate change in the UK. Future work as part of the PROSPER project aims to expand these estimates through collaborations with experts across the UK, particularly improving the representation of flooding, expanding adaptation strategies, and capturing water, energy, ecosystem and infrastructure risks. We will also be applying the methodology to other countries. An extensive evidence base on climate-change related risks and adaptation is available to inform fiscal and economic decisions. A key priority for the PROSPER project is to ensure that this evidence is translated into actionable insights.

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