



Policy brief

What will climate change cost the UK?

Summary

- Climate change poses numerous threats to the UK, causing damages to human welfare and the economy through various pathways – or impact channels – which include agriculture, flooding, ecosystems and health.
- Under current policies, the total cost of climate change damages to the UK are projected to increase from 1.1% of GDP at present to 3.3% by 2050 and 7.4% by 2100.
- Strong global mitigation action could reduce the impacts of climate change damages to the UK from 7.4% to 2.4% of GDP by 2100.
- The greatest single risk of climate change damages to the UK economy is from catastrophic disruption to the global economic system (worth 4.1% of GDP).
- Foreign trade will cause a 1.1% fall in UK GDP as other countries experience losses from climate change.
- Agriculture is one of the UK sectors expected to be most impacted by climate change. The reduction of arable land as regions become drier will halve its total contribution to UK GDP by 2100.
- There are strong economic reasons for the drive to net-zero: the benefits from mitigation exceed the costs in the second half of the century
- Co-benefits include significant health improvements, due largely to cleaner air, and stimulation of the economy through investment.
- Combined, the net-zero transition (estimated to cost a maximum of 2% of UK GDP) is expected to have a net benefit of around 4% of GDP.
- In the future, natural disasters, tourism, forestry, transport, conflict and displacement are likely to emerge as significant channels of climate risk.
- Proactive investment in adaptation measures such as coastal protection can potentially reduce the risk of climate-related damages.



This policy brief was written by James Rising, Simon Dietz, Marion Dumas, Ritika Khurana, Jarmo Kikstra, Timothy Lenton, Manuel Linsenmeier, Chris Smith, Charlotte Taylor and Bob Ward.

It summarises a longer report, available at: www.lse.ac.uk/granthaminstitute/publication/what-will-climate-change-cost-the-uk

“As the worst climate impacts in the latter part of the century depend on decisions made today, understanding their risks is crucial.”

The risks of climate change for the UK

Climate change is already having noticeable and serious impacts around the world. It threatens the food system, biodiversity, infrastructure and human health and disrupts crucial sectors of the economy.

The United Kingdom is relatively insulated from some of the most extreme effects of climate change, but it still faces significant socioeconomic consequences. Several areas of risk have been highlighted for the UK, such as sea level rise, degradation of habitats for plants and wildlife, and declines in the productivity of livestock and fisheries (IPCC, 2022). The worst of these impacts emerge under unmitigated climate change, but some risks are considerable even at low levels of warming.

Some impacts of climate change, such as reductions in agricultural productivity, will have a direct monetary impact on the finances of people and companies. Others, such as impacts on ecosystems and biodiversity, cannot be expressed as a direct monetary equivalent. In this brief, impacts are reported in common units as a percentage of gross domestic product (GDP), but they should also be understood as losses to societal welfare.

Our analysis estimates the total combined climate change risk for the United Kingdom across key impact channels – specific pathways through which climate change affects welfare. These range from flooding and drought to agriculture, health and trade effects.

These impacts are translated into equivalent losses to the UK’s GDP and are calculated for two different scenarios: under current policies and with high mitigation climate policies (see Box 1), to give consistent and comparable measures. We also show how the severity of impacts and their costs to UK GDP evolve from the present day to 2050 and 2100 across regions of the UK. Identifying these risks allows for improved adaptation planning for the areas that need it most.

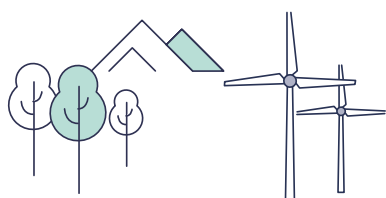
Box 1. Current policies and high mitigation scenarios

Current policies (SSP3-7.0)



The **‘current policies’** scenario is characterised by a lack of climate policy ambition and global coordination. CO₂ emissions increase, doubling by 2100 (with concentrations reaching 870 parts per million [ppm] in 2100 vs. 417 ppm today). Temperatures continue to rise so that the world warms by 3.2°C and the UK by 2.9°C by 2100, compared with 1995–2005. In this scenario there is a failure to invest strongly in green technologies and R&D.

High mitigation (SSP1-2.6)



The **‘high mitigation’** scenario is characterised by sustainable action through strong investments in green technologies. Global emissions fall throughout the century and become net-negative after 2075 through carbon dioxide removal. CO₂ concentrations increase to a peak of 470 ppm before falling. In this scenario, the world warms by 1.3°C and the UK by 0.8°C by 2100, compared with 1995–2005.



Flooding in Peebles, Scotland, following Storm Frank, December 2015.
Photo: Jim Barton, www.geograph.org.uk.

“Climate risks involve an abundance of impact channels that are difficult to quantify, but are potentially decisive.”

Impact channels

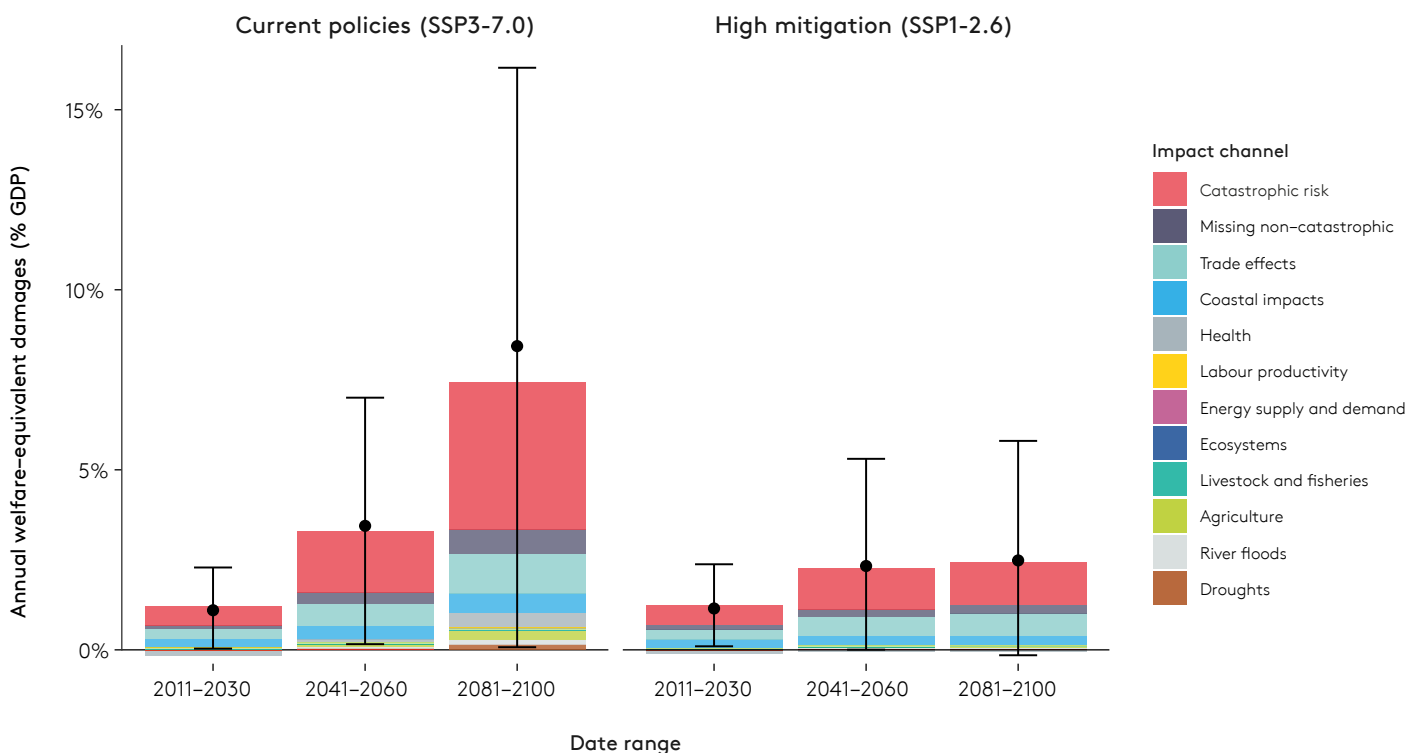
Here we provide a brief overview of nine key channels of climate impact and their estimated costs to the UK:

- **Droughts and flooding:** Drought risk increases rapidly after 2050 under current policies and there is a 1-in-20 chance that damages will be more than twice the expected level. Flood risk tends to occur in the same regions as drought risk and projected damages are similar in magnitude. *Total costs under current policies are 0.21% of GDP vs. 0.05% of GDP under high mitigation.*
- **Agriculture:** Crop production contributed £9 billion to the UK economy in 2020 (Defra, 2020), or 34% of agriculture’s total contribution to the economy. As regions become drier, driven by the weakening of Atlantic warming currents, UK agriculture (which currently accounts for 0.6% of GDP) is threatened. *Total costs under current policies are 0.28% of GDP under current policies vs. 0.02% under high mitigation.*
- **Livestock and fisheries:** Livestock production contributed £15 billion to the UK economy in 2020 (Defra, 2020), representing 56% of the total agriculture sector. Higher temperatures can impair the growth, milk production and reproductive efficiency of farm animals and enables the distribution of diseases. Algal blooms, a cause of fish fatalities, already cause £224 million of damage per year and this may double by 2100 under current policies. *Total costs under current policies are 0.02% of GDP by 2100 vs. 0.01% under high mitigation.*
- **Ecosystems:** The losses from global biodiversity decline outweigh the benefits of expected forest expansion in the UK under current policies. By 2100, 54% of habitats and species are impacted under current policies, with losses of 0.11% of GDP, while forest growth provides a benefit of 0.06%. *The combined cost is 0.03% of GDP under high mitigation.*

“Of the nine featured impact channels, international trade carries the greatest risk of causing economic damage to the UK.”

- **Energy supply and demand:** The energy system will see pervasive changes as renewable energy expands. Total energy demand is expected to decrease with warmer temperatures in the UK, reducing costs. However, the increase in energy production costs at the end of the century result in a *net loss of 0.03% to the UK's GDP in 2100*.
- **Labour productivity:** Outdoor labour productivity declines in higher temperatures due to increased heat stress. While the effect globally increases rapidly over the century, the impact to the UK remains small: *0.03% of GDP under current policies vs. 0.01% under high mitigation*.
- **Health:** The impacts of climate change on death and illness rates are among the most economically significant globally. In the UK, benefits from less extreme winters in the North will be overshadowed by heat impacts across the country. The death rate increases to 7.1 deaths per 100,000 people by 2100 under current policies but falls to 0.9 in 100,000 under high mitigation; *the second scenario can avoid costs equivalent to 0.45% of GDP*.
- **Coastal impacts:** Sea level rise could affect 5.4 million people in the UK, with expected damages of £68 billion by 2100 under current policies, compared with £30 billion under high mitigation. *The costs equate to 0.56% of GDP under current policies vs. 0.25% in high mitigation*.
- **Trade effects:** As other countries suffer relatively worse climate change impacts than the UK, these effects spill over to the UK through channels such as trade. The UK's GDP is projected to fall by about 0.16% for every 1% lost from its trading partners. *The total cost to UK GDP is 1.1% under current policies by 2100 vs. 0.06% under high mitigation*.

Figure 1. Total costs of climate change in the UK by sector



“Proactive investment in adaptation measures has the potential to reduce the risk of climate-related damages.”

Total cost estimates

Under a current policies scenario, total climate change costs are projected to increase from 1.1% of UK GDP at present to 3.3% by 2050 and 7.4% by 2100. Strong mitigation policies can reduce this to 2.4% of GDP by 2100, avoiding costs equivalent to five percentage points of GDP.

Of the nine featured impact channels, international trade carries the greatest risk of causing economic damage to the UK, acting as a ‘spillover effect’ from the effects of climate change globally.

Damages from impact channels vary across regions of the UK and over time. Coastal impacts and livestock and fisheries impacts predominate during 2011–2030. By 2100, health impacts are greatest in highly populated areas, while agricultural impacts are most damaging in the rest of the UK.

Integrating additional risks

The largest contributing cost to our overall estimates comes from catastrophic risk: the possibility that the global economy will experience large-scale disruption due to climate change (Howard and Sterner, 2017).

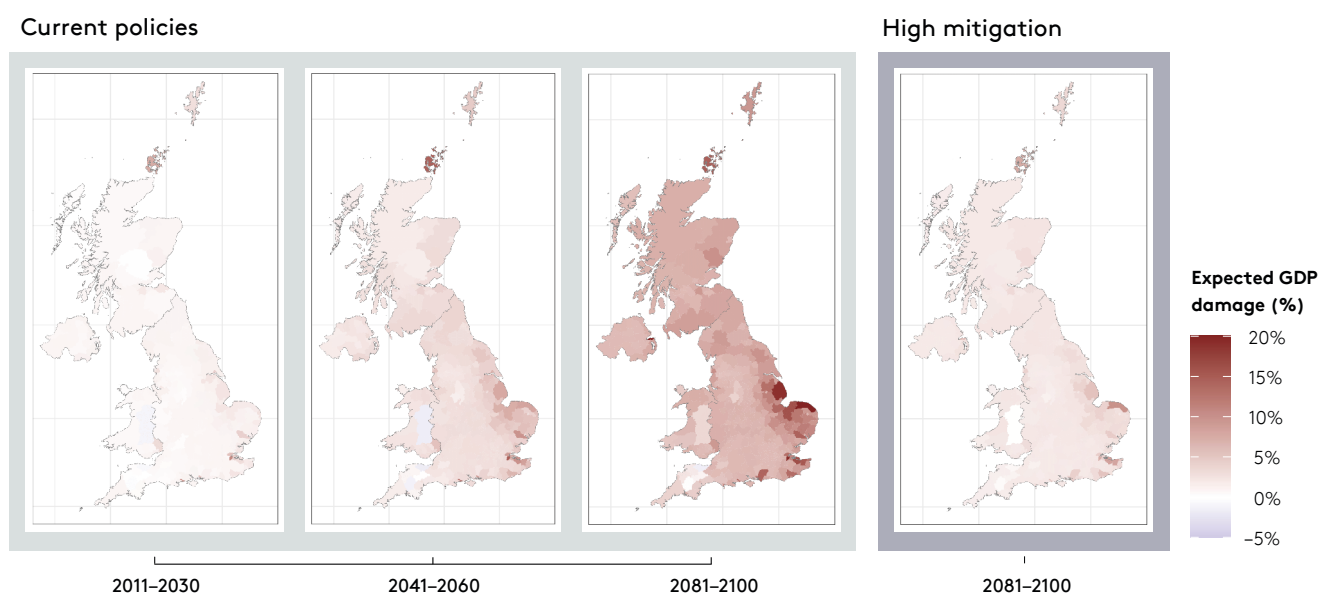
Climate risks could emerge from many other possible channels. Natural disasters, tourism, forestry, transport and conflict and displacement, for example, are likely to prove significant in the future. We account for these ‘missing risks’ as an approximation of 25% of the existing channels (following Nordhaus, 2013). This translates to 0.7% of GDP by 2100 under current policies, compared with 0.2% under high mitigation.

Adaptation

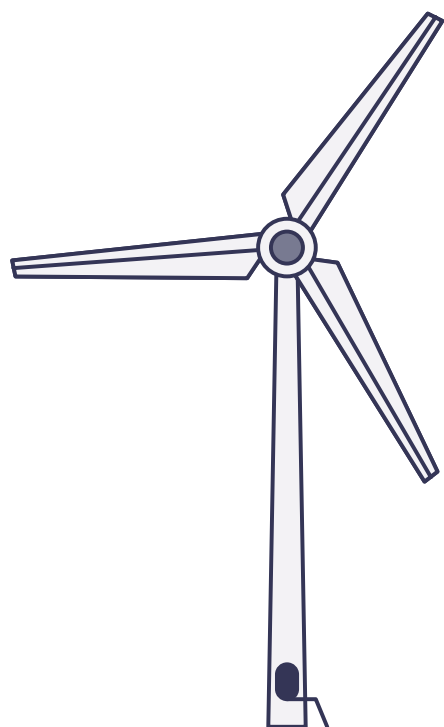
Proactive investment in adaptation measures, such as coastal defences, has the potential to reduce the risk of climate-related damages. It is recognised that insufficient progress has been made in the UK to prepare for most areas of climate risk (CCC, 2021). Proper adaptation planning requires a clear understanding of what is at risk, where and why.

Note: Climate risks entail the possibility of ‘low-probability, high-negative impact’ events, which have significant impacts for decision-making around climate change (Weitzman, 2020). These risks are captured in our ‘1-in-20’ chance estimates that damages will be greater than the expected range.

Figure 2. Total costs of climate impacts, under current policies and high mitigation scenarios



“Pursuing net-zero is a ‘no-regret’ policy as it provides benefits to the UK economy even if global emissions do not fall enough to avoid the worst damages from climate change.”



The net-zero transition

More than providing a stark warning of the damages resulting from a lack of climate action, estimating the costs of climate change in different scenarios offers a helpful comparison between the costs of damages and the costs of mitigation efforts – something that is particularly relevant to discussions around the UK’s net-zero pathway.

Costs and (co-)benefits

While the numbers are subject to some uncertainty, the research consistently estimates that the direct costs of transitioning to net-zero for the UK are unlikely to exceed 2% of GDP. Mitigation costs in some sectors are expected to be very low – or even negative, such as in transport and energy (CCC, 2019). The costs of mitigation have greatly decreased in the 14 years since the Climate Change Act was passed, and it is likely that costs will come down further over time.

Not only do climate mitigation policies avoid climate-related costs (a total of five percentage points of GDP by 2100), but they also bring additional benefits, which in turn have a positive impact on GDP. The most significant relate to improved health outcomes, such as through reduced air pollution and dietary change, which combined increase welfare by the equivalent of 3.3% of GDP. There are also productivity benefits as investment in green industries and infrastructure is expected to provide a boost of 2.8% of GDP.

Weighing up the costs and benefits of the net-zero transition results in a positive net impact on the UK’s economy, equal to 4.1% of GDP. Pursuing net-zero is therefore a ‘no-regret’ policy, as it provides benefits to the UK economy even if global emissions do not fall enough to avoid the worst damages from climate change.

The global dimension

The UK is well-positioned to take a leadership role in global decarbonisation efforts, being one of the least energy-intensive developed countries due to the low industrial share of its output (18% vs. a global average of 25%).

Despite recent reductions in fossil fuel emissions, the UK ranks eighth among countries in causing climate change over time (Evans, 2021). These emissions carry costs across the globe that are estimated to be equivalent to a loss of £39.5 billion per year, equivalent to 1.9% of the UK’s GDP. A net-zero UK would simultaneously benefit its own economy and economies around the globe.

If other countries also reduce their carbon emissions in line with the UK, additional economic damages of over five percentage points of GDP would be avoided by the end of the century.

“In addition to the ethical and geopolitical reasons to stop climate change, mitigation investments have important benefits on their own.”

Policy considerations

- There are multiple pathways through which climate change impacts human welfare and the economy across the UK. Mitigation policy is able to reduce these damages, by five percentage points of GDP by 2100.
- Aside from avoided damages, mitigation policy has important benefits on its own which exceed the costs of the transition to net-zero, providing strong economic reasons to pursue net-zero in the UK.
- The co-benefits of climate change mitigation include improvements to health and stimulation of the economy through investment.
- Climate change impacts can be more direct, such as with flooding and coastal impacts, or indirect, such as through losses from trade partners.
- A regional mapping of projected damages reveals the areas at greatest risks of specific climate impacts, to better inform adaptation planning.
- Climate change entails the risk of ‘low-probability, high-negative impact’ events, which are vital to consider in decision-making.
- It is important to address the risks from a wider range of impact channels from a policy perspective, even if they cannot be precisely quantified.

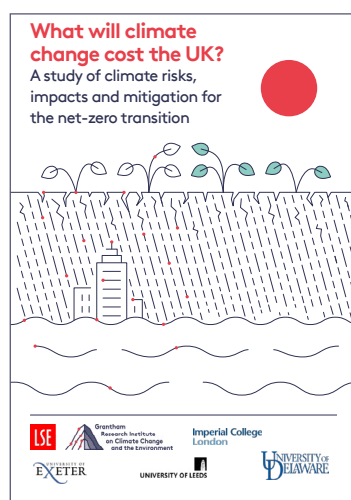
Conclusions

Transitioning from a current policies scenario to a high mitigation scenario reduces climate change losses by 1.1% of GDP by 2050 and 5% of GDP by end of century. At a global level, the benefits of mitigation policy exceed the costs in the latter half of the century, which is a short timeframe for reaping this level of benefits.

The combined co-benefits of 4.1% plus the climate risks benefits of moving from a current policies to a high mitigation scenario (five percentage points) provide a total benefit to the UK economy of 9.1% of its GDP by 2100. These findings show strong economic justification for an extensive energy transition to net-zero.

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Read the full report, ***What will climate change cost the UK? A study of climate risks, impacts and mitigation risks for the net-zero transition*** at: www.lse.ac.uk/granthaminstitute/publication/what-will-climate-change-cost-the-uk

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