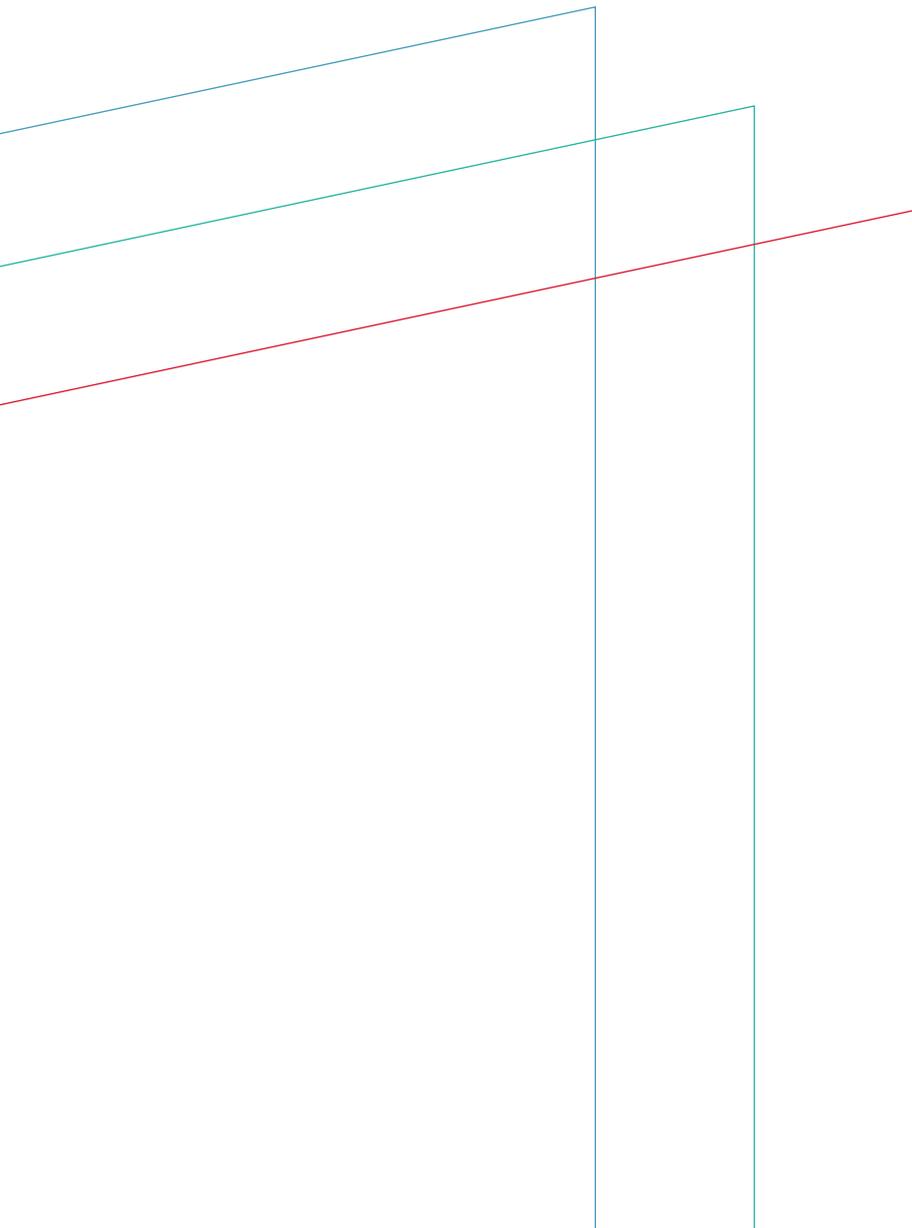


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# THE CLIMATE- FISCAL TIMEBOMB

HOW CLIMATE CHANGE WILL  
IMPACT PUBLIC BUDGETS

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# CONTENTS

<b>EXECUTIVE SUMMARY</b>	<b>2</b>
<b>1. INTRODUCTION</b>	<b>4</b>
<b>2. CLIMATE STABILITY IS FISCAL SUSTAINABILITY: MODELLING THE IMPACT OF CLIMATE CHANGE ON DEBT</b>	<b>7</b>
2.1 CLIMATE CHANGE WILL SHRINK ECONOMIC POTENTIAL	8
2.2 IGNORING PHYSICAL CLIMATE RISK WILL STRAIN PUBLIC BUDGETS	12
2.3 MITIGATION SPENDING WILL LOWER DAMAGES AND GROW THE ECONOMY	16
2.4 ADAPTATION SPENDING WILL LOWER FUTURE DAMAGES	19
2.5 CLIMATE RISK WILL INCREASE THE COST OF BORROWING	22
<b>3. SCENARIOS: HOW CLIMATE INVESTMENT SHAPES DEBT OUTCOMES</b>	<b>23</b>
3.1 EUROPE'S DEBT RULES IGNORE ITS BIGGEST DRIVER OF DEBT	23
3.2 FINANCING RESILIENCE REQUIRES MACROECONOMIC COORDINATION AND FAIR TAXATION	29
3.3 CLIMATE STABILITY IS FISCAL STABILITY	32
<b>4. IMPLICATIONS FOR POLICYMAKERS: THE EU'S ECONOMIC FRAMEWORK IS INCOMPATIBLE WITH CLIMATE REALITY</b>	<b>34</b>
4.1 REFORMING THE DSA TO ACCOUNT FOR CLIMATE RISK	34
4.2 MOVING TOWARD A NEW MACROECONOMIC FRAMEWORK	35
<b>5. CONCLUSION</b>	<b>37</b>
<b>ANNEXE: METHODOLOGY</b>	<b>38</b>

## EXECUTIVE SUMMARY

**B**y 2050, the average public debt of EU member states could be 58 percentage points (pps) higher than official forecasts unless climate risks are addressed. In 2070, that could rise to 197 pps. New modelling by the New Economics Foundation (NEF) finds that fiscal stability depends on early and coordinated climate action. Despite growing evidence of the severe economic impacts of climate change, the EU's economic framework still treats short-term public debt as the central threat to stability, while overlooking the deeper vulnerabilities that will drive debt in the decades ahead. Integrating climate damages, adaptation, and mitigation costs into debt paths shows debt ratios that rise steeply under inaction but are materially lower under credible climate investment and supportive policy settings. Meeting these challenges requires a fiscal framework that enables rather than constrains public investment.

At the same time, the EU faces a significant green investment gap. Institut Rousseau estimates that closing the mitigation investment gap will require around 1.6% of gross domestic product (GDP) in additional annual public investment to meet the 2040 and 2050 climate targets. The European Environment Agency (EEA) estimates that the investment need for adaptation in the EU27 and the UK combined will be around €40bn under a 1.5C scenario, rising to €80–120bn under 2C, and reaching €175–200bn under 3–4C (2015 prices).<sup>1</sup>

This report extends the European Commission's Debt Sustainability Analysis (DSA) to include climate impacts and transition dynamics - factors currently missing from official projections. Our model shows that because of weaker growth and productivity and reduced tax receipts, debt ratios rise once climate change impacts are incorporated, while investors demand higher borrowing costs to reflect mounting climate risk. The physical damage caused by climate change also requires billions in

public funds to repair and rebuild infrastructure and support affected communities. Mitigation and adaptation investment reverses this dynamic. Green spending boosts productivity and cuts the costs of climate damage. Building cleaner energy systems, resilient infrastructure, and efficient housing not only protects public finances but also delivers wider benefits, from lower energy bills and better transport to healthier, more secure communities.

Increased green investment will require additional borrowing. Higher debt levels make fiscal rules harder to meet and increase the economic and political trade-offs required to stabilise public finances. Therefore, while higher debt levels shouldn't necessarily be seen as opposed to the goal of debt sustainability, higher debt will continue to come with more economic and political trade-offs.

We have constructed five illustrative scenarios: climate agnostic, business as usual (BAU), early EU investment, delayed EU investment, and a scenario with early investment alongside global cooperation. We have also modelled two sub-scenarios under early EU investment, one where the EU adopts progressive tax policies and another where the European Central Bank (ECB) and fiscal institutions coordinate more effectively to achieve the transition.

Our stylised scenario modelling shows that early EU investment, particularly when combined with global cooperation, is more fiscally sustainable than late/no additional mitigation and adaptation investment. In that scenario, average debt increases by 4 pps above the Commission's official projections in 2050 and *decreases* by 12 pps *below* official projections by 2070 – completely reversing the estimated effects of climate inaction on public finances.

Assuming early EU action, introducing progressive taxation (eg through a wealth tax) could raise around €213bn a year across the EU. Implementing such taxation could lower average debt to 17 pps above the Commission's official projections in 2050 and 22 pps by 2070.

## THE CLIMATE-FISCAL TIMEBOMB

### HOW CLIMATE CHANGE WILL IMPACT PUBLIC BUDGETS

Coordination between monetary and fiscal policy, combined with EU early action could cut borrowing costs and lower debt ratios significantly. This results in debt increases being 21 pps above the Commission's official projections in 2050 and 15 pps above by 2070.

This report recommends a fundamental realignment of the EU's economic governance to reflect the climate reality. First, the DSA must be reformed to incorporate a climate-adjusted baseline, realistic green multipliers, and sovereign risk premiums that capture the fiscal cost of delay. Second, the fiscal framework should move toward a preventive model, where independent fiscal referees replace rigid numeric rules with qualitative assessments of climate and resilience spending. To prevent regional fragmentation, the EU should establish a permanent Climate Resilience Facility for common borrowing and expand the Solidarity Fund. Finally, by phasing out fossil fuel subsidies and deploying a broader toolkit of progressive taxation and monetary-fiscal coordination, Europe can lower the cost of capital for green investments while ensuring the transition is financed fairly.

**The conclusion is clear: climate stability is fiscal stability.** Inaction drives debt onto explosive trajectories, while early, globally coordinated action means climate-related fiscal risk is averted. Europe's fiscal rules and economic governance must now evolve to reflect this reality, integrating climate risk, supporting productive public investment, implementing fair taxation, and aligning monetary and fiscal policy to build lasting stability.

# 1. INTRODUCTION

Climate change is not only an environmental crisis, but also an economic and fiscal one. Rising global temperatures, driven by greenhouse gas emissions, are already increasing the frequency and severity of extreme weather events, from floods and storms to heatwaves and droughts. It will worsen existing health problems and generate new threats, including higher rates of respiratory and cardiovascular disease, heat-related illness, and injuries from extreme weather, shifting patterns of infectious diseases, and increasing mental health burdens. Left unchecked, climate change will intensify food and water insecurity, force large-scale displacement, and deepen social inequalities. Each of these impacts carries significant economic and financial costs, from disrupted supply chains and reduced productivity to a higher necessity for public spending and increased pressure on social safety nets and health care.

Yet 2024 was the first year to exceed 1.5C above pre-industrial temperatures.<sup>2</sup> Every additional increment of warming will exacerbate both the intensity and the frequency of climate-related disasters and impacts, with serious implications for economic stability and security, cost of living, public finances, and long-term debt sustainability.

Climate change affects economies through multiple channels. Higher temperatures reduce labour productivity (eg by affecting workers' productivity due to extreme heat); damage public and private infrastructure; and disrupt key sectors like agriculture, transport, and energy. These effects lower gross domestic product (GDP) potential and slow growth. At the same time, extreme weather events impose direct costs on public budgets as governments respond to emergencies, repair damaged assets, and support affected communities.<sup>3,4</sup>

Yet even as these pressures mount, Europe's fiscal architecture remains focused on debt reduction rather than strengthening fiscal resilience through climate resilience. In 2024, the EU reformed

its fiscal governance framework, requiring all member states to submit medium-term fiscal-structural plans explaining how they will ensure debt sustainability by detailing their investment strategies, cuts to budgets, and tax decisions. For countries with current debt above 60% of GDP or deficits above 3%, these plans must outline a path to reducing debt over a four- to seven-year horizon. The central tool for assessing compliance is the Debt Sustainability Analysis (DSA), the European Commission's analytical framework for projecting national debt trajectories and determining the risk of a member state's public debt.

In theory, the DSA should provide a forward-looking assessment of fiscal stability. In practice, it overlooks one of the most significant fiscal risks: climate change. As Ziesemer et al.<sup>5</sup> have shown, the DSA constructs a baseline that implicitly assumes continued smooth growth and only selected fiscal pressures, such as the costs of ageing. It does not factor in the costs of climate inaction, the benefits of avoided damages, or the macroeconomic impacts of achieving the EU's climate targets. As a result, Ziesemer et al. show, DSA projections are inconsistent with both the EU's climate objectives and the fiscal risks of failing to meet them, producing a framework that rewards short-term debt consolidation while constraining the very investments needed for long-term economic and ecological stability.

Encouragingly, recent changes to the Stability and Growth Pact<sup>6</sup> do include a requirement for member states to begin evaluating how macro-fiscal risks from climate change could affect the sustainability of public finances. This includes assessing climate- and disaster-related contingent liabilities and the fiscal costs of climate shocks. No harmonised methodology to present this data has been agreed, which means it is likely that there will be significant discrepancies in the detail of member state submissions. Since 2019, the Commission has been working on integrating climate impacts through stress tests and alternative policy scenarios.<sup>7</sup> However, there are only a handful of comprehensive, up-to-date estimates of climate-related damages on public budgets across member states, and the insights do not impact the DSA baseline projection, which is a key component of the EU's fiscal policy.

## THE CLIMATE-FISCAL TIMEBOMB

### HOW CLIMATE CHANGE WILL IMPACT PUBLIC BUDGETS

Debt sustainability does not have a precise definition across the economics literature. In government documents, sustainability is often conflated with what keeps a country within the fiscal rules the government sets to constrain debt and borrowing. In more academic texts, sustainability is often defined as a commitment to a declining or stabilised debt path – even if only at the infinite horizon.<sup>8</sup> In other cases, debt sustainability may simply relate to decisions that prevent debt default. This diversity reflects the difficulty of numerically defining debt sustainability: some countries have been in fiscal crisis with low levels of debt, yet others continue to avoid such crises with high levels of debt. In this report, we compare debt outcomes over time and suggest scenarios that lead to higher debt are less sustainable. These scenarios make fiscal rules harder to meet and debt harder to stabilise and will require more support from taxation or monetary policy to reduce debt burdens without defaulting. Therefore, while higher debt levels shouldn't necessarily be seen as opposed to the goal of debt sustainability, higher debt will continue to come with more economic and political trade-offs. If member states can credibly avoid higher debt levels, it is probably worthwhile doing so.

This report builds on the methodologies of the Office for Budgetary Responsibility (OBR), Ziesemer et al.,<sup>9</sup> the European Commission,<sup>10</sup> and the Organisation for Economic Co-operation and Development (OECD)<sup>11</sup> to assess how climate change could impact public finances and debt sustainability across 25 EU member states.

Central to our analysis are long-run climate scenarios developed by the OECD,<sup>12</sup> which form the basis for the recently released OECD EDISON tool for calculating the impacts of decarbonisation and environmental challenges.<sup>13</sup> Six OECD long-run climate scenarios set out alternative global pathways. To illustrate climate damages and, to an extent, transition GDP impacts under each of our stylised scenarios, we have mapped them to the most appropriate OECD scenarios. For our business-as-usual (BAU) scenario, we take GDP damage data from the OECD scenario where warming reaches 2.5C in the long run with a high damage curve. For our delayed EU action scenario, warming is limited to 1.6C but a high damage curve is applied and a transition that is

slow and costly. Our early EU action scenario is the same, but the transition is fast and low cost. Our global coordination scenario corresponds to the OECD scenario where warming is limited to 1.6C, a median damage curve is applied, and the transition is fast and low cost.

Using this OECD dataset, and building on additional datasets, including the European Commission's Debt Sustainability Monitor (DSM) data, EEA/CATDAT disaster-loss data,<sup>14</sup> PESETA IV/COACCH adaptation cost estimates,<sup>15</sup> and others, our analysis focuses on three dimensions:

- The economic drag from climate-related reductions in GDP growth, including lower tax receipts.
- The direct fiscal costs of climate-related physical damages as governments respond to emergencies, repair damaged assets, and support affected communities.
- The macroeconomic implications of different policy responses — from mitigation and adaptation to solutions such as wealth taxation and monetary-fiscal coordination.

Using empirical data and scenario modelling, we estimate how these factors will shape debt trajectories in the years ahead by comparing the following scenarios:

- **Commission climate agnostic baseline:** no additional mitigation or adaptation; no climate risk adjustments; follows the Commission's DSM projection to 2070.
- **Business as usual (BAU):** This scenario reflects already implemented measures, not policy plans or future commitments. It assumes continued policy rollbacks and no new mitigation or adaptation investments. The scenario is based on data consistent with around 2.5C of global warming and a high damage curve, an illustrative proxy for the trajectory of current EU<sup>16</sup> and global climate action. Investors apply a +100 basis points (bps) climate risk premium.
- **Early EU investment:** The EU scales up mitigation by 1.6% of GDP (with some of this cost covered through carbon pricing),

## THE CLIMATE-FISCAL TIMEBOMB

### HOW CLIMATE CHANGE WILL IMPACT PUBLIC BUDGETS

and adaptation. Global coordination remains limited, and while global temperature remains at 1.6C a high damage curve is applied, with a +50 bps climate risk premium due to continued warming.

- **Delayed EU investment:** Major investments are postponed until the 2030s, causing the EU to face higher costs and damages. Warming remains near 1.6C and a high damage curve is assumed, with a +50 bps risk premium.
- **Global cooperation:** The EU acts early and helps drive global net zero by 2050, limiting warming to 1.6C with a median damage curve assumed, and no climate risk premium.
- **Wealth tax:** Progressive taxation of extreme wealth to finance climate and resilience investment is applied to the early EU investment scenario.
- **Monetary-fiscal coordination:** Supportive monetary policy that lowers borrowing costs by 50 bps is applied to the early EU investment scenario.

By comparing the scenarios, we assess the costs of inaction with the benefits of early investment, showing that frontloaded mitigation and higher investment in adaptation can improve fiscal outcomes, reduce future liabilities, and support economic resilience.

All estimates are illustrative. Data on climate damages, especially adaptation, remains incomplete and uneven. Our aim is not to produce precise forecasts but to show the scale and direction of fiscal pressures once climate risks and different policy choices are integrated into debt sustainability analysis.

## 2. CLIMATE STABILITY IS FISCAL SUSTAINABILITY: MODELLING THE IMPACT OF CLIMATE CHANGE ON DEBT

A 2022 European Commission paper<sup>17</sup> shows that extreme weather undermines debt sustainability through two channels: lower gross domestic product (GDP) and higher public spending on emergency response, reconstruction, and infrastructure repair. These shocks shrink the economy while lifting deficits, compounding the debt-to-GDP ratio. Although the analysis focuses on medium-term effects of a one-off shock in high-risk countries, it strengthens the case for integrating climate risk into debt assessments. And indeed, in the Commission's 2021 Debt Sustainability Monitor (DSM, published in 2022), these impacts were integrated into the debt forecast as a stress-test scenario.

The Commission has recently built on this analysis to provide a more complete assessment of the impacts of climate risk on fiscal sustainability.<sup>18</sup> This update integrates both physical risks and transition impacts, incorporating the economic consequences of climate mitigation, adaptation, carbon pricing, deteriorating fossil fuel revenues, investment needs, and long-term growth effects out to 2050. Other recent work points in the same direction but remains partial. Zenios<sup>19</sup> develops a framework that links outputs from Integrated Assessment Models (IAMs) — capturing climate damage and economic impacts of climate change — with a stochastic, scenario-based sovereign Debt Sustainability Analysis (DSA) and finds substantially worse debt paths in high-emission scenarios. However, Zenios does not benchmark to the Commission's fiscal baselines or compare policy mixes (eg investment-led vs pricing-led).

Zieseimer et al.<sup>20</sup> extend the Commission's DSA for Italy by embedding both climate-damage and transition impacts (using Network for Greening the Financial System (NGFS) data based on REMIND<sup>21</sup> IAM and NiGEM macroeconomic models) and public-spending estimates. They show that climate-adjusted debt paths exceed the European Commission's official DSA baseline and that frontloaded public investment can deliver stronger growth and better long-run debt sustainability than heavy reliance on carbon pricing.

Agora Energiewende<sup>22</sup> models the fiscal impacts across EU member states in various transition scenarios, including a more investment-led transition (unconstrained by EU fiscal rules). The analysis incorporates deteriorating fossil-fuel revenues and household compensation. Using Oxford Economics models, they also find that higher public investment can raise GDP by 2040, vs pricing-led approaches that rely mainly on higher carbon prices rather than direct public investment or industrial policy. The International Monetary Fund (IMF)<sup>23</sup> has also developed a model which similarly links climate shocks to debt dynamics through empirically estimated temperature-GDP effects. However, it focuses on physical risks and adaptation speed, excluding the fiscal impacts of adaptation or mitigation spending, and omits transition effects. Coverage extends to only a handful of the EU member states.

The Organisation for Economic Co-operation and Development's (OECD) interactive EDISON tool links macro-fiscal data with the OECD's long-run global climate scenarios to assess the long-term fiscal impacts of decarbonisation and environmental challenges. It allows simulation of different policy scenarios, including timing and a mix of mitigation and adaptation investments, showing how these choices affect debt, GDP, and fiscal sustainability. While invaluable for OECD countries seeking to calculate the fiscal impacts of climate damages, it does not provide a consolidated overview of impacts to all EU member states in one place, which is what our report looks to do.

## THE CLIMATE-FISCAL TIMEBOMB

### HOW CLIMATE CHANGE WILL IMPACT PUBLIC BUDGETS

At the national level, evidence is striking but limited. The UK's Office for Budget Responsibility (OBR) estimates that a 3C scenario could lift public debt by up to 56% of GDP by 2073–74 (vs a no further-climate-change baseline), with GDP about 8% lower by 2073–4. The Bank of Greece<sup>24</sup> projects cumulative losses of hundreds of billions of euro by century's end. Institutions in France,<sup>25</sup> Portugal,<sup>26</sup> and Ireland<sup>27</sup> highlight how climate change is likely to weaken potential GDP output and result in higher public costs, but have yet to develop climate-aware debt-path projections.

While each analysis contributes important conclusions, only the Commission's 2025 publication offers a comprehensive, EU-wide estimate that integrates GDP losses, physical risks, mitigation and adaptation costs, and macroeconomic feedback across member states under different warming scenarios. Such a cross-country perspective is essential in the EU, where economic and fiscal stability are deeply interlinked through common monetary policy, shared financial markets, and fiscal rules that shape national investment decisions; yet both climate and fiscal modelling are highly uncertain, and scenarios are constructed based on layers of assumptions. This report complements the Commission's analysis, expanding the range of illustrative scenarios considered, drawing on different available datasets and applying alternative assumptions. Our top-down assessment covers 25 EU member states. We harmonise sources and methods and present results as stylised scenarios, not precise forecasts. Further work is needed to improve adaptation data, align methodologies, and embed climate risk in standard DSA practice (see recent European Commission<sup>28</sup> and Coalition of Finance Ministers<sup>29</sup> comprehensive guidance for countries looking to conduct such assessments).

We proceed as follows. First, we estimate the GDP losses from climate change. Second, we quantify the direct fiscal costs of physical damage from extreme weather. Third, we assess the fiscal and economic effects of mitigation spending, and fourth, of adaptation spending. Fifth, we incorporate a simple climate risk premium assumption to capture the impact of climate

exposure on sovereign borrowing costs. Chapter 3 brings these elements together in scenario analysis, including examining how wealth taxation and monetary-fiscal coordination can contribute to meeting the investment needs. Chapter 4 provides policymakers with recommendations.

## 2.1 CLIMATE CHANGE WILL SHRINK ECONOMIC POTENTIAL

A growing body of research shows that climate change acts as a persistent drag on economic growth and output. The mechanisms are well established and include lower labour productivity during heat stress,<sup>30</sup> shifting agricultural yields,<sup>31</sup> infrastructure damage from extreme weather,<sup>32</sup> tourism losses,<sup>33</sup> and higher morbidity and mortality.<sup>34</sup> Crucially, these impacts are not one-off shocks but have lasting effects on an economy's productive capacity: for example, destroyed infrastructure or loss of human potential can stunt possible output for years.

Estimates of potential GDP loss from unmitigated warming have increased as data and methods improve. A 2024 meta-analysis by Tol<sup>35</sup> of 69 estimates across 39 studies shows wide variation in the relationship between temperature change and welfare-equivalent income (a proxy for GDP). On average, Tol finds:

- A 2.5C rise reduces global income by 1.4%, with 95% confidence intervals ranging from –3.6% to +2.6%.
- A 5C rise reduces income by 4.2%, with 95% confidence intervals ranging from –7.3% to +5.3%.

Even so, these estimates are widely seen as conservative. They capture gradual productivity effects but largely exclude catastrophic or non-linear risks such as ice-sheet collapse, conflict, or large-scale forced migration. Wide confidence intervals, including the possibility of small gains, reflect historic averages rather than tail risks.<sup>a, 36</sup>

a Tail risk is the possibility of a rare and extreme event that has an outsized impact, occurring in the "tails" of a probability distribution. While these events are statistically infrequent, they can cause disproportionately large losses for investors and are often underestimated by traditional risk models that assume a normal distribution.

## THE CLIMATE-FISCAL TIMEBOMB

### HOW CLIMATE CHANGE WILL IMPACT PUBLIC BUDGETS

More recent work suggests much larger impacts. Bilal and Känzig,<sup>37</sup> focusing on global shocks and extreme events rather than gradual temperature changes, find that a 1C rise could reduce world GDP by about 20% in the long run. This is significantly higher than older estimates, which associate a 1C increase in global temperature with a 1–2% reduction in GDP growth in the medium term.<sup>38</sup> This difference reflects the inclusion of extreme events and non-linear feedback previously underrepresented in economic models.

The NGFS, a consortium of central banks and supervisors that have developed comprehensive, long-term macroeconomic climate scenarios, suggests substantial macroeconomic impacts by 2100 that vary with the degree of warming and the policy scenario. For example, in their Phase V data, under a “Current Policies” scenario, warming reaches ~3C by 2100. This leads to average GDP deviations of almost 9% for Europe relative to the reference by 2070. In contrast, in more ambitious mitigation scenarios like Net Zero 2050, cumulative physical damages to GDP are restricted to 4% over the same time horizon as warming and extreme events are constrained, although transition costs still produce some negative deviations relative to the no-climate-change baseline. However, the specific damage function used to derive these GDP impacts in the Phase V scenarios has recently been retracted.<sup>39</sup> Consequently, we have not employed the Phase V data in this iteration of our analysis, but we hope to update our results with the Phase VI data on release in late 2026.

For our analysis, we draw primarily on OECD long-run climate scenarios, which were updated in September 2025.<sup>40</sup> Under business-as-usual (BAU) scenarios, decarbonisation of the energy mix and improvements in energy efficiency continue in line with recent trends, meaning that progress in reducing greenhouse gas emissions remains clearly insufficient to prevent continued global warming and to remain below the “well below 2C” goal of the Paris Climate Agreement. Two variants are considered, based on median and high climate damage curves drawn from the scientific literature.<sup>b</sup> Under the median damage assumption,

global annual potential output growth is projected to slow from around 2.9% currently to 2.7% in the early 2030s, 2.1% in the early 2040s, and about 1.3% toward the end of the century. Global average surface temperatures are projected to rise steadily, reaching approximately 2.5C above pre-industrial levels by 2100. As a result, under the median damage curve variant, climate-related output losses increase from an estimated 1.75% of global GDP today to nearly 9% by 2100. Under the high-damage assumption, climate impacts are substantially more severe, reducing global output by 17% in 2050 and up to 36% by the end of the century. As the OECD states, these estimates exclude the catastrophic climate and economic impacts of tipping points, so damages are likely higher than estimated.

In contrast, energy transition (ET) scenarios assume an accelerated global shift toward decarbonisation and energy efficiency, with coal fully eliminated by 2050 and the shares of oil and gas in primary energy reduced to 5% and 10%, respectively. Decarbonisation is also achieved through greater energy efficiency and faster adoption of carbon capture and storage technology. This transition limits global warming to around 1.6C by 2100, consistent with the Paris Climate Agreement. See the annexe for a full discussion of the models, assumptions, and damage functions used to determine climate damages in the OECD scenarios.

However, the effects of climate change on global output depend critically not only on acute and chronic physical damages, but also on the GDP impacts of mitigation efforts, including carbon pricing and significant investment programmes. It is not possible to disaggregate these GDP impacts in the OECD data; hence the GDP impacts in Figure 1 capture both the GDP impacts of physical damages and of transition efforts, as they are modelled in the scenarios. Importantly, the OECD ET scenarios assume that mitigation spending always has a negative impact on GDP, and just differentiate between how quickly these costs decline over time (at a rate of 1% per annum for slow reduction in mitigation costs scenarios, or 4% per annum for fast reduction in mitigation

<sup>b</sup> The median damage curve is based on findings by the meta-study aggregation of Howard and Sterner, implying climate damages equal to 4% of global GDP for 2C of warming and 9% of GDP for 3C of warming over the pre-industrial average in the long term. The high damage function is calibrated based on the findings of Bilal and Känzig, which estimate damages of approximately 19% and 44% of global GDP at 2C and 3C of warming, respectively.

## THE CLIMATE-FISCAL TIMEBOMB

### HOW CLIMATE CHANGE WILL IMPACT PUBLIC BUDGETS

costs scenarios). This is due to the model's design, which assumes an efficient allocation of resources in the BAU scenarios. Thus, any distortion, such as government spending on climate mitigation, necessarily has a negative impact. The OECD itself states that this does not need to be the case, and has shown contrary results in additional modelling exercises.<sup>41</sup> Impacts of climate spending on GDP could thus be more positive than the results of the OECD long-run scenarios suggest.

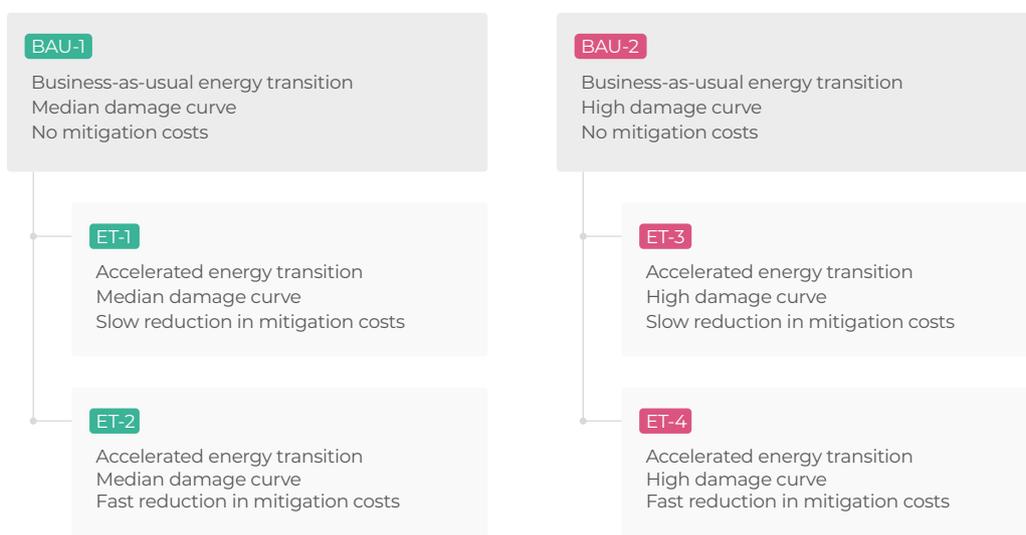
Four scenarios illustrate divergent potential transition pathway outcomes: with median climate damages and slowly declining mitigation costs (ET1), global output in 2100 remains below business-as-usual levels; with faster cost declines (ET2), the transition becomes output-positive around 2085. Under high climate damages, the transition yields net global output gains earlier – by the late 2050s with slow cost declines (ET3) and by the mid-2040s with rapid cost declines (ET4) – eventually benefiting all 139 modelled countries by 2080. Among these, the scenario combining

median climate damages with rapidly falling mitigation (ET2) costs delivers the most optimistic long-term outlook for global output per capita and living standards.

The OECD database does not have figures for Cyprus or Malta; hence these countries are excluded from our analysis.

We construct four scenarios in Section 3, mapping the OECD scenarios that best reflect ours and applying the associated GDP damages out to 2070. For our BAU scenario, we incorporate damages from the OECD's BAU2, the option with a high damage curve. The assumption of 2.5C warming under no action, is likely an underestimate. We map our early EU action scenario to the OECD's ET4; our delayed EU action scenario to the OECD's ET3, and our global cooperation scenario to the OECD's ET2. Figure 2 shows the GDP impacts mapped over from the OECD scenarios. See the annexe for further discussion on this mapping.

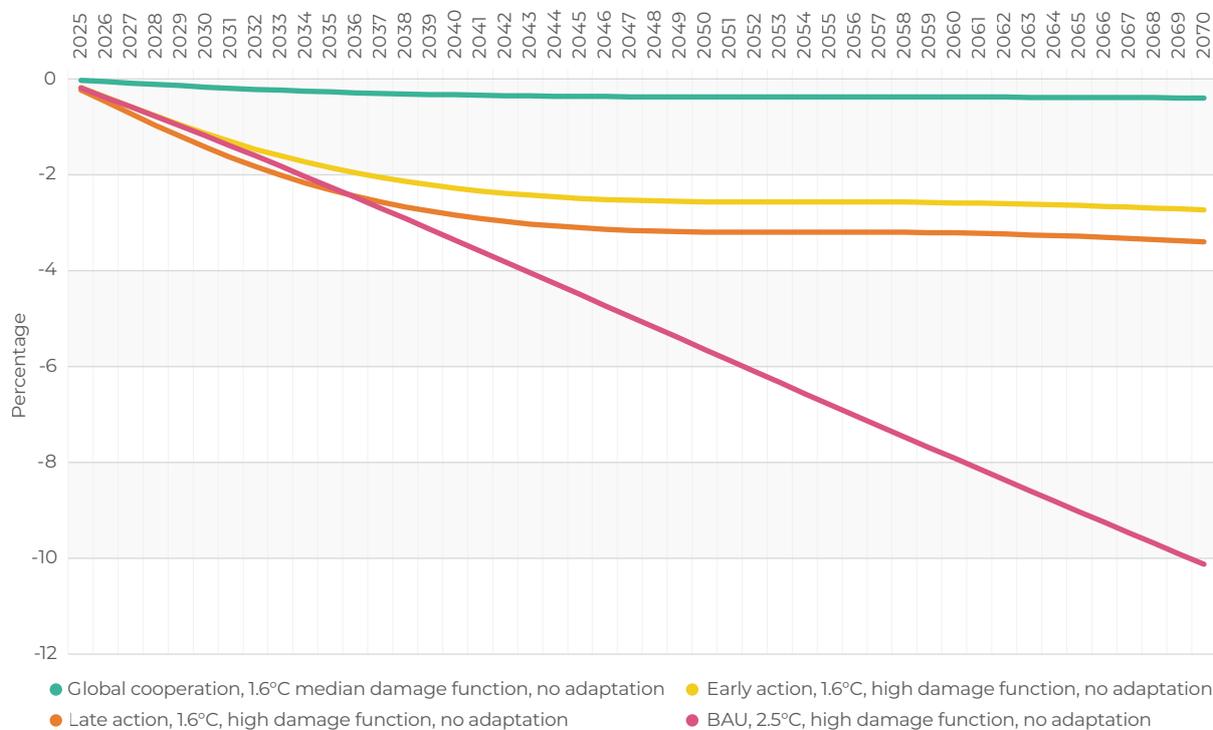
**FIGURE 1: OECD LONG-RUN CLIMATE SCENARIOS**



Source: OECD long-run climate scenarios.

**FIGURE 2: PHYSICAL CLIMATE DAMAGES SHARPLY REDUCE EU GDP UNDER HIGHER-WARMING SCENARIOS**

Average of EU25 GDP losses relative to DSA baseline, %, 2025-70. Modelled using OECD long-run scenario data.



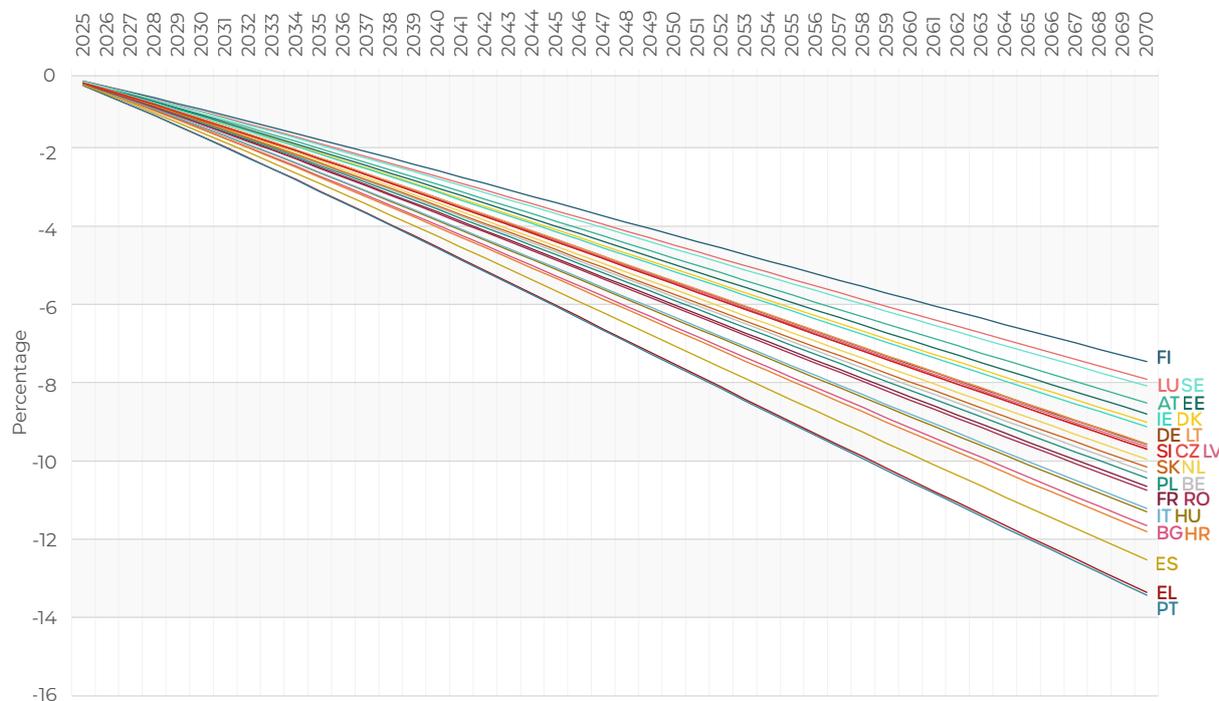
Source: NEF analysis, OECD long-run climate scenarios, re-based to 2024 as historical/current damages are assumed to be accounted for in forward DSA projections; OECD baseline assumed consistent with the Commission’s DSM baseline. Notes: While we map our global cooperation scenario on an OECD scenario with almost zero economic damages relative to 2024, this is likely a significant underestimate. Even under full global cooperation and rapid decarbonisation, additional warming is already locked in, and a growing body of literature suggests that standard economic damage functions likely underestimate long-run GDP losses by omitting nonlinearities, tipping points, and systemic risks.

Figure 3 shows wide cross-country divergence in chronic GDP impacts relative to 2024 by 2070 under a BAU, high damage curve scenario (no adaptation). Losses are heaviest in the Mediterranean region – Croatia, Greece, Italy, Portugal, Spain – averaging around 12% compared

to a climate-agnostic baseline. The Continental region shows an average of 10%. The Atlantic region also records 10% on average by 2070, with France recording the highest damages of the region. Nordic–Baltic countries see slightly smaller declines by 2070, just below 9% by 2070.

**FIGURE 3: CROSS-COUNTRY DATA OF GDP LOSSES UNDER A BAU, 2.5C, HIGH DAMAGE CURVE SCENARIO**

Projected change in real GDP relative to the DSA baseline, %, 2025-70, EU25 countries. Modelled using OECD long-run climate scenarios data under the BAU2 scenario.



Source: NEF analysis, OECD long-run climate scenarios re-based to 2024 as historical/current damages are assumed to be accounted for in forward DSA projections.

## 2.2 IGNORING PHYSICAL CLIMATE RISK WILL STRAIN PUBLIC BUDGETS

While slower growth reduces fiscal capacity, the damage to public assets and infrastructure directly increases fiscal pressure. The next section quantifies these physical costs to public budgets.

### 2.2.1 Direct costs to public budgets of physical climate risks

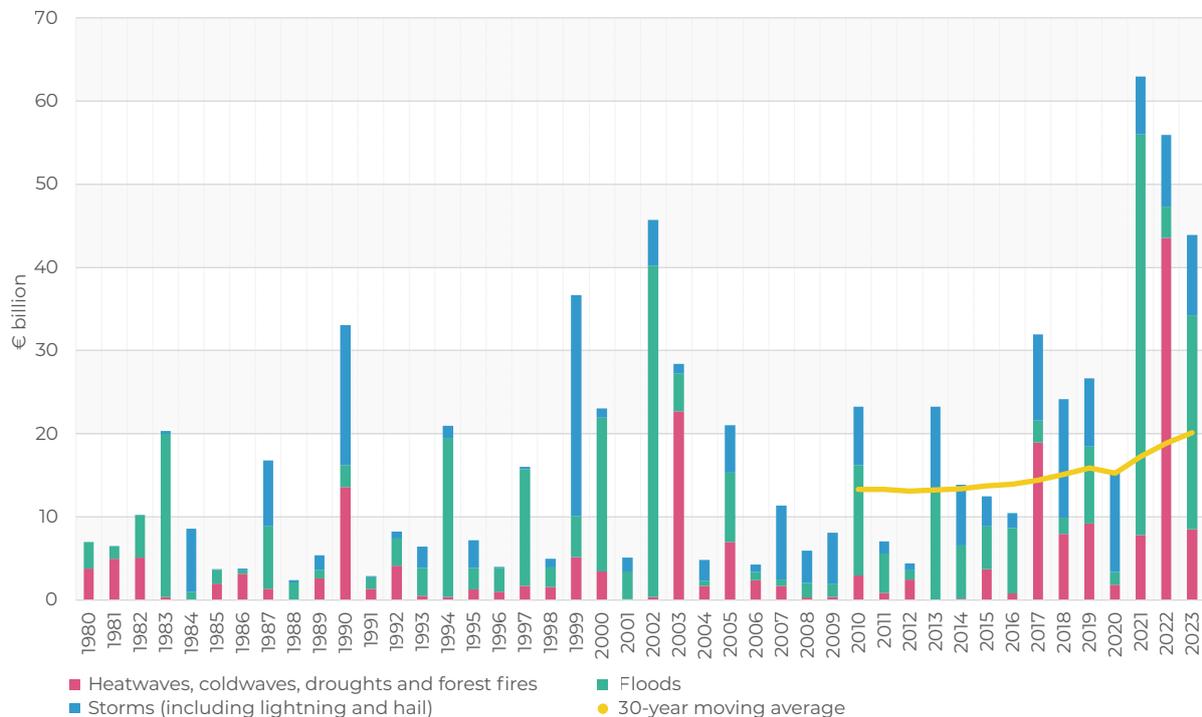
Beyond its impact on GDP, climate change will cause physical damage to assets, infrastructure, and supply chains, with direct fiscal consequences. Warmer temperatures will accelerate the degradation of transport networks, energy grids, and water systems, while extreme weather events will destroy housing, factories, and farmland. These losses not only require costly repairs and reconstruction but also disrupt economic activity, erode tax bases, and increase public spending on disaster relief, social protection, and health care. More frequent and severe climate-related disasters,

therefore, translate into rising public expenditure and potentially higher public debt, particularly where losses are largely uninsured.

Empirical evidence now shows that weather extremes such as floods, wildfires, and droughts are becoming more common and more costly as the climate warms. According to the European Commission,<sup>42</sup> average annual economic losses from climate and weather disasters roughly doubled between 1980–99 and 2000–20. The European Environment Agency (EEA) estimates total climate-related losses of about €650bn (in 2022 prices) across EU countries<sup>43</sup> between 1980 and 2022. Figure 4 shows that economic losses from weather- and climate-related extremes in Europe have become larger and more frequent since the 1980s, with the 30-year moving average now exceeding €20bn annually.

**FIGURE 4: WEATHER- AND CLIMATE-RELATED LOSSES IN EUROPE HAVE RISEN SHARPLY**

Economic losses from weather- and climate-related extremes in Europe, (2023 prices), 1980-2023.



Source: EEA and CATDAT data, 2024.

Recent years have brought multiple billion-euro disasters: floods in 2021 caused billions of euro of damage and resulted in 196 deaths in Germany and 43 in Belgium<sup>44</sup>; floods in Greece's breadbasket in 2023 destroyed billions of euro worth of crops<sup>45</sup>; and fires once again blazed across southern Europe in 2025.<sup>46</sup> As these events accumulate, governments face mounting fiscal pressure to repair roads, bridges, and power lines; support farmers and businesses; and strengthen future defences.

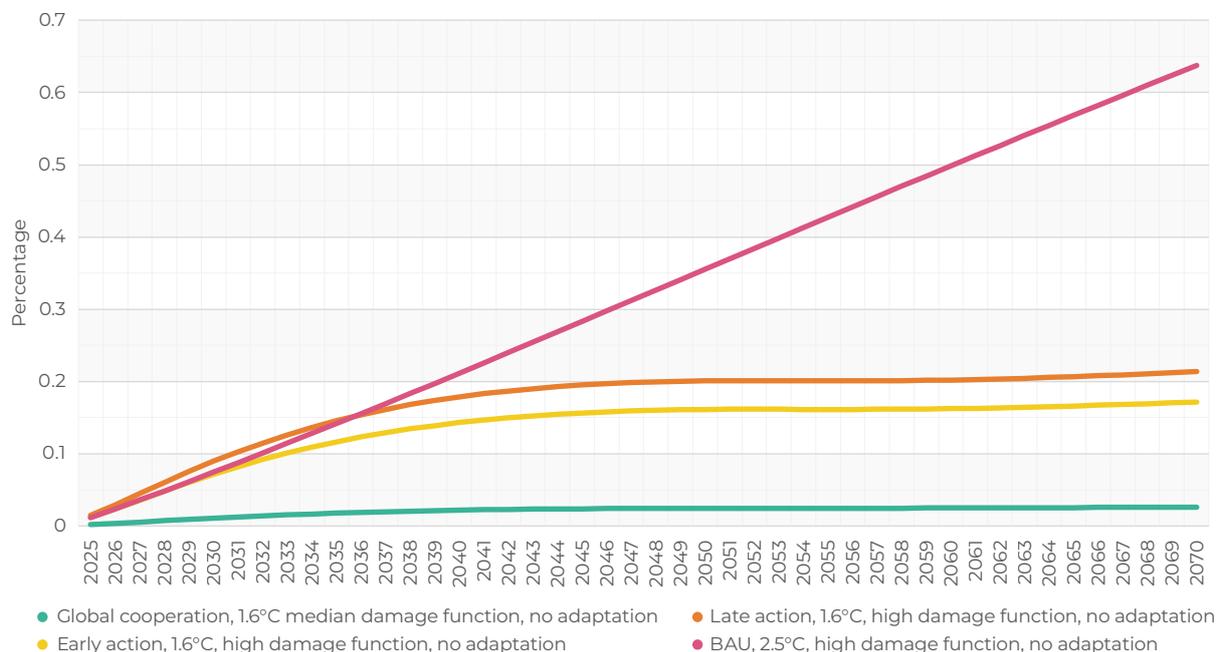
A key driver of this fiscal strain is the large insurance protection gap for natural disasters: most climate-related losses are not covered by private insurance. According to estimates for 1980-2024, in Europe, less than 20% of total losses were privately insured,<sup>47</sup> although this varied significantly across countries, from less than 2% in Lithuania, Romania, Cyprus, and Bulgaria to over 35% in Denmark, Luxembourg, Belgium, and the Netherlands. This means that when a catastrophe strikes, the majority of costs fall on individuals, businesses, and the public sector, rather than being absorbed by insurance payouts. Indeed, governments often serve as insurers of last resort when disasters strike, funding emergency

response, reconstruction of public infrastructure, and relief payments. As the climate crisis worsens, the insurance protection gap is likely to widen further. In its *2025 Financial Stability Review*,<sup>48</sup> the European Central Bank warns that, as the proportion of economic losses grows, insurance premiums will rise, making coverage increasingly unaffordable.

Evidence from past disasters shows that governments frequently end up shouldering a large share of uninsured losses. In the United States, for example, one analysis of 53 major disasters from 1989 to 2006 found that federal relief payments covered about 32% of the total disaster damages, which amounted to roughly 57% of the uninsured portion of losses on average.<sup>49</sup> In Europe, we have seen similar dynamics. For instance, the catastrophic floods in western Europe in July 2021, the costliest natural disaster on record for the region, caused an estimated €46bn in damage across countries, including about €33bn in Germany alone. Yet only a small fraction of those losses was covered by insurers (around €8bn of the German damage was insured).<sup>50</sup> In response, German federal and state authorities established a €30bn national reconstruction fund to help

**FIGURE 5: FISCAL COSTS EXPLODE UNDER HIGHER WARMING AND HIGHER DAMAGES, BUT REMAIN LIMITED IF WARMING AND DAMAGES ARE KEPT LOW**

Average of EU25 direct fiscal spending relative to the DSA baseline, % of GDP, 2025-70.



Source: NEF analysis of EEA/CATDAT and OECD long-run scenarios data, re-based to 2024 as historical/current damages are assumed to be accounted for in forward DSA projections. OECD baseline is assumed to be consistent with the Commission’s DSM baseline. Notes: While we map our global cooperation scenario on an OECD scenario with almost zero economic damages relative to 2024, this is a likely significant underestimate. Even under full global cooperation and rapid decarbonisation, additional warming is already locked in, and a growing body of literature suggests that standard economic damage functions likely underestimate long-run GDP losses by omitting nonlinearities, tipping points, and systemic risks.

rebuild homes, businesses, and infrastructure, reimbursing up to 80% of the incurred damage costs for uninsured victims. This aid package meant that the government assumed a significant share of the uninsured losses. While not every disaster leads to such a large public outlay, the 2021 flood response illustrates how, when private insurance falls short, governments step in as the payer of last resort for recovery.

We estimate the direct fiscal costs of climate-related shocks by starting from observed uninsured disaster losses and projecting them forward. Using data from the EEA and CATDAT,<sup>51</sup> we set a baseline for overall climate-related losses at 0.12% of 2024 EU GDP (as the 2023, 30-year moving average was 0.12% 2023 GDP), distributed across member states according to their historical shares of uninsured losses 1980-2023. These losses are then scaled over time using the OECD GDP damage trajectories under different scenarios.

To estimate the share of losses that fall on the public sector, we draw on the UK OBR,<sup>52</sup> which finds that governments typically bear about 43% of flooding losses and 50% of losses from other climate-related hazards such as heatwaves, droughts, coldwaves, and forest fires. We apply these ratios to the corresponding event types in the CATDAT database. Because the insurance gap in Europe is expected to widen as climate impacts intensify, our estimates are likely to understate the true fiscal exposure.

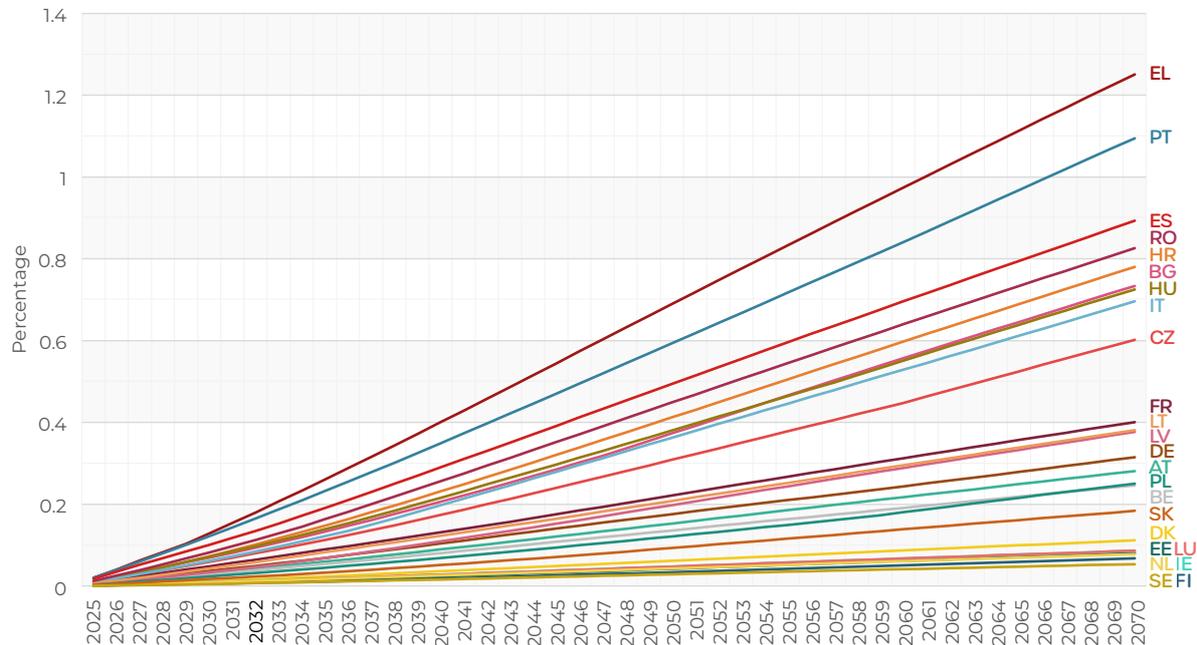
Figures 5 and 6 show how escalating climate damages gradually increase fiscal pressures across the EU. Under a BAU scenario without additional adaptation, direct fiscal costs rise to over 0.5% of GDP in most countries by 2070, with the Mediterranean and Continental regions hardest hit. Slovenia stands out as an outlier above 3% of GDP, reflecting the large relative scale of recent disasters in the base year. We have excluded Slovenia from Figure 5 to improve the visibility of

## THE CLIMATE-FISCAL TIMEBOMB

### HOW CLIMATE CHANGE WILL IMPACT PUBLIC BUDGETS

**FIGURE 6: FISCAL COSTS FROM CLIMATE DAMAGES RISE STEEPLY UNDER A BAU, HIGH DAMAGE CURVE SCENARIO**

Direct fiscal costs of physical climate damages relative to the DSA baseline, % of GDP, 2025-70, EU25 countries.



Source: NEF analysis of EEA/CATDAT and OECD long-run scenarios data. Notes: We have excluded Slovenia from this figure as, over the period, its costs increased to 3% of GDP, making it hard to distinguish differences with other countries. This result is seemingly an outlier, and is because Slovenia's losses have been so high since 1980 relative to its 2024 GDP, as compared to other countries, according to the EEA/CATDAT data. Therefore, while excluded in this chart, impacts are included in the final scenario analysis.

the differences between other countries. Nordic-Baltic countries face the smallest fiscal burdens. Averaged across the EU25, fiscal costs climb from close to no additional costs from today in a global cooperation world, to over 0.6% additional costs in a BAU world, showing how higher warming steadily compounds public budget pressures.

#### 2.2.2 Indirect costs to public budgets

Climate damages also weaken public finances indirectly, as slower growth erodes tax revenues while core spending commitments remain. We link revenues to GDP based on the current average tax rate. For example, if the government currently collects 40% of GDP in taxes, a 1% increase (or decrease) in GDP will see tax revenues rise (or fall) by 0.4% of GDP. Further, we assume governments maintain public service provision rather than cutting it in line with GDP. This is at odds with the OBR's approach, for example, which assumes that primary spending (welfare and pensions) moves in line with GDP, but thereby implicitly bakes in

austerity.

As with the direct-cost estimates, the approach is deliberately conservative, as it does not account for possible structural changes such as higher healthcare demand from climate-related illness, or losses in tax efficiency from more frequent disasters, both of which would further increase long-term fiscal pressure.

We exclude tax losses from the green transition (eg shrinking fossil fuel duty), which is an important issue but beyond the scope of this report. Implicitly, this assumes tax losses are offset elsewhere, through either lower spending or higher revenues.

### 2.3 MITIGATION SPENDING WILL LOWER DAMAGES AND GROW THE ECONOMY

If inaction raises fiscal costs, investment in mitigation can do the opposite. The following section explores how climate investment affects growth and debt dynamics.

#### 2.3.1 Direct costs to public budgets of climate mitigation spend

Limiting global warming to 1.5C, and well below 2C as set out in the Paris Climate Agreement, will require trillions of dollars in low-carbon investment every year for decades. The Intergovernmental Panel on Climate Change's (IPCC) latest assessment indicates that global climate mitigation investment must reach roughly \$1.6–3.8tn annually through 2050 to stay on track for 1.5C, alongside hundreds of billions more for adaptation.<sup>53</sup> These figures vastly exceed current spending levels, implying a steep increase in climate-related investment worldwide.

The EU has committed to cutting emissions by at least 55% by 2030 and net zero by 2050. EU leaders have agreed to a target of at least a 90% reduction by 2040. Achieving these goals will require massive up-front investment in clean energy, energy efficiency, electrified transport, and industrial decarbonisation. Recent estimates by I4CE<sup>c</sup> suggest that the EU must invest about €842bn annually in public and private mitigation spending this decade, around 4.9% of EU GDP, to meet its 2030 objectives. Current investment stands at roughly €498bn (2.9% of GDP), leaving a gap of around €344bn per year (about 2% of GDP). In other words, Europe must nearly double its climate-related investment to stay on track. The European Commission's own analysis points to a similar scale, estimating over €620bn in additional annual investment needs.<sup>54</sup>

Meeting these needs will require a combination of public and private finance. Much of the total will come from private actors, for example, utility firms building wind farms, automakers and consumers investing in electric vehicles, and homeowners retrofitting buildings. Yet a large share must still be financed through public budgets. Many climate solutions generate social benefits that markets

undervalue. Insulating low-income homes, for example, reduces both emissions and energy poverty but yields limited private profit. Likewise, early-stage clean technologies such as advanced batteries or green steel are often too risky or capital-intensive for private investors without public support. In these cases, public spending and industrial policy can lead the way, laying the groundwork for markets that private finance can later scale. Institute Rousseau<sup>55</sup> estimates total public investment needs to meet the EU's climate targets at around €510bn per year, implying an additional €260bn (1.6% of GDP) in annual public expenditure relative to today (2021 prices). Part of the additional public investment need will be covered by carbon revenues. A review of major modelling exercises by Ziesemer et al.,<sup>56</sup> including those by the European Commission, the OECD, and NGFS, finds that scenarios which rely mainly on carbon pricing to achieve climate goals typically produce GDP losses of around 1–2% by the mid-2030s. Such models treat carbon prices as exogenous cost shocks and often assume rapid global coordination and smooth technology switching, assumptions unlikely to hold in practice. In contrast, Ziesemer et al.<sup>57</sup> show that combining carbon pricing with substantial public investment in clean infrastructure and new technologies both reduces the economic costs of mitigation and improves long-term growth outcomes.

Consistent with this evidence, we model a balanced policy mix in which the transition is investment-led rather than price-led. We model two alternative mitigation strategies, namely early and delayed EU action. Both aim to achieve similar climate targets, but differ in the timing and efficiency of investment.

Following Ziesemer et al.,<sup>58</sup> in an early EU action scenario, we model that the government borrows 1% of GDP to finance additional net public investment. This estimate is based on a recent report by Heilmann et al. on the relationship between carbon price scenarios and additional public spending needs in Germany, but we are applying it to all 25 EU member states examined as a simplifying assumption.<sup>59</sup> Based on the Institut Rousseau estimate of a 1.6% of GDP total

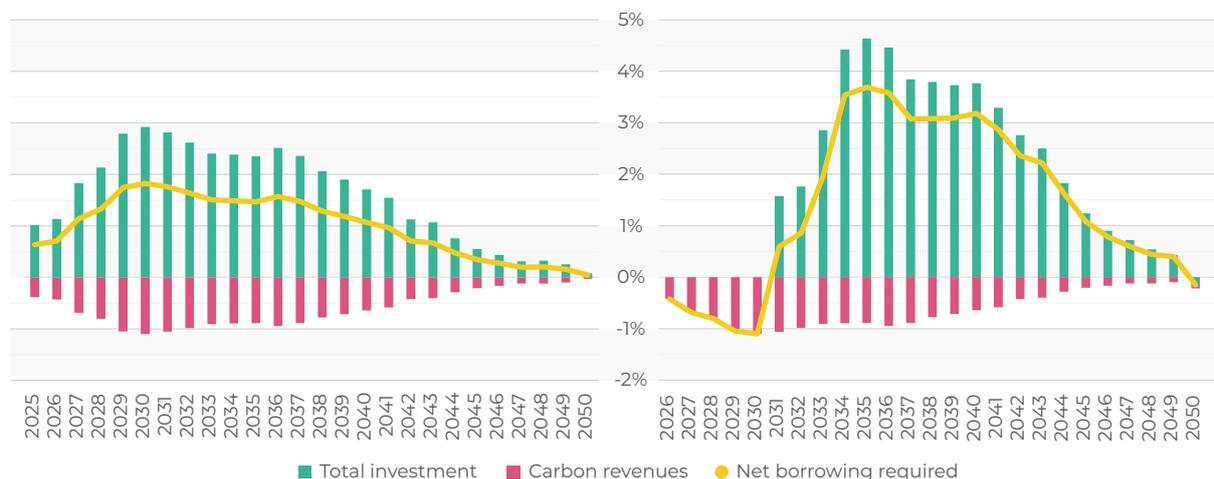
<sup>c</sup> These figures cover capital needs in renewable energy, power grids, building renovations, clean transport (electric vehicles, rail), and cleantech manufacturing within the EU. And they exclude some areas like heavy industry and agriculture, meaning the true investment needs are likely to be even higher.

## THE CLIMATE-FISCAL TIMEBOMB

### HOW CLIMATE CHANGE WILL IMPACT PUBLIC BUDGETS

**FIGURE 7: FRONTLOADING CLIMATE INVESTMENTS SPREADS COSTS OVER TIME AND LOWERS FISCAL PRESSURES**

Public mitigation investment needs across the EU as a share of GDP, %, 2025-50. Left panel: early EU investment scenario; right panel: delayed EU investment scenario. Bars show total investment and carbon revenues; lines show net borrowing required.



Source: NEF analysis of Institut Rousseau, UK Committee on Climate Change. Notes: The simplified assumption that carbon revenues cover roughly one-third of the mitigation investment need in the early EU action scenario could be an overestimate. However, other environmental tax revenues could also be considered for investment recycling.

public investment gap, this implies that roughly 0.6% of GDP, or around one-third of additional climate investment out to 2050, is covered through recycled carbon-pricing revenues.

This assumption sits reasonably within estimates in the literature. Across a range of countries assessed by the OECD, net carbon revenue (defined as revenue from carbon pricing instruments minus fossil fuel subsidies and implicit support through free allocation of ETS permits) is currently 0.6% of GDP on average, but modest carbon tax reform could boost that to 1.7%.<sup>60</sup> The IMF estimates that a carbon price of US \$50 per tonne CO<sub>2</sub> on top of existing schemes could generate about 1% of GDP in 2030 in emission-intensive countries, and around 0.5% in some EU member states (eg France, Germany, Italy).<sup>61, 62</sup> The European Central Bank's (ECB) modelled "carbon tax" scenario estimates that a gradual increase in the carbon tax will generate average annual revenues ranging between 0.3% and 1.1% of GDP in 2030,<sup>63</sup> arguing that under the current scheme, the carbon taxation is too low to achieve decarbonisation goals, and that there is

significant dispersion of carbon rate levels across euro area countries. Gagliardi (2025) compiles Emissions Trading Scheme (ETS) revenue data from official Commission projections, where revenues are mostly below 0.5% GDP. However, this does not account for revenues from the Carbon Border Adjustment Mechanism. Carbon price assumptions and, therefore, revenue estimates are highly uncertain, and a formal review of the EU's ETS system is expected in July 2026.

Given uncertainty regarding future carbon prices, policy design, sectoral coverage, and the scheduled 2026 review of the EU ETS, precise revenue projections remain highly uncertain. Against this backdrop, the assumption that recycled carbon revenues finance roughly one-third of additional mitigation spending, with borrowing covering the remaining two-thirds over the period, is one that represents a proportionate and literature-consistent modelling simplification.

We profile this additional investment need over time to assess the fiscal implications of early versus delayed action. Rather than following the approach

taken by Gagliardi in the 2025 Commission paper,<sup>d</sup> which explains that member- state-level figures are subject to significant uncertainty, and where costs do not tend to zero as 2050 approaches, we use a simplifying assumption that all countries invest across a similar time profile, as set out for the UK by the UK's Committee on Climate Change. The time profile of investments is highly uncertain: we have opted for simplification over spurious accuracy, given our main intention is to demonstrate an investment hump up front that tempers out toward 2050.

Figure 7 compares the timing of spending under early EU and delayed EU investment strategies. In the early action case, spending peaks around the early 2030s and declines steadily. In the delayed action case, investment and fiscal pressure both rise sharply after 2035 in the rush to meet delayed targets, with total costs around 25% higher to reflect compressed deployment, a higher reliance on expensive carbon removals, and missed innovation opportunities. We do not include household compensation payments or the erosion of fossil-fuel revenues in this analysis. As the EU's ETS is already legislated, we assume carbon tax revenues are fixed between the two scenarios to represent expected policy. In practice, less early support in a delayed action scenario may lead to higher carbon prices/revenues in that scenario.

### 2.3.2 GDP impacts of the transition

Well-targeted public investment can not only offset the economic costs associated with carbon pricing but also deliver a net boost to economic growth. A growing body of research<sup>64</sup> finds that climate-related investments have high fiscal multipliers; each euro of spending generates more than one euro of additional output through job creation, productivity gains, and technological innovation.

Evidence across studies consistently supports this. IMF analysis<sup>65</sup> finds that government spending on green technologies yields a cumulative multiplier of 1.1–1.5, with effects persisting for at least five years. Other work estimates even larger impacts, up to 4.2 for green-tech investment,<sup>66</sup> and similarly high returns for public infrastructure, with

multipliers of 1.4 in advanced economies<sup>67</sup> and around 2.0 in Europe.<sup>68</sup> A meta-analysis<sup>69</sup> of over 1,000 estimates confirms that public investment multipliers typically average around 1.5, higher than those for general government consumption. The weight of evidence, therefore, indicates that ambitious climate investment can stimulate the economy while cutting emissions.

Furthermore, these multiplier studies point to some persistent effects. This is because climate investment directly adds to the capital stock of a country in a lasting way, increasing the available infrastructure and technology base. For example, the UK OBR has recently incorporated the permanent effects of public investment on output, using a 0.1 elasticity. In other words, if public capital stock increases by 10% permanently, then output is expected to be permanently 1% higher.

Despite this, most European fiscal frameworks still understate these benefits. The European Commission's DSA assumes a fixed multiplier of 0.6, implying that every euro of public spending generates less than one euro of output. This runs counter to the Commission's own studies, which find typical returns of €1.00–1.40 per euro of public investments. Other institutions, such as the Dutch CPB, embed similarly cautious assumptions, often incorporating 'crowding out' effects that assume public spending displaces private investment<sup>70</sup>. These choices are not neutral: they systematically bias policy toward underinvestment by ignoring how well-designed public spending can raise long-term growth. As NEF's *Forecasting a Better Future report*<sup>71</sup> highlights, such conservative assumptions have repeatedly led to austerity policies that failed even on their own terms, raising the debt-to-GDP ratio rather than lowering it.

OECD data on GDP impacts from physical damage and from the transition is aggregated in their scenarios. In the OECD long-run climate scenarios, which employ the ENV-Linkages Computable General Equilibrium (CGE) model, GDP impacts of the transition emerge endogenously from the economy's response to binding emissions constraints. Emissions

<sup>d</sup> Gagliardi takes country-specific time profiles constructed using total EU-wide energy system costs across member states based on the "MIX-55" scenario (average for 2020–25), as published in the 2030 Climate Target Plan; the most recent figures from the Net Zero Industry Act Staff Working Document – covering Fit for 55 and REPowerEU – for the period 2021–30; and average EU-wide investment needs from the S2 and S3 scenarios for the period 2031–50 as reported in the 2040 Climate Target Plan. We have instead employed a simplifying assumption, given that our scenarios are illustrative.

## THE CLIMATE-FISCAL TIMEBOMB

### HOW CLIMATE CHANGE WILL IMPACT PUBLIC BUDGETS

reductions are primarily achieved through rising carbon prices, which increase production costs across carbon-intensive sectors and are transmitted through the economy via higher energy prices, shifts in production patterns, and changes in trade competitiveness. Low-carbon investment is included as a necessary adjustment to meet emissions targets, but it is treated as a compliance cost rather than a productivity-enhancing driver; that is, additional investment does not automatically increase total factor productivity or output. Moreover, large-scale transition investment is assumed to be partially inflationary: it raises demand for materials, labour, and equipment in the short to medium term, contributing to higher prices for intermediate inputs and final goods. As a result, some of the GDP impact arises not only from the resource cost of abatement but also from these price effects. Over time, as abatement requirements tighten, marginal costs rise and inflationary pressures continue, producing accelerating GDP losses in later periods. The framework also accounts for heterogeneity across sectors and countries, so impacts are generally larger for regions with high industrial intensity or energy dependence, reflecting structural differences in exposure to the transition.

We believe that a much larger share of the transition can and should be achieved through proactive investment rather than solely through pricing mechanisms. Accordingly, we add on the mitigation-related investment costs and explicitly account for the positive GDP impacts that such spending generates via short-term multipliers in the economy. To remain conservative, however, we only apply these effects to net spending above expected ETS revenues, rather than to the full investment envelope, ensuring that we do not overstate the economic expansion potential. Under this approach, low-carbon investment is not assumed to be inflationary or a pure compliance cost; instead, it can stimulate productive capacity, foster innovation, and support broader growth, offsetting or even reversing the short-term drag on GDP that is typical in CGE-based conservative frameworks like ENV-Linkages. Early EU action spreads investment over three decades, generating stronger growth multipliers (1.3), while delayed EU action compresses spending after 2035, reducing the multiplier to 1.0 due to supply constraints, weaker productivity effects, and lost first-mover

and innovation advantages.

We also model long-term growth effects using IMF figures<sup>72</sup> on the public capital stock across EU member states. In our early EU action scenario, we assume a 1% increase in the capital stock translates into a 0.065% increase in output, representing the lower estimates of output elasticity in the literature. We chose this lower estimate as we do not account for capital depreciation or diminishing returns; using a lower estimate will not overestimate these effects. Further, in the delayed EU action scenario, we halve this elasticity assuming that capital investment in the delayed scenario does not have as many economic benefits due to lost competitiveness and is more likely to substitute for other infrastructure, ie a lack of international and domestic additionality.

#### 2.4 ADAPTATION SPENDING WILL LOWER FUTURE DAMAGES

Even with rapid emissions cuts, some climate impacts are now unavoidable. Adaptation spending, therefore, becomes the second pillar of fiscal resilience.

##### 2.4.1 Direct costs to public budgets of adaptation

Even with rapid emissions cuts, the world will still experience more heatwaves, floods, and droughts over the coming decades. This means adaptation is not optional; it is a necessary parallel track to mitigation. Adaptation is about preparing societies to live with a warmer, more unpredictable climate, protecting lives, livelihoods, and infrastructure from unavoidable impacts. This can mean building coastal defences to shield towns from storm surges, upgrading drainage systems to handle extreme rainfall, reinforcing power grids to cope with heatwaves, or expanding early warning systems so communities can act before disasters strike. It is about climate-proofing the everyday systems we rely on.

Adaptation spending thus represents a direct cost to public budgets. Estimates of the total investment in adaptation needed across Europe vary. We use the PESETA IV<sup>73</sup> and COACCH<sup>74</sup> studies, which estimate adaptation needs under different warming scenarios for various sectors by assessing the changes in the cost of inaction over time. They estimate that annual investment

## THE CLIMATE-FISCAL TIMEBOMB

### HOW CLIMATE CHANGE WILL IMPACT PUBLIC BUDGETS

needs for the EU27 and UK will be around €40bn under a 1.5C scenario, rising to €80–120bn under 2C, and reaching €175–200bn under 3–4C (2015 prices).<sup>75</sup> We take the high end of the ranges to avoid underestimating potential fiscal pressures. Adaptation cost estimates remain incomplete for several sectors (eg health, ecosystems, and social protection) and often exclude compounding risks from simultaneous heat, flood, and drought events. Using the upper bound, therefore, provides a more precautionary estimate that better reflects the uncertainty of adaptation spending needs. Moreover, although the underlying studies include the UK, its removal would alter the aggregate total only marginally, well within the uncertainty range of the data, so we retain the full estimate.

Our adaptation spending profile is flat, and we have not found evidence for how best to distribute costs and impacts over time. Therefore, although Campagioto et al.<sup>76</sup> find that early and fast adaptation spending is more effective than late and gradual spending, we have been unable to model the impact of shifting the time profile of adaptation spending under different scenarios.

We allocate adaptation costs across member states using a composite index combining three weighted indicators: climate risk exposure (based on the 2025 Climate Risk Index<sup>77</sup>), population share, and GDP share. Each factor is weighted equally.

#### 2.4.2 GDP impacts of adaptation

In the absence of robust estimates of the economic multiplier effect of adaptation spending in the literature, we apply a multiplier of 0.75 in line with the conservative estimates in the Commission's DSA at the time of modelling.

The second part of the GDP impact of adaptation spending is its mitigation of GDP losses due to climate change. Although the literature on this subject is fragmented and lacks consistent estimates across Europe, there is a consensus that adaptation spending averts some of the GDP losses from climate change.

According to the Global Commission on Adaptation, adaptation can provide a triple

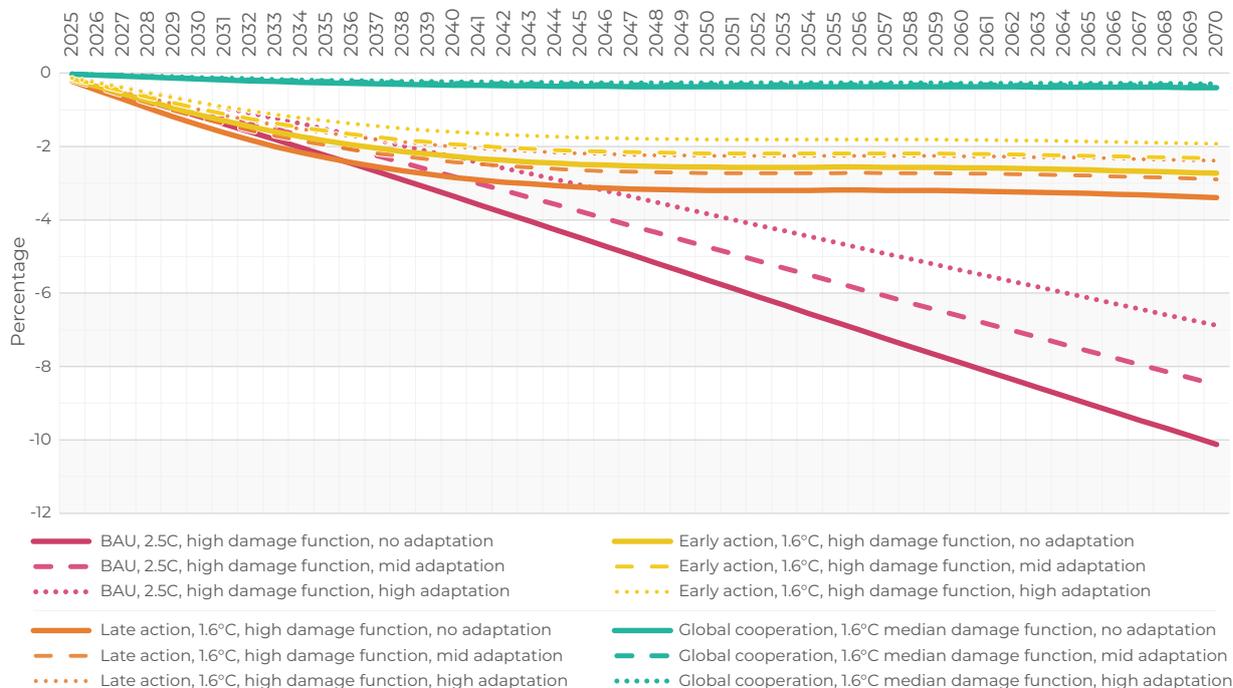
dividend: it avoids economic losses, brings positive economic gains, and delivers additional social and environmental benefits.<sup>78</sup> The second dividend – positive economic gains – reflects that adaptation investment can create jobs and spur innovation (eg in climate-resilient construction materials or advanced water-management systems). These sectors not only meet rising demand but can also drive productivity and competitiveness, offsetting part of the upfront costs. While damage repair and crisis response can also stimulate short-term economic activity, these gains are typically temporary and come at far higher human and financial cost.

This triple dividend means that investment in adaptation can reduce future fiscal costs. Empirical evidence on the effectiveness of adaptation varies widely across countries and sectors. Cross-sectoral studies, such as OECD<sup>79</sup> and de Bruin et al.,<sup>80</sup> find that adaptation can avert roughly a quarter to a third of total climate damages. A recent study by the Potsdam Institute for Climate Impact Research<sup>81</sup> finds that adaptation to flooding has already reduced economic losses in Europe by around 60%, although adaptation spending has its limits, underscoring that adaptation cannot fully offset escalating climate damages.

Country-level analyses show even greater variation, from modest gains in Austria<sup>82</sup> to near-complete offsetting of agricultural productivity losses in Spain.<sup>83</sup> Using a macrosimulation model of the Italian economy from 2021 to 2050, Campigotto et al.<sup>84</sup> analysed the impact of adaptation spending on debt sustainability across four scenarios, averaging the results of different levels of adaptation spending effectiveness. They found that the fast adaptation scenario achieved a reduction in the debt-to-GDP ratio of approximately 7.5 percentage points (pps) by 2050, which was more than double the reduction obtained by the slow adaptation scenario.<sup>85</sup> Their results suggest that an increase in the public deficit due to adaptation spending improves rather than impedes debt sustainability due to the offsetting effect on climate damage.

**FIGURE 8: ADAPTATION SPENDING SIGNIFICANTLY REDUCES LONG-TERM GDP LOSSES ACROSS ALL WARMING SCENARIOS**

EU25 average GDP deviation from the DSA baseline, %, 2025–70, with and without optimum adaptation.



Source: NEF analysis; OECD long-run climate scenarios.

While quantitative estimates of the exact effect of adaptation spending on the reduction of GDP losses are fragmented and vary considerably, we think it is useful to include some illustrative estimates in our modelling, akin to a what-if analysis of potential adaptation impacts, given the significant effect early adaptation spending could have on alleviating the debt ratio increases resulting from climate damage.

For this, we make two assumptions about the effect of adaptation spending on GDP losses from climate damage.

First, to capture the effect of adaptation on economic outcomes, we draw on the OECD’s global adaptation cost curve<sup>86</sup> to estimate the share of climate damages that can be averted under different levels of spending.

This cost curve shows that the ‘optimum’ level of adaptation spending, in this case the PESETA IV and COACCH study optimum adaptation spending estimate of around €40bn annually in the EU in a

1.5C world (≈€52bn in 2024 prices, about 0.3% of EU GDP), can avert on average 27% of damage.

Second, there appears to be a link between the size of the effect of adaptation spending and the warming scenario. In a higher warming scenario, adaptation spending is generally more effective, thus there is an increase in the percentage of losses avoided from climate damage. For example, Tiggeloven et al.<sup>87</sup> find that as adaptation costs rise by about 25% between moderate (≈ 2–3C) and high (≈ 5C) warming scenarios, benefits roughly double, Dottori et al.<sup>88</sup> show that the benefit-cost ratio of flood adaptation in Europe increases by around 16% between 1.5C and 3C, and Fried<sup>89</sup> estimates a roughly 5-pp greater reduction in storm-related damages under higher warming conditions. Since evidence is scarce and the effectiveness of adaptation spending varies significantly by country, as illustrated by Preinfalk et al.,<sup>90</sup> we adopt conservative estimates regarding the difference in the effectiveness of adaptation spending in different warming scenarios. We assume that, between a global cooperation

## THE CLIMATE-FISCAL TIMEBOMB

### HOW CLIMATE CHANGE WILL IMPACT PUBLIC BUDGETS

scenario and BAU, an additional 5 pps of GDP in damages are averted by optimum adaptation spending. Where investment falls short of this optimum level, we assume the avoided losses are halved. This simplification reflects the absence of a consistent empirical source for sub-optimal adaptation effectiveness.

Figure 8 shows that adaptation spending significantly reduces long-term GDP losses across all warming scenarios. Under a BAU scenario, GDP falls by about 7% rather than 10%, while under an early EU action scenario, the decline is contained to around 2%. While under the global cooperation scenario, adaptation investment appears to deliver comparatively smaller benefits, as discussed above, the GDP damage figures in this scenario are likely an underestimate, thus some degree of adaptation investment would still be worthwhile.

#### 2.5 CLIMATE RISK WILL INCREASE THE COST OF BORROWING

Beyond direct spending pressures, markets are beginning to price climate risk into sovereign borrowing costs. The IMF shows that a 10-pp increase in climate vulnerability correlates with about a 30-basis-point (bp) rise in 10-year government-bond spreads, while a 10-pp improvement in resilience corresponds to a 7.5-bp fall in spreads.<sup>91</sup> Another analysis<sup>92</sup> finds that when sovereign credit ratings account for adaptation efforts, the projected rating downgrades from climate impacts are substantially smaller, implying that resilience investment not only reduces physical vulnerability but also protects creditworthiness and lowers long-term capital costs.

Broader policy and market guidance reinforce this direction of travel. The NGFS notes that sovereigns face climate-related risks through fiscal, macroeconomic, and market-perception channels, and that these risks are increasingly being incorporated into investment and risk-management frameworks by central banks and sovereign investors.<sup>93</sup> The NGFS encourages integrating climate scenarios and transition pathways into sovereign risk assessment to anticipate future shifts in yields and credit quality. Similarly, the OECD highlights that climate

impacts pose growing fiscal and financial risks for governments and should be embedded in public-finance and debt-management frameworks.<sup>94</sup> Together, these analyses support the case for factoring climate risk into debt-sustainability assessments and for treating credible climate action as a component of fiscal resilience.

According to the recent European Central Bank<sup>95</sup> working paper, countries with greater exposure to physical climate risks tend to receive modestly lower credit ratings. Post-Paris 2015, stronger CO<sub>2</sub>-reduction targets and falling emission intensities correlate with comparatively higher ratings, suggesting that markets are beginning to distinguish between proactive and lagging transition pathways. Although the paper does not convert these rating gaps into specific borrowing-cost increments, it emphasises that the economic impact of climate variables is currently small but could grow over time.

Forward-looking modelling confirms that climate change could directly trigger sovereign downgrades: one study covering 108 countries finds that under a high-emissions scenario, 63 sovereigns would be downgraded by 2030 (average 1 notch) and 80 sovereigns by 2100 (average 2.5 notches), raising global sovereign-borrowing costs by \$137–205bn annually<sup>96</sup>. The study found that these effects are largely avoided under a Paris-aligned scenario.

Empirical studies also underscore the scale of potential impacts. World Bank analysis<sup>97</sup> shows that downgrades to sub-investment-grade status can raise borrowing costs by up to 138 bps, while S&P Global Ratings<sup>98</sup> finds that within investment grade, a downgrade from AA to A adds roughly 40 bps, and a further downgrade to BBB adds around 100 bps. Spillovers within the eurozone also matter. When one member state is downgraded, others' bond yields rise by an average of 12 bps, reflecting financial contagion through integrated markets.<sup>99</sup>

Taken together, these studies indicate that the difference between a resilient and a highly exposed sovereign could plausibly exceed 100 bps. Our modelling therefore applies a +50 bps risk premium to scenarios with high damage, but some further mitigation and adaptation effort and +100 bps in a BAU scenario.

### 3. SCENARIOS: HOW CLIMATE INVESTMENT SHAPES DEBT OUTCOMES

**T**aken together, these channels - slower growth from climate damage, budget, and gross domestic product (GDP) impacts of mitigation and adaptation investment and higher financing costs - feed directly into debt outcomes. Chapter 3 models their combined impact under different policy scenarios.

#### 3.1 EUROPE'S DEBT RULES IGNORE ITS BIGGEST DRIVER OF DEBT

The scenario analysis shows that debt ratios rise steeply compared to the Commission's climate-agnostic baseline in all cases once climate impacts are accounted for, except for the global coordination scenario. The scale of the increase depends on four factors: the extent of climate action, whether governments frontload investment that generates economic returns or instead face escalating costs later, the level of warming and GDP damages reached, and the impact of perceived risk on the interest rate. In the business as usual (BAU) scenario (shown in the figures as a pink diamond), there is no new public spending mitigation or adaptation, there is a 100-basis-point (bp) climate risk premium on borrowing, and global warming is assumed to be around 2.5C with a high damage curve. At the EU level, this implies average debt around 58 percentage points (pps) of GDP higher than the Commission's climate-agnostic baseline by 2050 and around 197 pps higher by 2070. This scenario serves as the baseline for comparison; it represents where debt ratios go, once we include the impacts of climate change and, therefore, where we might expect debt ratios to go if no action is taken to mitigate these effects.

Figures 9 and 10 show how early and coordinated climate action can substantially moderate debt ratios by mid-century compared with delayed or fragmented responses.

Public investment in mitigation and adaptation delivers clear fiscal benefits. In our early EU investment scenario, member states frontload adaptation spending, while limiting global warming somewhat relative to the BAU scenario, but still incurring high damages.<sup>e</sup> Adaptation helps avert direct economic losses, while mitigation generates additional growth gains. Missing the Paris Climate Agreement comes at the cost of a climate-risk premium of 50 bps on borrowing. Early EU investment lowers average debt to 47 pps above the Commission's official estimates in 2050 and 84 pps above by 2070. Compared with the BAU scenario, the debt increase in the early EU investment scenario is 20% smaller in 2050 and 58% smaller in 2070. Early investment spreads costs over time, limits damages, and generates stronger growth through innovation and first-mover advantages.

Our modelling also shows that early investment makes a difference. In our delayed EU investment scenario (orange diamond in the figures), the EU only starts additional investment in mitigation by 2030, increasing the overall cost of mitigation. We also assume this spending is less effective at stimulating the economy with lower multipliers and less aversion of losses from adaptation. Average debt reaches 53 pps above the Commission's official projections in 2050 and 99 pps by 2070. By 2050, debt increases are 9% smaller than under the BAU scenario and by 2070, they are 50% smaller, as the eventual acceleration of investment curbs damages and eases borrowing costs. However, debt remains above the early EU investment scenario, confirming that delay is economically costly.

A more coordinated global scenario delivers a far stronger fiscal dividend. Under global cooperation (green diamond in the figures), we assume the world achieves net zero by 2050, warming is contained to 1.6C with a median damage curve applied, and there is no climate risk premium pushing up borrowing costs. Average debt is 4

<sup>e</sup> Due to data restrictions in those scenarios we were able to model (the OECD only has six defined scenarios), this scenario assumes 1.6C warming, which is unrealistically low in a world without global coordination, so we use the OECD scenario that also applies a high damage curve to better proxy likely damages in a hotter world.

**THE CLIMATE-FISCAL TIMEBOMB**  
 HOW CLIMATE CHANGE WILL IMPACT PUBLIC BUDGETS

pps above the Commission’s official projections in 2050 and 12 pps below it by 2070. This corresponds to debt increases 94% smaller in 2050 and 106% smaller in 2070 than under inaction. Under this scenario, the world achieves net zero by 2050,

warming is contained to 1.5C, and there is no climate-risk premium pushing up borrowing costs. In several member states, debt ratios even fall below the Commission’s climate-agnostic baseline.

**FIGURE 9: EARLY EU CLIMATE INVESTMENT AND GLOBAL COOPERATION LOWER LONG-TERM DEBT RATIOS ACROSS ALL EU COUNTRIES IN 2050**

Debt-to-GDP deviation from the Debt Sustainability Monitor (DSM) baseline, percentage points, 2050.



Source: NEF analysis.

**FIGURE 10: EARLY EU CLIMATE INVESTMENT LIMITS DEBT INCREASES, WHILE DELAYED INVESTMENTS RESULT IN HIGHER DEBT OUTCOMES**

Debt-to-GDP deviation from the DSM baseline, percentage points, 2070.



Source: NEF analysis. Notes: Estonia is an outlier. By 2070, its debt-to-GDP ratio is lower under BAU than under the early EU action scenario. For Croatia, Greece, and Lithuania, early EU action appears more costly than delayed EU action. These results reflect top-down, assumption-heavy modelling and should be interpreted as illustrative rather than as a forecast. Adaptation costs allocated based on GDP, CRI score, and population end up large relative to GDP in these countries: under an early EU action scenario, adaptation investment reaches around 5% of GDP in Estonia, 4.5% in Croatia, 3.8% in Lithuania, 3% in Greece, and 2.4% in Latvia. For all other countries, it’s below 2%. By contrast, Estonia, Latvia, and Lithuania rank relatively low in terms of GDP losses from climate damage under the BAU scenario, with Estonia among the least affected, Latvia is also low, and Lithuania is closer to the middle of the distribution (although Croatia’s and Greece’s damages are substantial).

## THE CLIMATE-FISCAL TIMEBOMB

### HOW CLIMATE CHANGE WILL IMPACT PUBLIC BUDGETS

Interpreting this result requires caution. Even under global cooperation, warming already locked in implies ongoing physical damage, the risk of tipping points being tested or crossed, and cumulative second-order effects that are unlikely to be fully captured in standard potential-growth assumptions. As discussed, due to the limits of current climate economics models, the global cooperation scenario should therefore be read as a lower bound on climate-related fiscal risk and is likely an underestimation.

Figures 11–14 break down the main components driving debt changes across scenarios, highlighting how different combinations of growth, budgetary, and interest rate effects determine overall outcomes for each member state. Each bar shows the contribution of GDP losses, public spending on climate damages, mitigation and adaptation investment, the growth effects of that investment, and higher interest rates associated with climate risk. The black diamond indicates the total change in the debt-to-GDP ratio compared with the Commission’s baseline.

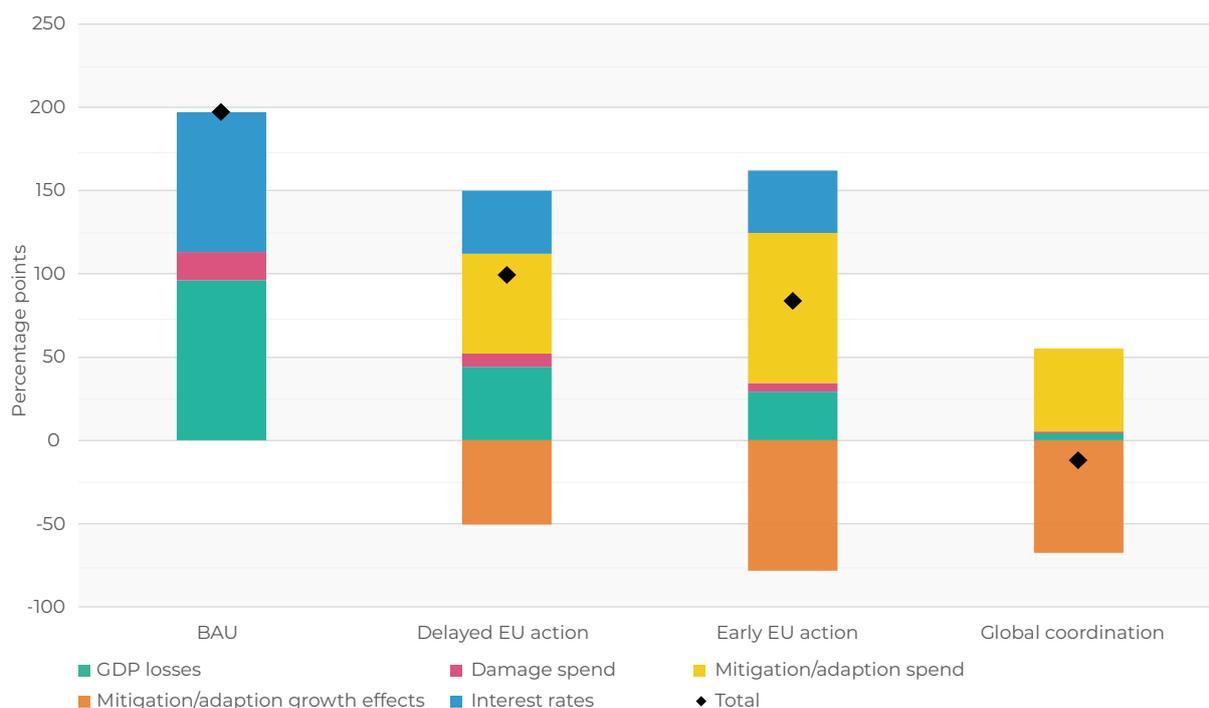
Under the BAU scenario, rising climate damages and lower output are the dominant forces increasing debt. Across almost all member states, GDP losses and higher interest rates account for the majority of the total increase, illustrating how physical risks and market pricing of climate exposure can overwhelm public finances in the absence of sufficient climate action.

In the early EU investment scenario, debt composition shifts markedly. Larger upfront spending on mitigation and adaptation initially pushes debt higher, but this is more than offset over time by stronger growth and avoided damages. The balance of effects turns positive by 2070 in most countries, with the growth dividend from investment and lower interest costs outweighing early fiscal outlays.

The delayed EU investment scenario shows a less favourable profile. Because investment is postponed, mitigation and adaptation spending peaks later and at a higher level, while lower multipliers mean weaker growth effects. Physical

**FIGURE 11: CLIMATE INACTION DRIVES DEBT UP THROUGH GDP LOSSES AND HIGHER BORROWING COSTS**

Average contribution of GDP losses, public spending, investment, growth effects, and interest rate changes relative to the Commission’s baseline, percentage points, 2070.



Source: NEF analysis. Notes: spending adds more to debt in the early EU action scenario because there is an assumed higher level of adaptation spending, which also reduces GDP losses by more than in the delayed EU action scenario. Mitigation spending is also assumed to have a higher multiplier in the early EU action scenario as described in Section 2.3.2.

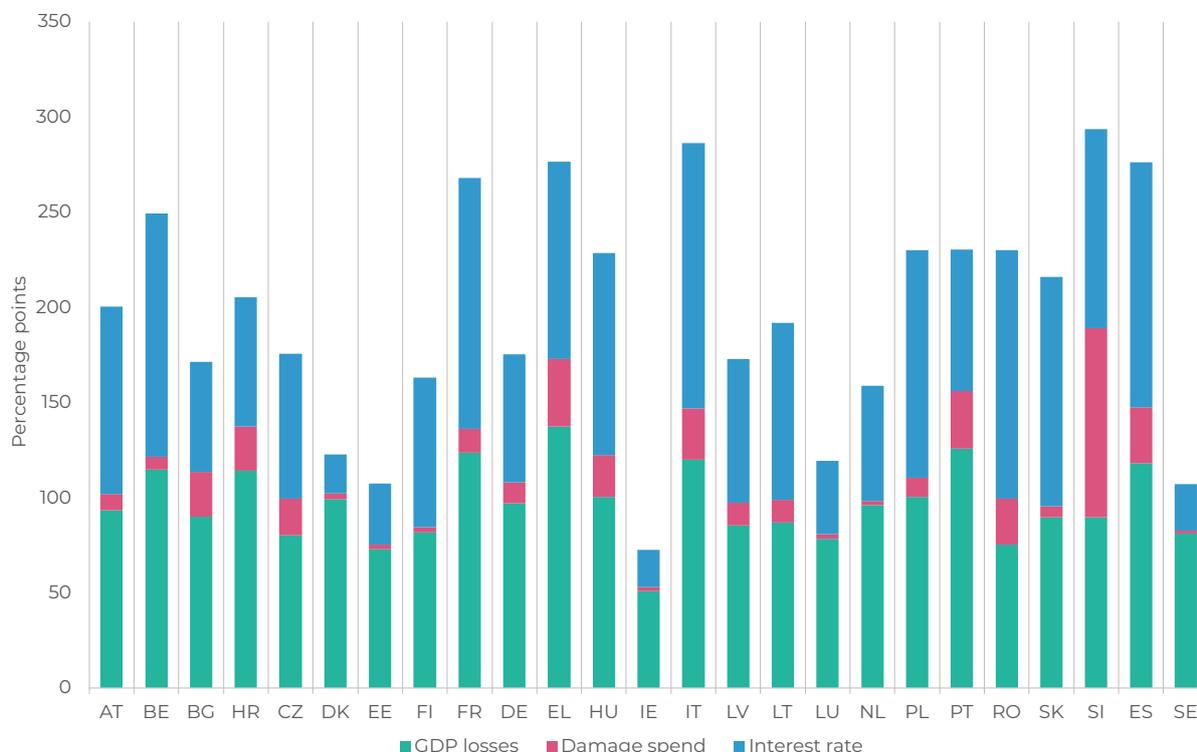
**THE CLIMATE-FISCAL TIMEBOMB**  
 HOW CLIMATE CHANGE WILL IMPACT PUBLIC BUDGETS

damages also remain elevated for longer, leaving overall debt outcomes substantially worse than under the early EU action scenario, even by the end of the projection period.

Under the global cooperation scenario (figure 15), the composition of debt drivers changes again. Earlier and better-coordinated global mitigation limits both domestic GDP losses and interest rate effects, while the combination of lower warming and cheaper finance delivers the strongest fiscal improvement across all member states.

**FIGURE 12: UNDER THE BAU SCENARIO, GDP LOSSES AND HIGHER INTEREST RATES DOMINATE DEBT INCREASES**

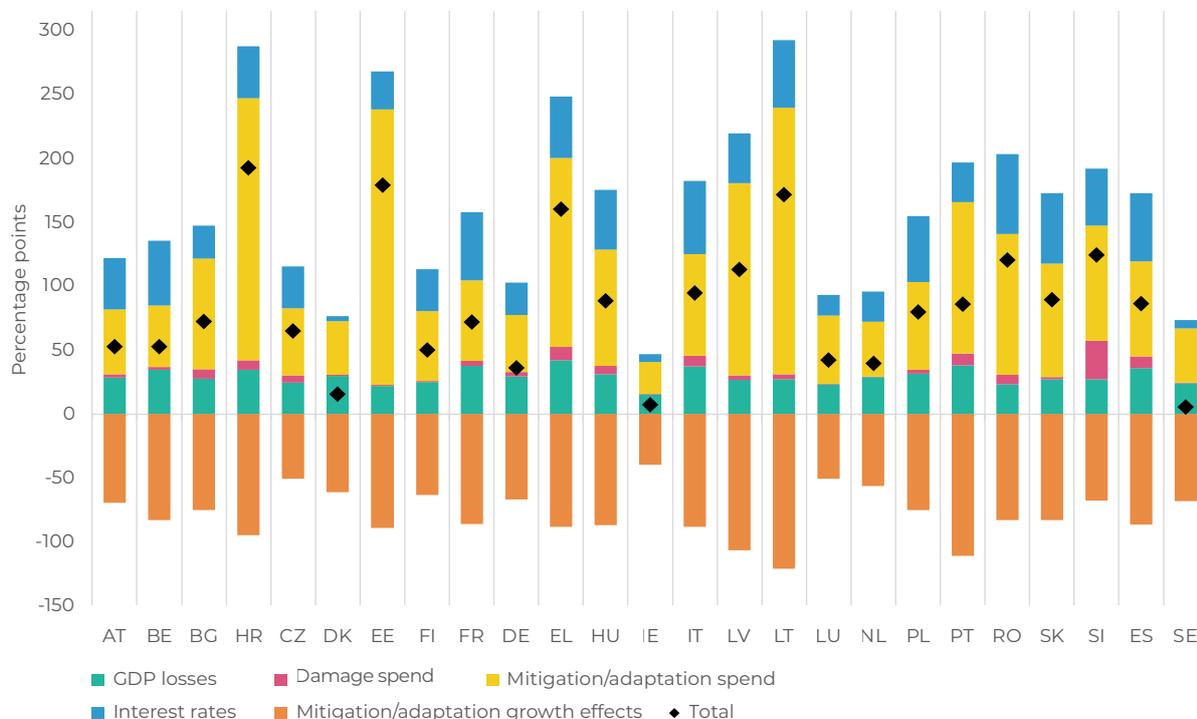
Average contribution of GDP losses, public spending, investment, growth effects, and interest rate changes to debt-to-GDP differences relative to the Commission’s baseline, percentage points, 2070.



Source: NEF analysis. Notes: This chart clearly shows how Slovenia’s fiscal costs of climate damages are disproportionately large. This is because according to EEA/CATDAT data, Slovenia’s historical damage costs have been very large, and this data is used as the basis for projecting forward.

**FIGURE 13: EARLY EU ACTION RAISES INVESTMENT NEEDS, BUT GROWTH GAINS OFFSET COSTS OVER TIME**

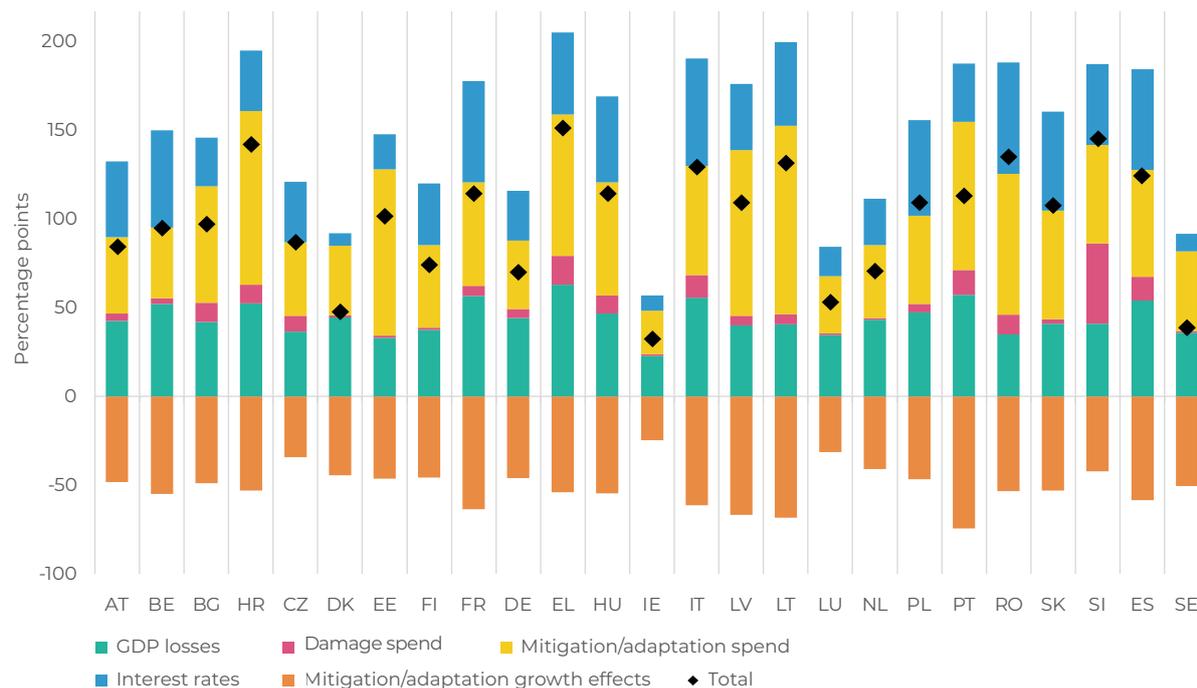
Average contribution of GDP losses, public spending, investment, growth effects, and interest rate changes to debt-to-GDP differences relative to the Commission's baseline, percentage points, 2070.



Source: NEF analysis.

**FIGURE 14: DELAYED EU ACTION RAISES TOTAL MITIGATION COSTS AND WEAKENS GROWTH BENEFITS**

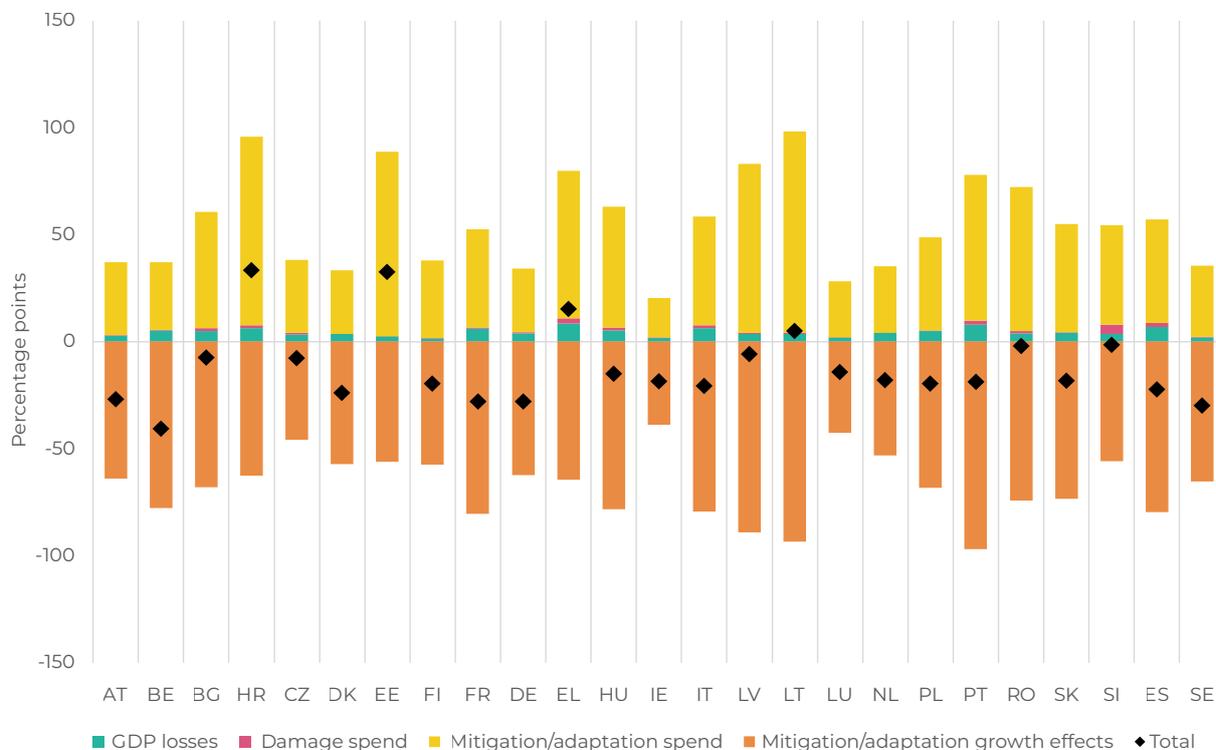
Average contribution of GDP losses, public spending, investment, growth effects, and interest rate changes to debt-to-GDP differences relative to the Commission's baseline, percentage points, 2070.



Source: NEF analysis. Note: This chart clearly shows the large impact that a disproportionately large allocation of adaptation costs has on the debt ratios of some countries. This is a result of the cost distribution index applied and is likely a significant overestimate.

**FIGURE 15: GLOBAL CLIMATE COOPERATION DELIVERS THE STRONGEST FISCAL GAINS ACROSS ALL MEMBER STATES**

Average contribution of GDP losses, public spending, investment, growth effects, and interest rate changes to debt-to-GDP differences relative to the Commission’s baseline, percentage points, 2070.



Source: NEF analysis.

National results reflect differences in exposure to physical climate impacts, the scale and timing of transition investment, and country-specific economic structures. Figure 16 demonstrates how the Mediterranean region sees the steepest debt increases without new climate investment, driven mainly by large GDP losses and rising borrowing costs. The Continental and Atlantic regions see similarly steep declines, whilst the Nordic-Baltic region has slightly lower than average debt

increases. The Nordic-Baltic region sees the debt-to-GDP ratio increase slightly more in the early EU action scenario than in the delayed action scenario. This reflects the prevalence of countries with a disproportionately large allocation of adaptation costs in the Nordic-Baltic region (see figure 10).

**FIGURE 16: SIGNIFICANT REGIONAL VARIATION OF CLIMATE-RELATED FISCAL RISK**

Average of EU25 Debt-to-GDP deviation from the DSM baseline, percentage points, 2070, by regional group.



Source: NEF analysis, see the annexe for regional classifications.

### 3.2 FINANCING RESILIENCE REQUIRES MACROECONOMIC COORDINATION AND FAIR TAXATION

The scenario results point to one conclusion: fiscal sustainability depends on climate action and coordination. This section turns to the policy instruments that can make it even easier to justify, reducing pressure on debt-to-GDP ratios further.

#### 3.2.1 Progressive taxation

Progressive taxation must form part of Europe’s fiscal response to climate risk and inequality. A net wealth tax is one option, but far from the only one. Other approaches, such as NEF’s proposed EU frequent flyer levy (which could generate €64bn in Europe<sup>100</sup>) and fossil fuel profit tax (which could generate €28bn of additional public revenue), can similarly ensure that those most able to pay contribute fairly to the costs of transition.

In our modelling, we use a wealth tax as a proxy for a wider package of progressive revenue measures. Using a wealth tax as a proxy has clear analytical advantages but also limitations. Wealth is unevenly distributed and recorded differently across countries, meaning revenue potential may not align perfectly with broader measures of fiscal capacity or progressivity. Moreover, some alternative revenue sources, such as closing tax loopholes, reforming capital

gains, or implementing coordinated windfall or carbon taxes, might have different economic or distributional effects. Our results should therefore be interpreted as illustrating the order of magnitude of potential progressive fiscal policy space, rather than the impact of any single policy instrument. This choice also reflects the availability of consistent country-level estimates, not a policy preference for one instrument over others.

Following recent evidence,<sup>101</sup> a modest progressive net wealth tax, modelled on the Spanish system and ranging from 1% on fortunes above €5m to 3% on those above €1bn, could raise around €213bn annually across EU member states, equivalent to roughly 1.3% of EU GDP.

Using this revenue breakdown across member states, we simulate the effect of raising an additional 1.3% of GDP in public revenues through progressive taxation. In this scenario (blue circles in Figures 17 and 18), average debt-to-GDP 17 pps above the official climate-agnostic baseline in 2050 and 22 pps by 2070. This lowers debt-to-GDP increases compared to the BAU scenario by 71% in 2050 and 89% in 2070, helping to finance the transition while strengthening fiscal resilience. In practice, a mixed package of progressive measures, combining wealth-, windfall-, and consumption-based taxes, could achieve potentially more

## THE CLIMATE-FISCAL TIMEBOMB

### HOW CLIMATE CHANGE WILL IMPACT PUBLIC BUDGETS

revenues for a just transition. We assume the tax has no impact on GDP growth, so these should be treated as upper-bound estimates of the potential fiscal effect.

#### 3.2.2 Monetary-fiscal coordination

Climate shocks, energy volatility, and geopolitical disruptions are increasingly driving inflation. As the recent surge in food and energy prices<sup>102</sup> has shown, supply-side shocks, whether from war, fossil fuel markets, or extreme weather, now appear to be increasing in frequency.<sup>103</sup> Climate change will intensify these dynamics,<sup>104</sup> making such shocks more frequent, severe, and persistent.

Yet macroeconomic policy remains ill-equipped for this environment.<sup>105</sup> Central banks have largely responded to supply-driven inflation by raising interest rates, despite growing evidence that this approach does little to tackle the underlying causes.<sup>106</sup> Higher rates, meanwhile, raise borrowing costs for governments, firms, and households, making it harder to finance essential investments in clean energy, infrastructure, housing, and food security.<sup>107</sup> The result is a damaging contradiction: fiscal authorities are expected to scale up climate investment just as monetary policy constrains their ability to do so.

A new approach is needed. As NEF<sup>108</sup> has argued, monetary and fiscal policy must work together to deliver price, climate, economic, and fiscal stability. Central banks can help by keeping borrowing costs low for investments aligned with long-term goals, such as green infrastructure, energy security, and resilience. Governments, in turn, can manage inflationary pressures through targeted fiscal tools like energy price caps, strategic reserves, and windfall or excess-profit taxes, reducing reliance on blunt interest-rate adjustments. This does not imply compromising central bank independence, but rather fostering coordination through clear mandates and complementary policy frameworks. Such coordination can create the conditions for affordable, frontloaded climate investment, lowering the risk of future shocks and stabilising debt trajectories over time.

In our monetary-fiscal coordination scenario, borrowing costs are 50 bps lower than the Commission's current projections. This reflects both targeted green interventions by central banks and a broader macroeconomic stance in which fiscal authorities share responsibility for price stability. In such a framework, lower interest rates are not limited to green sectors but extend across the economy, easing finance for housing, infrastructure, and industrial policy that underpin resilience and long-term price stability.

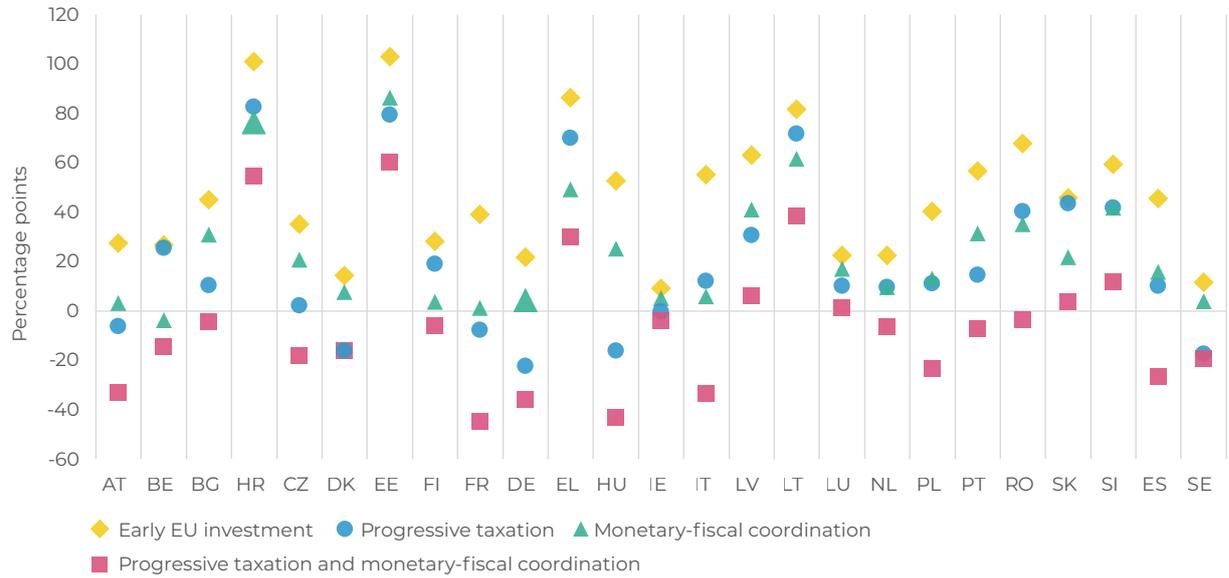
The fiscal benefits are substantial. Figure 17 shows the impact of monetary-fiscal coordination. Here, coordination increases debt ratios by an average debt stands 21 pps above the DSA baseline in 2050 and 15 pps by 2070. This results in the debt increase being 64% smaller in 2050 and 93% smaller in 2070 compared to the BAU scenario.

The most favourable outcomes arise when progressive taxation is paired with monetary-fiscal coordination. When both measures are applied together, average debt reaches 5 pps below the Debt Sustainability Analysis (DSA) baseline in 2050 and 35 pps by 2070. This combined policy scenario reduces debt increases by 109% in 2050 and 115% in 2070 compared to the BAU scenario, with some countries achieving debt levels even below the Commission's climate-agnostic baseline. This underscores that climate change is not only a source of fiscal risk but also an opportunity to rethink economic policy, showing that with fair taxation and coordinated monetary policy, the transition can strengthen, rather than strain, public finances. Stronger taxation and monetary-fiscal coordination are beneficial to debt ratios in any scenario. Therefore, the growing risks of climate change are an opportunity for governments and central banks to wield these tools. Figure 19 disaggregates the factors driving differences between scenarios.

**THE CLIMATE-FISCAL TIMEBOMB**  
 HOW CLIMATE CHANGE WILL IMPACT PUBLIC BUDGETS

**FIGURE 17: FAIR TAXATION AND MONETARY-FISCAL COORDINATION REDUCE DEBT LEVELS**

Debt-to-GDP deviation from DSM baseline, percentage points, 2050.



Source: NEF analysis.

**FIGURE 18: FAIR TAXATION AND MONETARY-FISCAL COORDINATION REDUCE DEBT LEVELS**

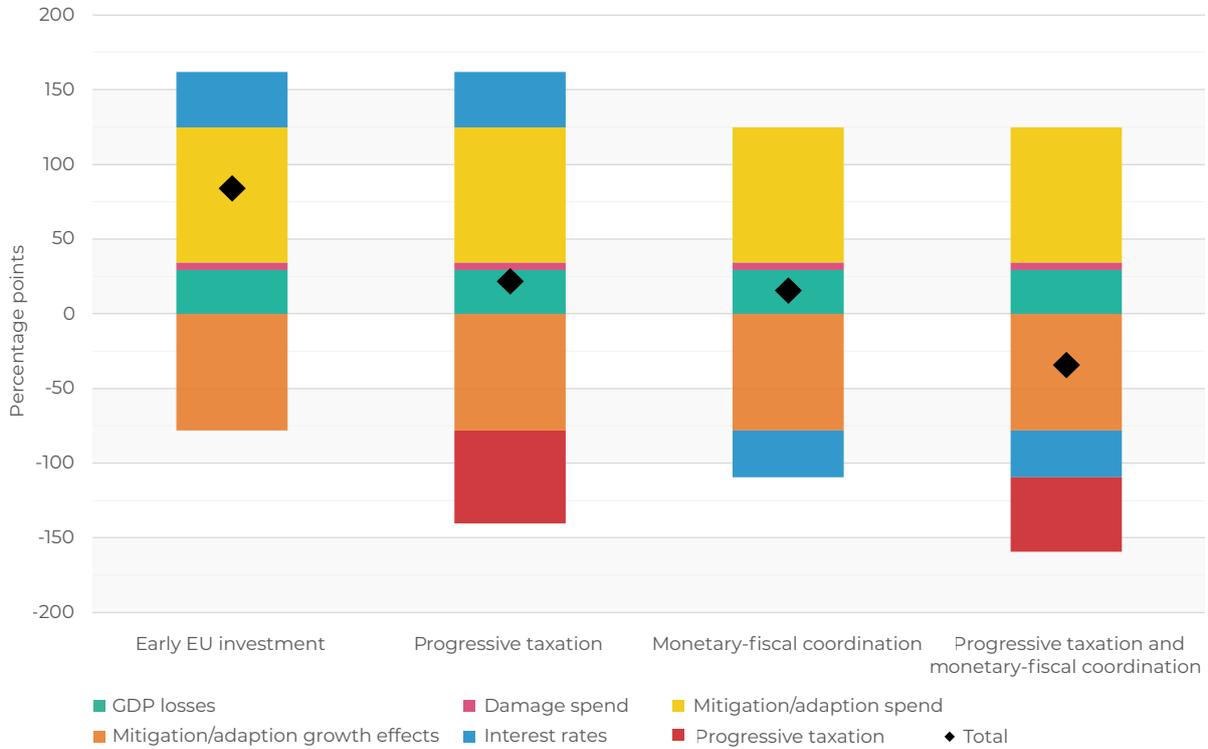
Debt-to-GDP deviation from DSM baseline, percentage points, 2070.



Source: NEF analysis.

**FIGURE 19: COORDINATED FISCAL AND MONETARY POLICY, COMBINED WITH FAIR TAXATION, DELIVERS THE STRONGEST DEBT REDUCTION**

Average contribution of GDP losses, damage spending, mitigation and adaptation investment, growth effects, interest rates, and wealth taxation to debt-to-GDP differences relative to the Commission’s baseline, percentage points, across all EU member states, 2070.



Source: NEF analysis.

**3.3 CLIMATE STABILITY IS FISCAL STABILITY**

The extreme debt ratios in our model are illustrative, not predictive. Long before reaching such levels, governments and central banks would be forced to adjust. The results underscore how decades of underinvestment have left Europe highly exposed. Even under the most optimistic, globally coordinated scenarios, climate change still weakens growth and strains public finances. Macroeconomic policy must adapt. Fiscal policy, taxation, and monetary policy need to be considered to frontload investment and protect Europe’s economies from systemic instability.

This will require a broader fiscal toolkit, including progressive wealth and environmental taxation (eg aviation taxation), greater flexibility to use debt to invest toward green infrastructure, and closer monetary-fiscal coordination to maintain affordable financing conditions for private and public green investments. At the same time,

European solidarity mechanisms, from joint borrowing to expanded disaster-support facilities (eg European Union Solidarity Fund), are essential to prevent fragmentation, as fiscal pressures will fall unevenly across regions.

Our results also show that sequencing matters. Frontloading mitigation and adaptation spreads costs over time, prevents damages from compounding, and lowers sovereign risk premiums. Realising these fiscal and economic gains also depends on coordinated industrial policy across member states and global supply chains. If critical inputs or technologies lag elsewhere, individual governments may not be able to realise the full economic benefits of frontloaded investment and capture its full growth benefits. Delayed action, by contrast, risks higher long-term debt, loss of industrial capacity, and diminished competitiveness as Europe forfeits its first-mover advantage in clean technologies.

## **THE CLIMATE-FISCAL TIMEBOMB**

### HOW CLIMATE CHANGE WILL IMPACT PUBLIC BUDGETS

Finally, climate risk is not only fiscal but also monetary and financial. Climate shocks are already impacting inflation. Indeed, recent research by the European Central Bank (ECB) and the Potsdam Institute for Climate Impact Research finds that by 2035, food inflation could rise by 0.9–3.2 pps and headline inflation by 0.3–1.2 pps annually on average.<sup>109</sup> Such pressures threaten financial stability itself. While our modelling does not capture these feedback loops, in reality, higher inflation and financial instability could further raise borrowing costs. This reinforces the need for early, coordinated action by governments and central banks to secure long-term price and fiscal stability in the face of accelerating climate impacts.

## 4. IMPLICATIONS FOR POLICYMAKERS: THE EU'S ECONOMIC FRAMEWORK IS INCOMPATIBLE WITH CLIMATE REALITY

Europe's macroeconomic architecture is not equipped for a hotter, more shock-prone world. It overlooks the structural risks that climate change poses to growth, price stability, and public finances. Aligning the Debt Sustainability Analysis (DSA), fiscal rules, and monetary policy with climate reality is now a precondition for long-term economic and debt sustainability.

Our findings show that both Europe's debt sustainability framework and its wider macroeconomic model remain misaligned with these realities. Safeguarding fiscal and financial stability requires a shift toward preventative macroeconomic policy, one that treats climate resilience as a core objective rather than a secondary environmental concern.

### 4.1 REFORMING THE DSA TO ACCOUNT FOR CLIMATE RISK

The Commission has begun researching how climate change impacts debt sustainability. The April 2024 update to Council Directive 2011/85/EU took effect in January 2026 and requires member states to assess macro-fiscal climate risks. The Commission's recent guidance,<sup>110</sup> which provides methodological guidance, supports this process. Since 2019, the Commission has also deepened its understanding, including by research into how climate-related stress impacts debt mechanics.<sup>111</sup> Yet the DSA underpinning the new fiscal rules still omits climate damages, transition costs, and

adaptation benefits, and there is no published timeline for incorporating a climate-adjusted baseline. In the absence of a climate-adjusted baseline, fiscal surveillance systematically overstates fiscal space and underprices sovereign risk, biasing decisions against frontloaded resilience spending.

However, more progress is needed to embed climate risk in Europe's fiscal architecture. Data gaps, especially on adaptation, remain large. Further work is required to build on the Commission's methodology so that climate damages are incorporated into the core baseline, not treated as a side scenario.

To make fiscal planning credible and forward-looking, the DSA must capture both the fiscal costs of climate damages and the opportunities of the transition. The current approach understates the drag from rising temperatures, omits contingent liabilities from extreme weather, and undervalues the growth effects of green investment. The Commission should consider the following steps to integrate climate-related fiscal risk into the DSA:

- **Publish a climate-adjusted baseline.** Alongside the climate-agnostic path, the Commission should publish a standard climate-adjusted baseline to 2070, embedding chronic and physical damages. This makes cross-country comparisons possible.
- **Publish a roadmap to integrate climate risk into the DSA.** The Commission should set out a clear timeline and methodology for embedding climate risk within the DSA, developed through an open process that engages member states, civil society, and social partners.
- **Model sovereign risk premiums from climate risk.** The Commission should include interest-rate paths reflecting climate-related credit risk to capture the fiscal cost of delay and reward credible transitions.
- **Recognise physical risk on public assets.** The Commission should include cost repairs and replacements to infrastructure, health, and civil-protection systems, and disclose climate-related contingent liabilities.

## THE CLIMATE-FISCAL TIMEBOMB

### HOW CLIMATE CHANGE WILL IMPACT PUBLIC BUDGETS

- **Treat adaptation as an investment with avoided losses.** The Commission should develop consistent methods and datasets to quantify how resilience spending reduces future fiscal costs.
- **Apply realistic multipliers for green spending.** The Commission should use empirical evidence, such as NEF's "bucket" method,<sup>112</sup> to capture the higher returns of well-targeted public investment.

These methodological reforms are essential to align fiscal assessments with Europe's climate and economic goals. Crucially, they are consistent with emerging international best practices. The Coalition of Finance Ministers for Climate Action has urged governments to integrate climate risks into fiscal frameworks and debt assessments, emphasising that contingent liabilities from climate impacts and transition investments must be central to public financial planning.<sup>113</sup>

#### 4.2 MOVING TOWARD A NEW MACROECONOMIC FRAMEWORK-

Climate-related fiscal risks are so large that all policy options must be considered. Our results show debt ratios rising even in best-case scenarios; long before reaching such levels, governments would be forced to adjust. Early action is economically far preferable to delay. The core lesson is that we have left action too late, globally and at home, and must now deploy a broader policy toolkit.

- **Reform fiscal rules with independent referees.** Fiscal rules that limit green investments are incompatible with climate stability. Models cannot fully capture the shocks ahead, so fiscal rules should not rely primarily on them. Instead, we should appoint independent fiscal referees to review and verify carve-outs for climate and resilience spending, ensuring they truly deliver value and preventing greenwashing. As NEF's *Calling Time* report argues,<sup>114</sup> these referees would operate as an advisory committee (eg within national fiscal boards), setting a target range for the optimal primary balance, and holding governments accountable to clear fiscal principles rather than rigid numeric rules.

- **EU-level instruments for shared risks.** No single member state can shift global emissions alone, but the EU as a bloc can. The Commission should create an EU Climate Resilience Facility (NextGenEU-style common borrowing) to co-finance mitigation, adaptation, and cross-border infrastructure, and expand the Solidarity Fund.
- **Phase out fossil fuel subsidies.** Europe still spends tens of billions each year supporting fossil fuels, locking in vulnerability and draining fiscal space. Redirecting these funds toward resilience and clean energy is both fiscally and environmentally necessary. For detailed estimates, see Climate Action Network Europe's 2024 report<sup>115</sup> on EU fossil fuel subsidies. Redirecting this spending unlocks structural fiscal space and reduces future disaster and health spending. The Commission should publish an annual fossil-to-resilience reallocation statement to track progress.
- **Coordinate monetary and fiscal policy.** Rate hikes alone cannot counter supply-side shocks. Central banks and governments should work together: monetary policy should keep borrowing costs compatible with the investment ramp-up, while fiscal tools manage energy and food shocks directly. Practical short-term policy options include green dual rates and differentiated interest rates, which lower the cost of capital on green taxonomy-aligned investments. See NEF's report<sup>116</sup> on monetary-fiscal coordination for a fuller discussion.
- **Taxation for resilience and fairness.** Scaling climate investment requires fair new revenues. Options include a European wealth tax ( $\approx$  €213bn/year per Greens/European Free Alliance (EFA) estimates<sup>117</sup>) and levies such as NEF's proposed frequent-flyer tax ( $\approx$  €64bn/year<sup>118</sup>), ensuring costs fall mainly on the wealthiest, who are also contributing disproportionately to climate breakdown. Together, these reforms would shift Europe's macroeconomic model from one that manages symptoms to one that reduces risk at source, through prevention, shared financing, and fair taxation. The case for early action is no longer speculative. Frontloaded resilience spending lowers expected future deficits and stabilises sovereign risk premiums. The alternative is structurally higher

## **THE CLIMATE-FISCAL TIMEBOMB**

### HOW CLIMATE CHANGE WILL IMPACT PUBLIC BUDGETS

public outlays on disaster response, health, and asset replacement. Macroeconomic planning must recognise that early investment not only avoids future losses but also reduces volatility and price instability, supports growth, and delivers lower debt paths over time.

## 5. CONCLUSION

Our analysis shows that failing to account for climate change in fiscal planning leads to higher debt, slower growth, and rising inequality, while early, coordinated investment in mitigation and adaptation strengthens resilience and long-term stability. The evidence is clear: climate stability is fiscal stability. Europe's task is not simply to manage debt, but to manage the transition, to invest now in protecting communities, transforming industries, and ensuring that the costs of the crisis are shared fairly. A new macroeconomic framework that aligns fiscal rules, monetary policy, and taxation with climate goals would not only safeguard public finances but also lay the groundwork for a more equitable and sustainable European economy.

## ANNEXE: METHODOLOGY

This technical annexe documents in full the data sources, assumptions, and modelling steps used to integrate climate-related economic and fiscal effects into the European Commission's Debt Sustainability Analysis (DSA) framework. Its purpose is to make each stage of the analysis transparent and reproducible.

The modelling covers 25 EU member states, corresponding to those with complete macro-fiscal and climate-risk data across the Organisation

for Economic Co-operation and Development (OECD), European Commission, and European Environment Agency (EEA) datasets. Results are reported at both country and regional aggregation levels (Nordic-Baltic, Atlantic, Continental, Mediterranean).

The projection horizon runs from 2025 to 2070, aligning with the Commission's long-term fiscal planning horizon. The base year for all prices and fiscal ratios is 2024.

The Debt Sustainability Monitor (DSM)<sup>119</sup> provides the official baseline to 2035. Beyond that date, the baseline is extended to 2070 using macro-variables from the *2024 Ageing Report*,<sup>120</sup> ensuring consistency of growth, interest, and demographic assumptions (Chapter 3). All climate-adjusted scenarios are expressed as deviations from this baseline.

**TABLE A1: SUMMARY OF SCENARIOS USED IN MODELLING**

Scenario	Description	Global warming (2100)	Mitigation and adaptation spending	Multipliers	Monetary stance	Wealth-tax policy
<b>Debt Sustainability Monitor baseline</b>	Commission's DSM projection extended to 2070. No climate-risk adjustments.	Climate-agnostic baseline	No additional mitigation/adaptation; no shocks beyond those in the DSM projection.	No change	No change	No
<b>Business as usual (BAU)</b>	Current policies persist; minimal new EU or global action.	≈ 2.5C + high damage curve	No additional mitigation or adaptation.	No change	Climate risk premium +100 bp	No
<b>Early EU investment</b>	EU frontloads mitigation and adaptation within a fragmented world; limited global coordination.	1.6C + high damage curve + quick, low cost transition	High early EU mitigation and optimum (medium) adaptation investment; global inaction.	Mitigation – 1.3 Adaptation – 0.75	Climate risk premium +50 bp	No
<b>Delayed EU investment</b>	EU delays major mitigation/adaptation; fragmented world.	1.6C + high damage curve + slow, high cost transition	Delayed mitigation spending, low adaptation spending; global inaction.	Mitigation – 1.0 Adaptation – 0.75	Climate risk premium +50 bp	No
<b>Globally coordinated early action</b>	Global cooperation achieves net zero by 2050; strong EU and international alignment.	1.6C + median damage curve + quick, low cost transition	High early mitigation; optimum (low) adaptation; globally coordinated action.	Mitigation – 1.3 Adaptation – 0.75	0 bp	No
<b>Wealth-tax financing</b>	As the early investment scenario, with a progressive EU-wide wealth tax used to finance climate and resilience investment.	1.6C + high damage curve + quick, low cost transition	Early EU investment, optimum adaptation, wealth taxation	Mitigation – 1.3 Adaptation – 0.75	Climate risk premium +50 bp	Yes
<b>Monetary-fiscal coordination</b>	As the early investment scenario, with central-bank support lowering green-borrowing costs by 50 bp.	1.6C + high damage curve + quick, low cost transition	Early EU investment, optimum adaptation, wealth taxation, monetary-fiscal coordination	Mitigation – 1.3 Adaptation – 0.75	–50 bp	No

## THE CLIMATE-FISCAL TIMEBOMB

### HOW CLIMATE CHANGE WILL IMPACT PUBLIC BUDGETS

#### OECD LONG-RUN CLIMATE SCENARIOS

The OECD long-run economic scenarios<sup>121</sup> provide a reference to understand how climate change and an accelerated energy transition impact gross domestic product (GDP) over time. Estimations are based on a long-term model (LTM) which includes six scenarios with differing assumptions about (i) the speed of the energy transition, (ii) the extent of climate damages, and (iii) the pace at which carbon mitigation costs decline.

Regarding (i) the speed of the energy transition, the model differentiates between two business as usual (BAU) scenarios and four energy transition (ET) scenarios. In the BAU scenarios, decarbonisation of the energy mix and improvements in energy efficiency continue along current trends, leading to an increase in greenhouse gas emissions above the 2C Paris Climate Agreement goal. In the ET scenarios, all countries accelerate decarbonisation and energy efficiency efforts, eliminating coal as an energy

source by 2050 and lowering the shares of oil and gas in primary energy to 5% and 10%, respectively. This limits the global temperature increase to 1.6C by 2100, meeting the Paris Climate Agreement goal.

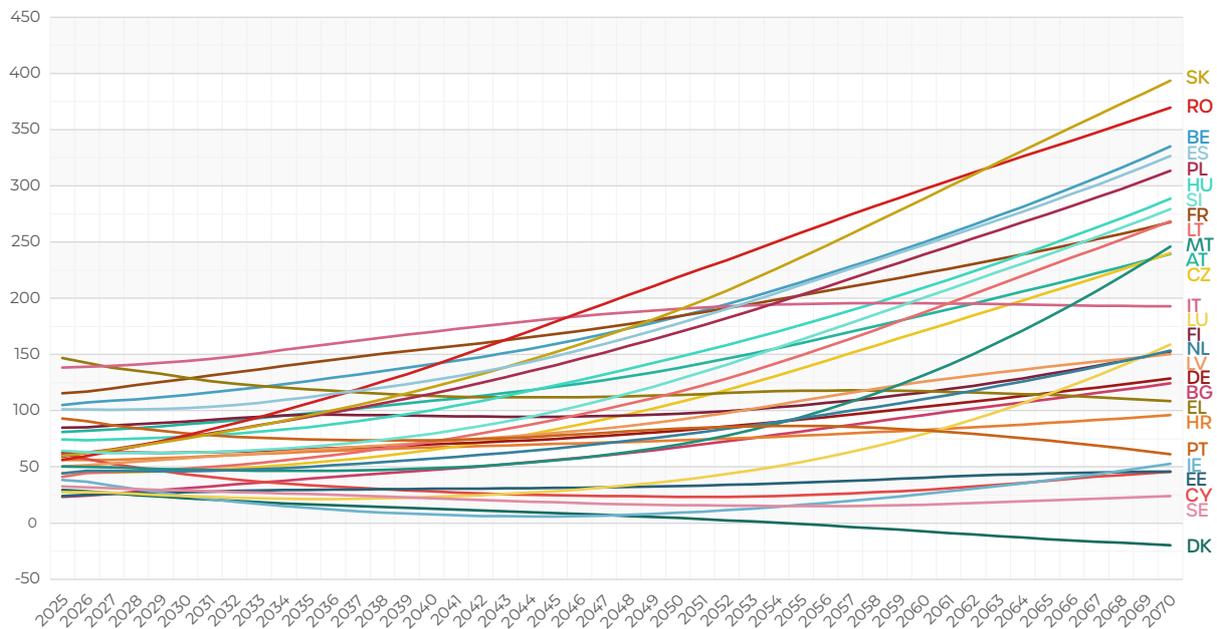
Regarding (ii) the extent of climate damages the model differentiates between a median and a high climate damage curve, both in the form of a one-parameter quadratic equation. The median climate damage curve is based on the meta-study aggregation of Howard and Sterner<sup>122</sup> and implies climate damages equal to 4% of global GDP for 2C of warming and 9% of GDP for 3C of warming over the pre-industrial average. The high climate damage curve is based on the findings of Bilal and Känzig,<sup>123</sup> which estimate damages of approximately 19% and 44% of global GDP at 2C and 3C of warming, respectively. Note, Bilal and Känzig recently updated their analysis finding that a 1 °C warming reduces world GDP by over 20% in the long run.<sup>124</sup>

**TABLE A2: OECD LONG-RUN SCENARIOS DESCRIPTIONS**

Scenario	Description	Climate damage assumption	Mitigation costs	Key features/outcomes
BAU1	Baseline scenario with current pace of energy transition and a median climate damage curve; insufficient to meet the Paris goals.	Median	None	Continued warming (~2.5C by 2100), gradual slowdown in global growth, ~9% reduction in global GDP from climate damages by 2100.
BAU2	Baseline scenario with current pace of energy transition and a high climate damage curve; insufficient to meet the Paris goals.	High	None	Continued warming (~2.5C by 2100), climate damages already rise to 35% by 2100.
ET1	Accelerated energy transition with median climate damages and slow decline in mitigation costs.	Median	Slow decline (1% per annum)	Transition reduces warming; projected global output still 3.5% below BAU counterpart (BAU1) in 2100; benefits of avoided damages are delayed.
ET2	Accelerated energy transition with median climate damages and a quick decline in mitigation costs.	Median	Quick decline (4% per annum)	Transition reduces warming, becomes net positive for global output by around 2085, as mitigation becomes cheaper and damages are avoided.
ET3	Accelerated energy transition with high climate damages and a slow decline in mitigation costs.	High	Slow decline (1% per annum)	Transition reduces warming, avoided damages are large due to high damage assumptions; positive growth effects of averted climate damages almost fully offset mitigation costs in the 2040s and the transition becomes net positive in the late 2050s.
ET4	Accelerated energy transition with high climate damages and a quick decline in mitigation costs.	High	Quick decline (4% per annum)	Transition reduces warming, with strongest outcome: transition becomes net positive for global output earliest (mid-2040s); all modelled countries benefit by ~2080.

**FIGURE A1: EUROPEAN COMMISSION DSA BASELINE**

Projected debt-to-GDP ratios for EU27 member states. Direct DSA data to 2035, extended to 2070 using macroeconomic variables from the CoA.



Source: Commission's DSM, CoA.

Regarding (iii) the pace at which carbon mitigation costs decline, policy action to reduce emissions is assumed to lower output in the LTM due to the implicit assumption that the counterfactual economy in the BAU scenarios features an efficient allocation of resources. Thus, any diversion from that has, by design, a negative GDP impact. In the LTM, the output costs of carbon mitigation are given by marginal abatement cost curves (MACCs), which are upward sloping and convex, implying rising marginal abatement costs for a given state of technology. There is an expectation that MACCs will flatten over time, making future carbon abatement cheaper than envisaged today. For example, due to technological innovation and economies of scale, the cost of a renewable energy plant is likely to decline over time. The LTM thus includes two illustrative modelling assumptions. Under the first, the elasticities of output to carbon mitigation that determine the MACCs are assumed to decline by 1% per year from 2026 onward. Under the second assumption, the rate of decline is 4% annually.

The six long-run scenarios are summarised in Table A2.

### EXTENDING THE DSA BASELINE FROM 2035 TO 2070

The DSA baseline macroeconomic variables are only published out to 2035 in the 2025 DSM.<sup>125</sup> To extend to 2070, we take macroeconomic variables from the *Cost of Ageing Report (CoA)*,<sup>126</sup> smoothing the difference between the DSM and CoA variables until 2050, when CoA variables have full weighting. Furthermore, data for structural primary balance changes, such as taxes and property income, is only available in the DSM and not in the CoA. Therefore, our baseline is calibrated with a primary surplus adjustment so the DSM's S1 indicator (required effort in 2026 to bring debt to 60% of GDP by 2070) achieves the expected result by 2070. This is done by assuming the structural balance in 2035 in the DSM's accounting for taxes and property adjusts smoothly to a fixed value by 2050. Figure A1 shows the Commission's DSA baseline debt ratios extended to 2070.

**DEBT DYNAMICS**

To feed the input data into debt ratios, we use the Commission’s debt dynamics equations as set out in Annexe 3 of the *2024 Debt Sustainability Monitor Methodological and Statistical Annexes*.<sup>127</sup> Debt dynamics can be decomposed into three effects: two effects that depress debt-to-GDP ratios and one that enlarges them. Depressing debt-to-GDP ratios are growth and inflation – these forces act on the denominator of the debt-to-GDP ratio, so any positive growth or inflation should depress the debt-to-GDP ratio in later years. Enlarging debt is the interest rate paid on the debt itself – sometimes referred to as the snowball effect. Left unchecked, this adds to borrowing each year and increases debt. The equations to calculate these effects are set out as below.

$$\text{Real GDP growth effect: } -d_{t-1} * \frac{gr_t}{1+g_t}$$

$$\text{Inflation effect: } -d_{t-1} * \frac{\pi_t * (1+gr_t)}{1+g_t}$$

$$\text{Interest rate effect: } d_{t-1} * \frac{i_t}{1+g_t}$$

Where  $d_{t-1}$  is the debt level in the previous year, and for the calculated year,  $gr_t$  is the real growth rate,  $g_t$  is the nominal growth rate,  $\pi_t$  is the inflation rate, and  $i_t$  is the interest rate on government debt.

Debt can also be changed by tax or spending decisions, which will affect the primary balance, ie how much is borrowed to fund spending that is not interest payments. The primary balance, along with the real GDP growth, inflation, and interest rate effects, is added to the debt level in the previous year to calculate the debt level in the year of interest.

**INTEGRATING CLIMATE IMPACTS INTO DEBT DYNAMICS**

To integrate these into our debt dynamics equations, we adjust the primary balance for the proposed mitigation/adaptation spending in each scenario, along with the fiscal costs associated with climate damages, any tax policy changes, and how we expect tax revenues to react to GDP changes. Furthermore, GDP will be altered by the multiplier effects of mitigation and adaptation spending, along with the long-term effects of mitigation investments and the physical and transition costs of climate change. Lastly, interest rates will be affected by climate-risk premiums or reduced in the case of monetary fiscal coordination. This feeds into our calculation of the primary balance, GDP, and interest rate as below.

*Scenario primary balance*

$$pb_s = pb_{bl} - FC_{mitigation,s} - FC_{adaption,s} - FC_{damages,s} + TR_p + (\% \Delta GDP_s) * TR_{bl}$$

*Scenario gross domestic product:*

$$GDP_s = GDP_{bl} + m_{m,s} * FC_{mitigation,s} + m_{a,s} * FC_{adaption,s} + m_{it,s} (*) - D_{transition,s} - D_{physical,s}$$

*Scenario interest rate*

$$i_s = i_{bl} + p_s$$

Where  $s$  is the scenario, and  $bl$  is the baseline.  $FC$  is the fiscal cost for mitigation, adaptation, or damages, depending on the scenario.  $TR$  is the tax revenue raised by additional policies ( $TR_p$ , ie wealth tax). In the baseline, the baseline tax revenue is multiplied by the % change in the scenario GDP compared to the baseline, representing an elasticity of 1, ie a 10% increase (or decrease) in GDP leads to a 10% increase (decrease) in tax revenues.  $m$  is the multiplier on mitigation ( $m_m$ ),

## THE CLIMATE-FISCAL TIMEBOMB

### HOW CLIMATE CHANGE WILL IMPACT PUBLIC BUDGETS

adaptation ( $m_a$ ) spending or the long-term multiplier/supply-side effect ( $m_{lt}$ ), which is a function of previous mitigation spending compared to the public capital stock. These multipliers may change depending on the scenario.  $D$  is the GDP losses associated with the green transition and physical climate damages. Lastly,  $\rho$  is the premium/discount on the baseline interest rate.

Using the scenario GDP and baseline assumptions of inflation, the growth and real growth rates can be calculated, alongside the primary balance and interest rate. This can be input into the debt dynamic equations to calculate debt each year and project debt trajectories to 2070.

### REGIONAL COUNTRY CLASSIFICATIONS

Region	Countries
Continental	Austria, Bulgaria, Czechia, Hungary, Luxembourg, Poland, Romania, Slovakia, Slovenia
Atlantic	Belgium, France, Germany, Ireland, Netherlands
Mediterranean	Croatia, Greece, Italy, Portugal, Spain
Nordic-Baltic	Denmark, Estonia, Finland, Latvia, Lithuania, Sweden

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