IMK
Macroeconomic Policy Institute

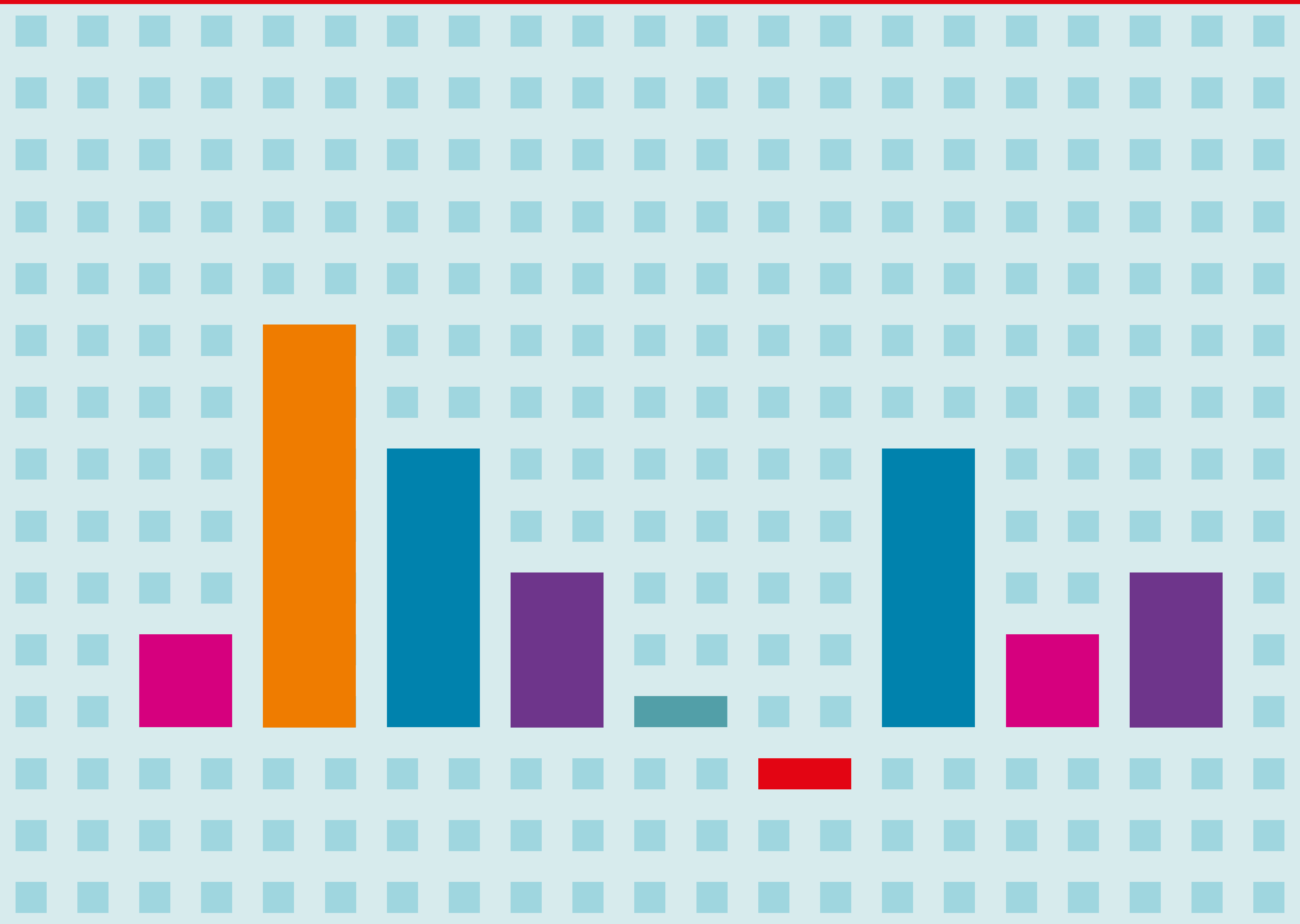
The IMK is an institute of the Hans-Böckler-Stiftung

POLICY BRIEF

IMK Policy Brief No.197 · September 2025

THE MACROECONOMIC EFFECTS OF A GREEN EUROPEAN PUBLIC INVESTMENT FUND – TAKING CLIMATE CHANGE INTO ACCOUNT

Christoph Paetz, Yannick Rinne, Sebastian Watzka



THE MACROECONOMIC EFFECTS OF A GREEN EUROPEAN PUBLIC INVESTMENT FUND – TAKING CLIMATE CHANGE INTO ACCOUNT

Christoph Paetz[1], Yannick Rinne[2], Sebastian Watzka[3*]

Summary

This policy brief presents simulation results of the macroeconomic effects of a green EU public investment fund for the euro area using the macroeconometric simulation model NiGEM. After briefly outlining the investment needs in the EU, we first present results using the standard version of NiGEM. We then extend the simulations in the main part of the Policy Brief by taking climate change into account. Applying the climate version of NiGEM we simulate various policy scenarios of the Network for Greening the Financial System (NGFS) with and without an EU investment fund.

Our results show considerable negative GDP effects together with inflationary effects from CO2-taxation alone. Accounting for climate change and the corresponding long-term damage to GDP, however, our results show that not acting on climate change now causes far more severe damages in the future. An EU investment fund would help – besides from faster promoting the greening of the European economies – by cushioning the negative transitory GDP effects in the next ten years. Finally, our results highlight the importance of cooperation such that climate change policies are implemented on a global level.

---

[1] IMK, Head of European economic policy, christoph-paetz@boeckler.de

[2] Student at Göttingen University and formerly intern at IMK, yannick.rinne@stud.uni-goettingen.de

[3] IMK, Head of European macroeconomics, sebastian-watzka@boeckler.de (corresponding author)

[*] We would like to thank Ian Hurst for very helpful advice and Tobias Heinz for excellent research assistance. All remaining errors are our own.

1 Investment needs in the EU

Europe faces substantial challenges in the near future. In addition to the security threats, which necessitate an increase in defence capabilities, the continent must significantly boost its investments in climate-neutral technologies to achieve its goal of reaching net-zero CO2 emissions by 2050. This commitment is vital for Europe to take its share of responsibility in preventing global temperatures from rising further with severe economic and social consequences of the resulting global climate crisis (Copernicus Climate Change Service and World Meteorological Organization 2025). Beyond decarbonisation and defence, Europe also needs to invest in its digital infrastructure.

Europe's investment gap is widely acknowledged and scientifically reasonably well documented (Draghi 2024; European Central Bank 2024b; Heimberger and Lichtenberger 2023; Institut Rousseau 2024; Koch et al. 2024). To close the investment gap, it is estimated that approximately 850 bn EUR, or around 5 % of EU GDP, is needed in additional investments each year for the period 2027-2034. Around one-fifth to one-quarter of this amount is expected to be public investment. In other words, additional public investment of the order of 1 % of EU GDP or approximately 170 bn EUR is needed every year during this period. The bulk of these additional public investments is needed to decarbonise our economies (around 80 %), followed by defence and digital investments (each accounting for approximately 10 %) (European Central Bank 2024b).[4]

While recent political debates have understandably focused on increasing investments for defence, this policy brief instead examines the macroeconomic effects of decarbonising Europe's economies. Recent studies suggest that the economic damages caused by climate change may be even higher than previously assumed (Bilal and Känzig 2024; Kotz, Levermann and Wenz 2024).

Against the backdrop of last year's reformed EU fiscal rules, the European Commission's debt sustainability analysis, which has now moved to the center of the framework, indicates that many member states will face significant fiscal consolidation efforts in the coming years (Paetz and Watzka 2024). In the context of limited national fiscal space, it will be extremely challenging for member states to prioritize public investment in a manner that not only protects it but also stimulates it to the necessary extent described above.

Particularly in the provision of European public goods – where climate policy is included alongside for instance research and development expenditure, as well as foreign and security policy – an EU investment fund has the advantage of financing the necessary transformation expenditures more efficiently than most member states could achieve individually. The Recovery and Resilience Facility (RRF), the debt-financed EU investment capacity developed in recent years and the principal instrument of Next Generation EU (NGEU), can be seen as a blueprint for organizing a public investment program at the European level. The RRF has had a sizeable positive impact on overall EU GDP growth and the potential output of member states (Bańkowski et al. 2024; Michels et al. 2025; Millard 2025; Watzka and Watt 2020).

[4] These figures were being prepared before the European Commission announced its ReArm Europe plan which aims to further increase public defence investment by up to 800 bn Euro (European Commission 2025). Taking this into account would result in the following shares of public funding in the three areas: green investments 50 %, defence investments 50 %, and less than 1 % for digital investment.

To simulate the macroeconomic effects of a debt-financed EU-investment fund, we utilize the NiGEM-model of the National Institute of Economic and Social Research (NIESR). The next section abstracts from climate change and presents results using the standard version of NiGEM. The following section then takes climate change into account and employs the climate version of NiGEM, along with input from the Network for Greening the Financial System (NGFS). Four NGFS climate policy scenarios are compared, and simulation results are shown under various considerations: (i) transitional CO2-tax effects only, (ii) transitional CO2-tax-effects together with GDP damages arising from climate change, and (iii) accounting in addition for an EU investment fund. A final section focuses on a scenario with an EU-investment fund, but in which only the EU adheres to its net-zero by 2050 climate goal, whilst other world regions continue with their nationally determined contributions.

Our results show considerable negative GDP-effects, along with inflationary pressures resulting from CO2-taxation alone. However, when accounting for climate change and the corresponding long-term damage to GDP, our findings show that not acting on climate change now will lead to far more severe damages in the future. An EU-investment fund would help – apart from faster promoting the greening of the European economies – by cushioning the negative transitory GDP effects in the next ten years. Finally, our results highlight the importance of cooperation to ensure that climate change policies are implemented on a global level.

2 Macroeconomic effects of an EU investment fund in a standard macroeconometric model

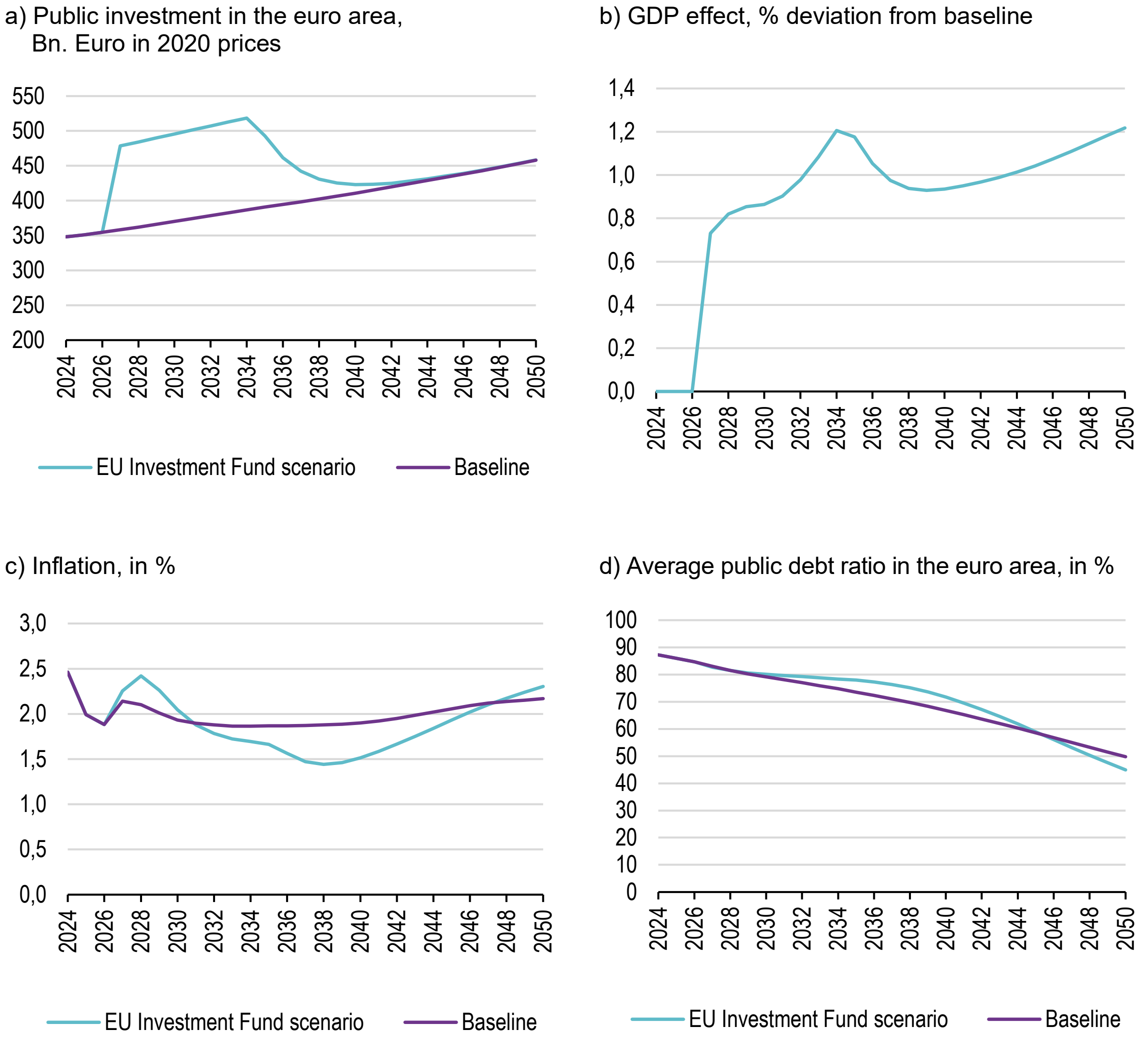
We simulate the macroeconomic effects of an EU investment fund using the widely recognized multi-country macroeconometric model NiGEM, developed by NIESR and employed by institutions such as the IMF, OECD, and various central banks. NiGEM is a comprehensive simulation and forecasting model for the global economy that incorporates typical New Keynesian elements, including the expectations of economic agents, as well as price and wage rigidities. This model allows for an examination of both the short- and long-term effects of such an economic policy on key macroeconomic variables, including Gross Domestic Product (GDP), private investment, inflation, and the public debt ratio. Additionally, NiGEM distinguishes between public spending on investment and consumption, making it particularly suitable for analyzing a long-term public investment program. The model encompasses 17 EU member states, which collectively account for 94% of the EU population and 96% of total EU GDP. Furthermore, it includes all OECD countries, as well as numerous emerging economies, allowing our simulations to account for spillover effects resulting from international trade.

We use the aforementioned investment gap of 1% of GDP and feed it into the model by raising public investment in the EU by 1% of GDP per year. This translates to approximately 170 billion Euro in additional annual government investment in the euro area (Figure 1a). The fund is projected to cover the entire duration of the next multiannual financial framework, to be precise it is assumed to last from 2027 to 2034. This time span helps to prevent potential cuts in public investment related to necessary adjustments due to the new fiscal rules and the expiration of existing EU programs (NGEU). Whilst we simulate the EU investment fund using public investment in all 17 EU member states included in NiGEM, we show results only for the euro area. This is due to variable availability in NiGEM.

It is assumed that the investments will be entirely financed by debt raised jointly by the EU member states, and which will be repaid by the member states collectively. Each member state is allocated 1% of its GDP for additional national public investment, which is accounted for by a corresponding increase in its national public debt. We reflect these assumptions in our simulation by increasing public investment of each member state by 1% of GDP and not endogenously increasing tax rates during the simulation period.[5]

We assume that the European Central Bank (ECB) will support the EU's investment initiative and will refrain from any additional interest rate reaction during the program period (in other words, monetary policy is technically assumed to be fixed on base). Once the fund expires in 2035, we assume that monetary policy will become endogenous. The simulation results extend to 2050.

Figure 1: Macroeconomic effects of an EU Investment Fund for the euro area



Source: IMK simulations using NiGEM.

[5] To focus on the effects of the additional public investment, we also kept the levels of public consumption and transfer payments exogenous in the simulations.

GDP Effects

Figure 1b illustrates the impact on euro area GDP. The additional annual GDP compared to the baseline scenario increases from approximately 0.8% as an immediate response to the public investment shock to around 1.2% by the end of the program, where it remains until the end of the simulation horizon in 2050. The increase in public investment influences economic growth in the model through two distinct channels. First, it boosts aggregate demand. Second, public investment enhances the economy's production potential by increasing the public capital stock. While aggregate demand rises immediately at the start of the investment program, potential output grows with a time lag due to the gradual increase in capital stock.

Private Investment

The public investment initiative also stimulates private investment in the euro area.[6] Due to the positive effects on aggregate demand and GDP, the investment program encourages greater business investment activity. Private investment is projected to be approximately 1% higher immediately at the start of the program and around 2.5% higher by the end of the investment fund. Consequently, the additional public investment will significantly contribute to mobilizing the private investment necessary for the transformation.

Inflation

Looking at the inflationary effects of the EU investment fund (Figure 1c), we find that the additional economic activity at the first years of the program generates some upward pressure on prices in the euro area, albeit temporarily and to a limited extent only. After a few years, the increase in the capital stock has increased the economy's production capacity, allowing companies to produce more goods and services at lower costs. This increase in supply then exerts downward pressure on prices. Given the limited inflationary effects during the program's duration, we believe it is reasonable to assume that the ECB will adopt an accommodating stance and maintain interest rates at the baseline. This is particularly relevant since we also assume that the ECB will not respond to the above-mentioned price-dampening effects with interest rate cuts during the final years of the program.

Debt-to-GDP Ratio

Finally, we look at the effect of the investment fund on the average public debt ratio in the euro area. Since the fund is fully debt-financed in this simulation, we observe a temporary increase in the public debt ratio in the eurozone, as shown in Figure 1d. Concerns about the potential dangers of higher public debt resulting from a credit-financed investment initiative often overlook the fact that these investments will, in part, finance themselves through higher economic growth and, consequently, increased tax revenues in the future. Additionally, the debt-to-output ratio is expected to decline as a result of the economic growth associated with the additional investments. In our simulation, the sustainability of total debt is not at risk. Instead, the public debt ratio remains on an overall downward trajectory, even if it may stagnate during the program period. In the long run, due to the positive macroeconomic effects, the debt ratio is projected to surpass the baseline scenario, which excludes the public investment program, indicating substantial benefits from the fund – even within the standard model.

---

[6] Due to space limitations the results for private investment are not shown in Figure 1.

3 Taking climate change into account

To investigate the effects of an EU-investment fund that is primarily targeted towards green investment, it is important to take economic damages arising from climate change into account. Although the uncertainty around the estimates of economic damages from climate change is huge, it seems that they have – if anything – only become bigger recently (Bilal and Känzig 2024; Kotz, Levermann and Wenz 2024). As such, when investigating the effects of an investment fund into the greening of the European economies one needs to take a stance on the counterfactual if preventive action is in fact not taken. This is the approach we will carry out in the following.

With the European Green Deal the EU set itself the goal to become climate neutral by 2050. Net CO2-emissions are to be reduced to zero by then (European Commission 2019). To facilitate this achievement the EU set itself an interim target ('Fit-for-55') of reducing 55 % of CO2-emissions by 2030 (compared to the level of emissions in 1990).

In order to account for the economic impacts of climate change, we draw on the work of the Network for Greening the Financial System (NGFS). The NGFS calculates climate change costs for seven different climate adaptation pathways and the respective temperature scenarios. In our analysis, we focus on the four scenarios *Net Zero 2050* (1.5° path), *NDC* (Nationally Determined Contributions), *Below 2°C* and *Current Policies* from the NGFS Phase V data (Figure 1). The first of these involves limiting global warming to 1.5°C compared to pre-industrial levels and assumes strict global climate policies that ensure the achievement of net-zero CO2 emissions by 2050. This corresponds to the above mentioned European Green Deal with the goal of reducing CO2-emissions in the EU to zero by 2050. The *Nationally Determined Contributions (NDC)* scenario presumes that all countries worldwide will meet the climate targets they have politically committed to, regardless of whether these have already been translated into concrete laws and transition measures. In the *Below 2°C* scenario, it is expected that countries will progressively intensify their efforts to reduce emissions, ultimately resulting in a two-thirds chance of limiting global warming to 2°C. *Current Policies*, on the other hand, assumes that only the climate protection measures already legally implemented will continue, with no additional climate transition measures taking place (NGFS 2024b). Figures 2a and 2b show the projected development of the global average temperature in the different scenarios relative to the pre-industrial level and the corresponding pathways of CO2 emissions in the EU until 2050.[7]

According to the NGFS approach, the economic perils of climate change and adaptation can be categorized into two parts (NGFS 2024b). First, there are the *economic transition risks* arising from the limitation of global warming, such as the introduction of a carbon tax which puts pressure on certain sectors and businesses to reduce greenhouse gas emissions. These impacts are to be seen as mitigation costs. Second, there are *physical risks* emerging from higher global temperatures and other changed climatic conditions. This includes primarily chronic physical damages resulting from a permanent decline in productivity due to lasting changes in climatic circumstances, such as higher temperatures, less fertile soils, or sea level rise. While our main simulations thus focus on accounting for those chronic risks, acute physical impacts from extreme

[7] Note that Figure 2a shows temperatures at a *global* level, whilst Figures 2b and 2c show CO2-emissions and shadow prices for the *EU*. Whilst globally the *Below 2°C* scenario is more ambitious than the *NDC* scenario, this is not the case in Europe. See also the discussion in Section 3.1 related to Figure 2c.

weather events can also be included in light of the higher likelihood of floods or droughts with rising average temperatures (see Infobox).

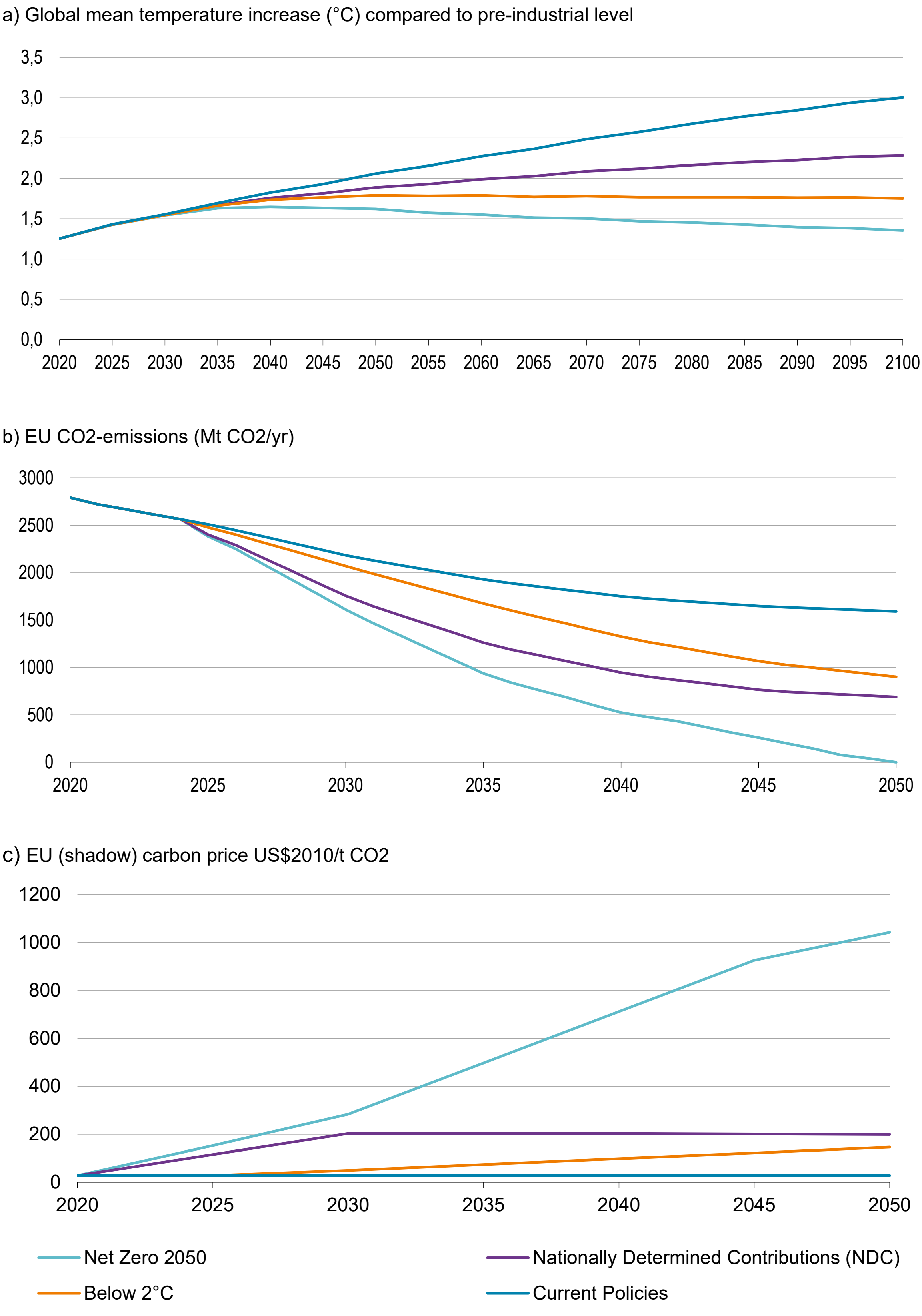
To simulate the various climate related risks and costs in NiGEM we apply the Integrated Assessment Modelling (IAM) framework "REMIND-MAgPIE" of the Potsdam Institute for Climate Impact Research (PIK).[8] This framework provides the necessary data to align the simulation calculations in NiGEM with the IAM results, both for the transition shocks due to carbon emissions reduction and for the chronic physical shocks. The corresponding chronic physical risks are based on a damage function (Kotz, Levermann and Wenz 2024). This provides country-specific GDP damages reflecting the extent of climate adaptation and CO_2 emissions reduction of the different transition scenarios and their respective temperature pathways.

3.1 Mitigation costs of CO_2-taxation

When modelling the transition costs of different climate adaption pathways according to the NGFS scenario framework, two steps need to be considered. First, there is the carbon tax shock resulting from the implementation of a carbon tax to reduce greenhouse gas emissions. The IAM data provided by the REMIND-MAgPIE framework of the Potsdam Institute for Climate Impact Research (PIK) to implement the carbon tax shocks in NiGEM comprises inter alia carbon tax values, energy intensities of output and consumption levels of fossil as well as renewable energy sources. Using this imported data, the carbon tax shock is run in NiGEM, followed by the second part of the transition shock, which involves the so-called recycling of tax revenues. In contrast to the default procedure of the NiGEM climate extension, we assume that the whole revenues of the implemented carbon tax are handed back through transfer payments to the population. Thus, we model a carbon fee and dividend system in which the revenues are completely redistributed. Even though the only supposed policy lever to drive the climate transition in the NGFS scenarios is carbon pricing, this taxation is to be seen as a shadow price, which also comprises potential other climate policy instruments. This shadow price can be understood as the marginal abatement costs of CO2, meaning the overall economic additional costs to avoid one more unit of carbon emissions by switching to a fossil-free alternative production technology. Essentially, the shadow carbon price thus represents the price difference between conventional and CO2-free production in economic activities. Ultimately, within the REMIND modelling framework it does not matter whether the actual CO2 reduction occurs through a CO2 price at the level of these additional costs, which encourages economic agents to switch to green technologies, or whether it is partially achieved through other policy measures, such as environmental standards or subsidies for climate-neutral alternatives (NGFS 2024b; Vogt-Schilb and Hallegatte 2014; Wein 2025).

[8] The first part of the acronym REMIND-MAgPIE stands for REgional Model of Investment and Development, the second part for Model of Agricultural Production and its Impact on the Environment.

Figure 2: Climate adaptation pathways of the four NGFS scenarios

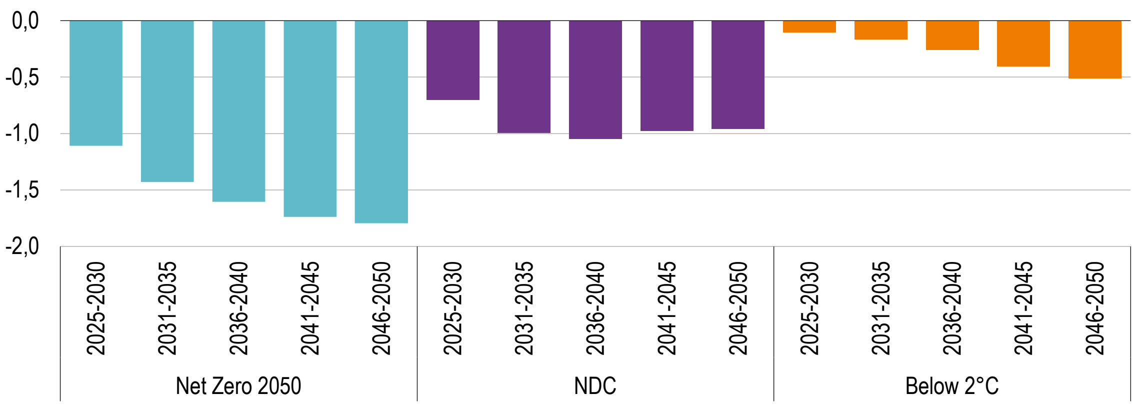


Sources: NGFS, NiGEM.

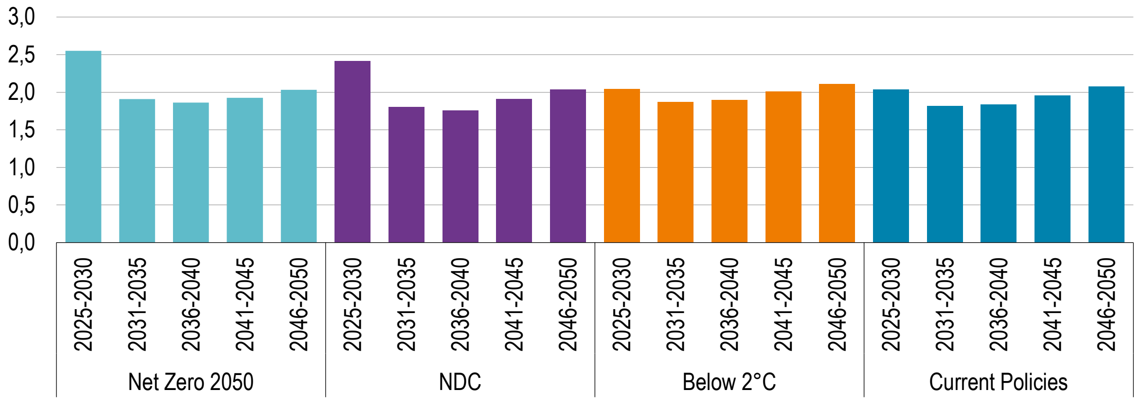
The EU (shadow) carbon price developments underlying the corresponding emission reduction pathways in the REMIND-MAgPIE framework are depicted in Figure 2c. While the *Net Zero 2050* scenario assumes a pretty steep and largely linear increase in the shadow carbon price up to around 1000 USD (2010) per tonne of CO2 by mid-century, the *Nationally Determined Contributions (NDC)* scenario, which reflects the climate adaption goals set by the EU but not yet completely translated into concrete measures, foresees a much flatter rise to only 200 USD (2010) by 2030 and remaining constant at that level thereafter. The CO2 price by 2050 is only slightly lower in the *Below 2°C* pathway, at just under 150 €, but the price increase assumed there begins later than in the *NDC* scenario. It is important to note that the order of the intensity of carbon taxation is reversed when viewed globally at this point. On a global level, the *Below 2°C* scenario is associated with higher CO2 prices than the *NDC* scenario, leading to a stronger global emissions reduction overall. In Europe, however, this is reversed, as the politically targeted goals are more ambitious compared to the international standard.

Figure 3: Macroeconomic effects of various climate adaptation scenarios in the euro area

a) Euro area GDP deviation from Current Policies (in %) with transition shock (carbon taxation)



b) Euro area inflation (in %) with transition shock (carbon taxation)



Source: IMK simulations using NiGEM and based on NGFS.

The macroeconomic effects of transitioning the European economies through the corresponding increases in CO2-taxes along the various scenarios are depicted in Figure 3. Looking at the upper panel, it can be seen that the implementation of higher carbon taxes has a substantial negative impact on euro area GDP. Compared to the *Current Policies* Scenario with no further increases in carbon taxation, the projected GDP in the euro area in the short-term (2025-30) is 1.1% lower in the *Net Zero 2050* scenario and 0.7% in the *NDC* scenario. Only in the somewhat less ambitious *Below 2°C* scenario is the immediate negative effect almost negligible.[9] Over the simulation horizon carbon taxation continues – as expected – to impact GDP development negatively in the three scenarios with rising carbon taxes leading to higher reductions of GDP vis-à-vis the *Current Policies* scenario. The extent of the long-run deviations from the baseline mirrors the corresponding carbon price paths of the scenarios, with GDP nearly 2% lower by 2050 in the case of the *Net Zero 2050* target, while the *Below 2°C* scenario shows a maximum deviation of only around 0.5% lower compared to *Current Policies*, respectively, and *NDC* is roughly in between with GDP being around 1% lower.

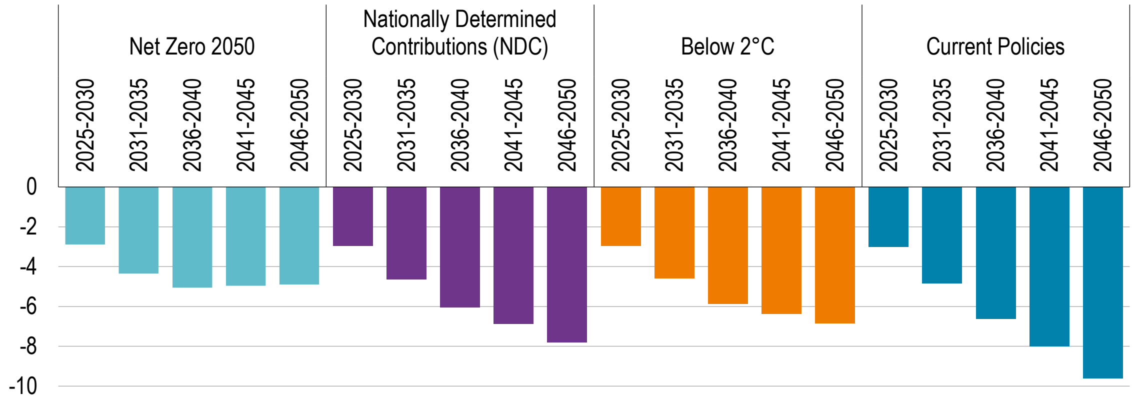
The negative effects of CO2 prices on economic performance are closely related to the inflationary impact of the taxation, which calls for interest rate increases by the central bank and weakens consumer demand. A look at the development of simulated inflation rates across the four scenarios in Figure 3b shows that especially the CO2 prices of the *Net Zero 2050* scenario, and in a milder form those of the *NDC* scenario, induce an increase in inflation in the short term. However, this inflationary trend diminishes over the course of a few years. Overall, the inflationary effects of CO2-taxation are found to be transitory and of manageable order.

3.2 Accounting for economic damage from climate change

So far, our analyses neglected the economic damage arising from climate change. The simulated CO2-taxation paths required to achieve the various limits on temperature rises were meant to induce the agents of the model, businesses and households, to shift production and consumption towards greener goods. However, according to the NGFS modelling approach physical risks from climate change must still be added if long-term projections are being made. This means *chronic climate damages* representing a persistent reduction in productivity that occurs gradually due to the scenario-specific changing climatic conditions need to be considered (NGFS 2024b). The chronic damages from the REMIND-MAgPIE model data we used stem from an empirical damage function, which links the different temperature paths of the scenarios to the resulting levels of economic damage (Kotz, Levermann and Wenz 2024). Particularly noteworthy about these damage estimates is that lagged effects are also included to better capture the persistence of the altered climatic conditions due to global warming (NGFS 2024a). However, potential tipping points of climate change, which could lead to irreversible additional global warming and corresponding climate damages, are not considered (NGFS 2024a). In a second step we will also consider acute risks resulting from extreme weather events (see Infobox).

[9] This compares reasonably well with the results of Brand et al. for the median GDP effects of carbon tax policy in the euro area for the period 2022 to 2030 (European Central Bank 2023).

Figure 4: Chronic physical damages (5-year averages in % of GDP) in the euro area

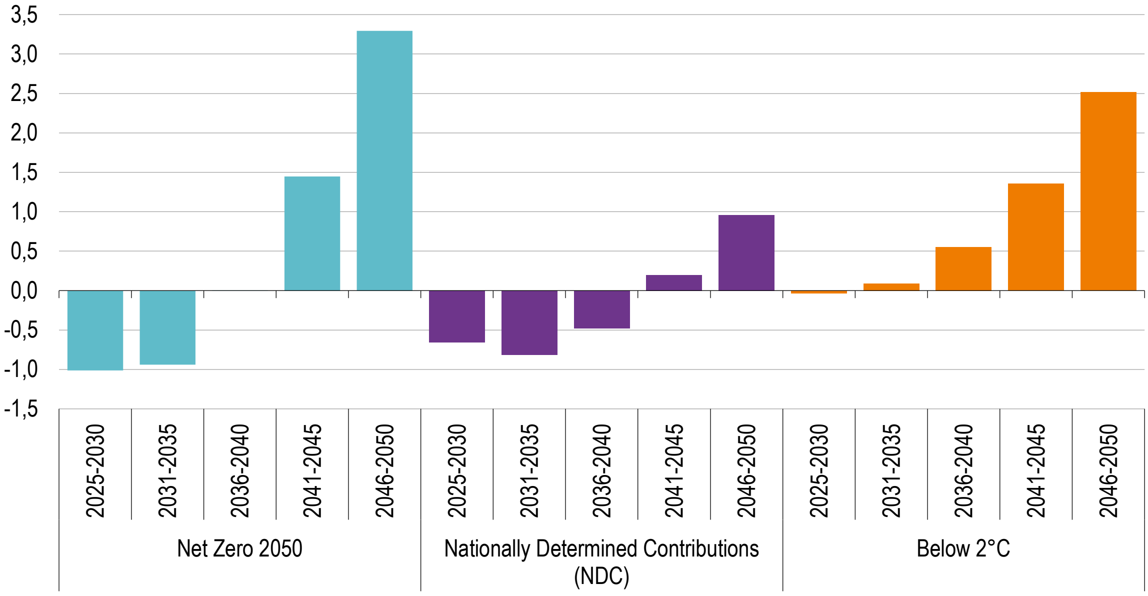


Source: IMK simulations using NiGEM and based on NGFS.

Figure 4 shows the chronic damages resulting from a permanent reduction in productivity due to changing climatic conditions. All these values should be seen as deviations from a counterfactual baseline with no physical damages caused by climate change (NGFS 2024b). Accordingly, in the *Current Policies* scenario chronic climate damages will lead to a macroeconomic income loss of more than 9% in the euro area by 2050. However, with more ambitious emission reductions at the European and global level, this can be significantly reduced. In the *Net Zero 2050* scenario, the chronic macroeconomic damage in 2050 is reduced to only half the size, with GDP loss less than 5%. Considering these damages, it is already evident that the economic costs of the transition shock of the previous section from implementing a carbon tax or other measures to reduce emissions are more than offset by the benefits of reduced climate damages.

Figure 5 shows the GDP deviations of the three more ambitious scenarios from the *Current Policies* scenario, now including the transition shock, i.e. the CO2 taxation and revenue recycling through transfers, as well as the chronic climate-related economic damages. The scenarios with more ambitious climate adaption project better economic development in the long term due to lower physical damages, even though the higher CO2 prices are temporarily dragging down output. While the Net Zero 2050 scenario projects GDP about 1% lower in the first ten years of the simulation period compared to the *Current Policies* scenario, the projected GDP is substantially higher after 2040. By the end of the simulation period, a GDP deviation of almost +3,5% between the *Net Zero 2050* and *Current Policies* scenarios is projected. The two other scenarios, *NDC* and *Below 2°C*, also show long-term GDP benefits, albeit to a lesser extent. While they are accompanied by lower transition costs in the earlier years due to a smaller carbon tax than in the *Net Zero 2050* case, they also lead to less pronounced GDP increases compared to the *Current Policies* in the long run, with approximately +1% for the *NDC* and +2,5% in the *Below 2°C* scenario in the period 2046-2050.

Figure 5: Euro area GDP deviation from Current Policies scenario (in %) with transition shock and chronic damages



Source: IMK simulations using NiGEM and based on NGFS.

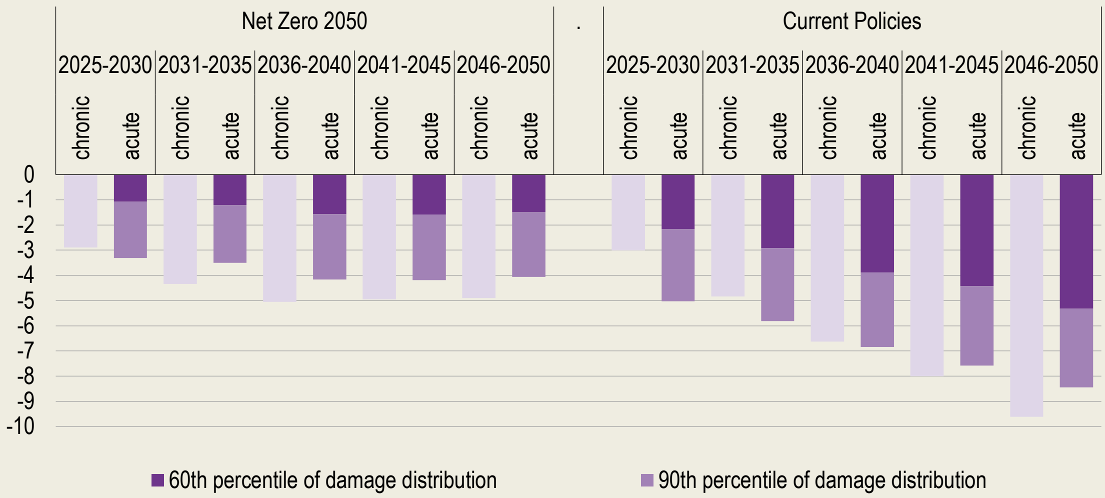
IMK

Infobox: Considering tail risk by taking acute damages into account

Apart from incorporating chronic physical risks of climate change, the NGFS approach also foresees in a further step to include *acute damages* resulting from extreme weather events against the backdrop of their higher likelihood with rising average temperatures. The corresponding data for these acute weather impacts stem from Climate Analytics and cover damages caused by droughts, heatwaves, floods and cyclones (NGFS 2024b). In Europe as well as globally, the main part of the acute physical risks is attributed to droughts and heatwaves.

However, the risk of double-counting physical damages through mere aggregation of chronic and acute physical risks cannot be ruled out, and the extent of this cannot be precisely assessed. This is primarily because the damage function used by Kotz, Levermann and Wenz (2024) to estimate the chronic damages does not only consider the global average temperature but also includes other climatic variables that are more correlated with extreme weather events (NGFS 2024a). Therefore, we refrain from simply adding acute climate damages to the chronic damages in the main simulations of the scenarios. Nevertheless, it makes sense to take a closer look at the extent of these potentially additional damages caused by extreme weather events. Acute risks can still be meaningfully incorporated to assess the possibility of additional tail risks, which should be seen as an impact of stochastic uncertainty.

Figure 6: Acute & chronic physical damages (in % of GDP) in Euro area



Source: IMK simulations using NiGEM and based on NGFS.

Figure 6 shows the estimated acute damages from extreme weather events in the euro area as a percentage of GDP until 2050 for the two scenarios *Net Zero 2050* and *Current Policies*.[10] The damage levels should again be seen as deviations from a counterfactual baseline without any physical damages caused by climate change. To facilitate comparison, the corresponding chronic damages are also shown. To make the extent of uncertainty of the acute damages more apparent, we show both the 90th percentile of the distribution for the damage estimates (as it is used by the NGFS in their representations) (NGFS 2024c) and the 60th percentile, which is the most conservative estimate of acute damages provided by Climate Analytics.

The depicted values show that the acute damages from extreme weather events in the euro area could amount to up to 8% of GDP in the *Current Policies* scenario by the middle of the century, or, according to the more conservative estimate of the 60th percentile, around 5%. By contrast, the *Net Zero 2050* scenario limits the income loss due to acute damages to 4% or 1.5%, respectively.

If the acute damages were included in the NiGEM simulations by adding them on top of the chronic damages, the long-term benefits of an ambitious climate policy would become even more pronounced. Assuming that acute damages were indeed occurring fully complementary in what could be called a tail risk scenario would mean that an effective limit of the temperature increase to 1.5°C with the *Net Zero 2050* scenario results in a GDP level that is approximately 8 to 9 percent higher (depending on the chosen percentile of acute damages) than in the *Current Policies* scenario by mid-century. Furthermore, the transition costs of carbon pricing are outweighed much earlier in the simulations that include acute risks as the physical damages avoided through emission reductions manifest sooner and with greater magnitude if extreme weather events are taken into account.

[10] These two scenarios are the only ones of the four scenarios used in this Policy Brief for which acute damage estimates are available from Climate Analytics / NGFS.

3.3 Role of an EU investment fund to promote decarbonisation in Europe

Based on the climate adaptation scenarios presented above we now study the role of an EU investment fund to promote the decarbonization of our economies. We assume that EU member states will invest an additional 1% of their GDP annually from 2027 to 2034. These public investments are assumed to be debt-financed and intended to support the green transition of the European economy.

The additional public investment into the green transition is supposed to increase the efficiency and availability of green technologies and thus make them less costly to adopt to in the long term. To account for this effect, we assume in the EU investment fund scenario that the shadow carbon price path is somewhat reduced. To be precise, the carbon price path is exemplary assumed to be 10% lower than in the Net Zero 2050 scenario.[11]

This assumption on the shadow price of carbon emissions deserves some more critical comments. On the one hand, the investment fund could be used for untargeted lump-sum subsidies or transfer bonuses to compensate businesses or households for the increased CO2-costs. Such measures would most likely not reduce the social marginal abatement costs, i.e. the shadow carbon price, of greenhouse gas emissions as they do not (sustainably) alter the price differences between a unit of output based on fossil energy production and one based on green energy production (see e.g. Vogt-Schilb and Hallegatte 2014). Instead, lump-sum subsidies to firms or transfers to households merely compensate for higher CO2-taxation through government spending, thereby shifting the costs to the tax-paying public. Whilst this could still be in the interest of society in order to distribute the burdens of the transition costs related to climate adaptation more equitably, the shadow price of CO2, which corresponds to the marginal abatement costs, would remain largely unchanged.

On the other hand, if targeted appropriately, a European investment fund would at least to some extent reduce the shadow carbon price provided that the investment or subsidies in the development of more climate-friendly technologies sustainably reduce the transition costs from fossil to CO2-free production.[12] Thus, under the assumption that the public investments or subsidies increase the efficiency and availability of green alternative technologies and reduce their costs in the long term, the marginal CO2 abatement costs will decrease. In our simulations of the EU investment fund scenario in the climate version of NiGEM we therefore implement a shadow carbon price that is exemplary assumed to be 10% lower than in the Net Zero 2050 scenario.

Figure 7a shows for the *Net Zero 2050*, *NDC*, and *Below 2°C* scenarios and for each scenario supplemented by the EU investment fund the percentage deviation of GDP from the projected value of the *Current Policies* scenario, the latter without the fund. Compared to the performance of the NGFS scenarios of the transition shock and chronic damages but without the investment fund (see Figure 5 and depicted as points for comparison here), it is noticeable that the initial negative effects of CO2 taxation in the three scenarios in relation to the *Current Policies* path are

---

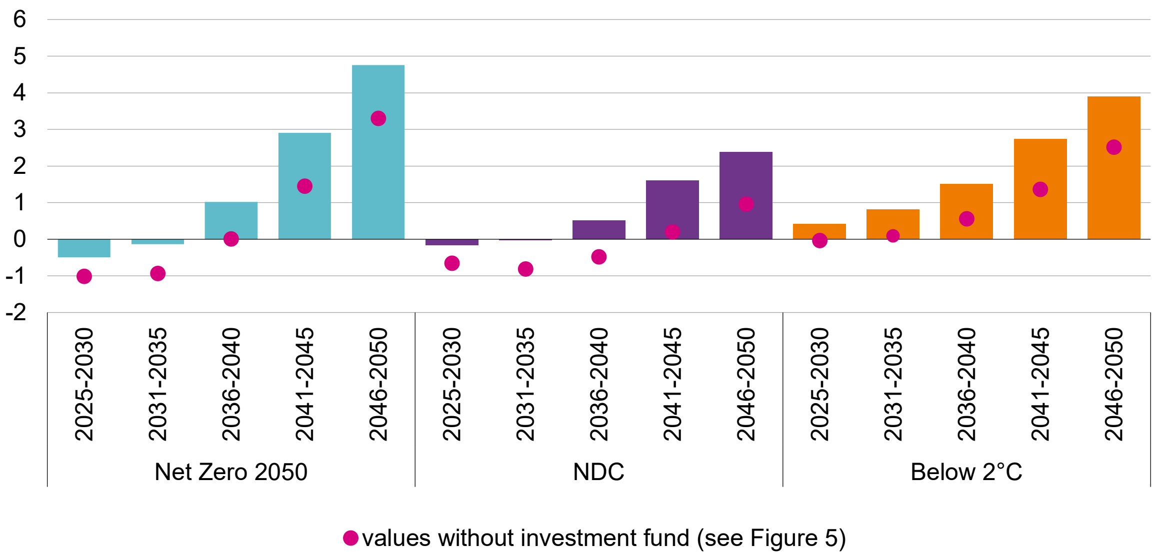
[11] See Sigl-Glöckner, Steitz and Ziesemer (2025) for an analysis in which CO2-shadow prices are reduced by 50%. We believe this strong reduction in *shadow* prices is beyond what can plausibly be assumed and hence opted in our example for a mere 10% reduction. See also European Central Bank (2024a) for a similar analysis of a policy mix scenario using market CO2-prices.

[12] Examples include amongst others targeted public subsidies or investments in the build-up of electricity networks, research and development in green technologies, or installation of green production facilities.

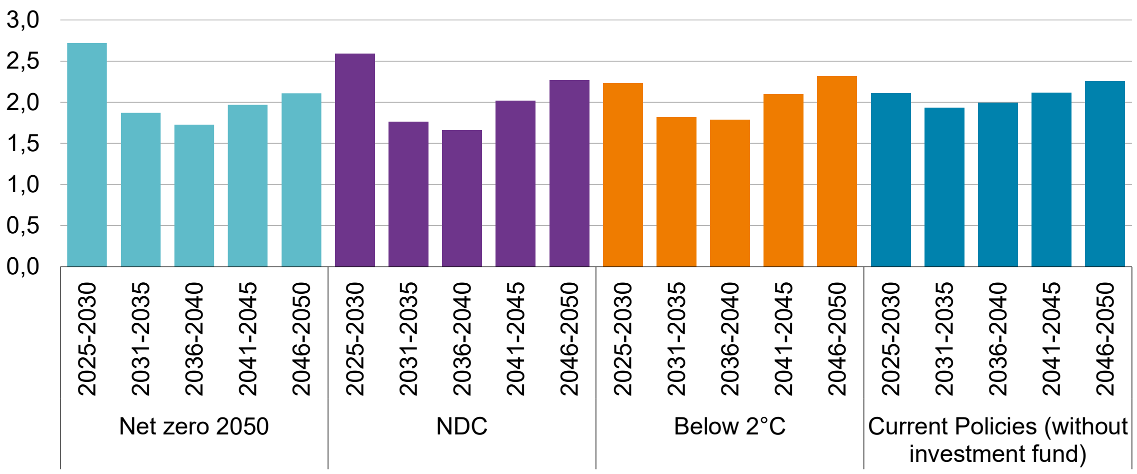
significantly mitigated. In the Net Zero 2050 scenario, GDP is projected to be 1% lower in the immediate period from 2025 to 2030. However, with the establishment of the investment fund, this figure is now only about 0.5% lower. In the *Below 2°C* scenario the public investment impulse even leads to a slightly higher GDP than in the *Current Policies* scenario already in the first years of the simulation.

Figure 7: Macroeconomic effects of an EU investment fund

a) Euro area GDP deviation from Current Policies scenario (in %) with EU Investment fund



b) Euro area inflation (in %) with EU investment fund



Source: IMK simulations using NiGEM and based on NGFS.

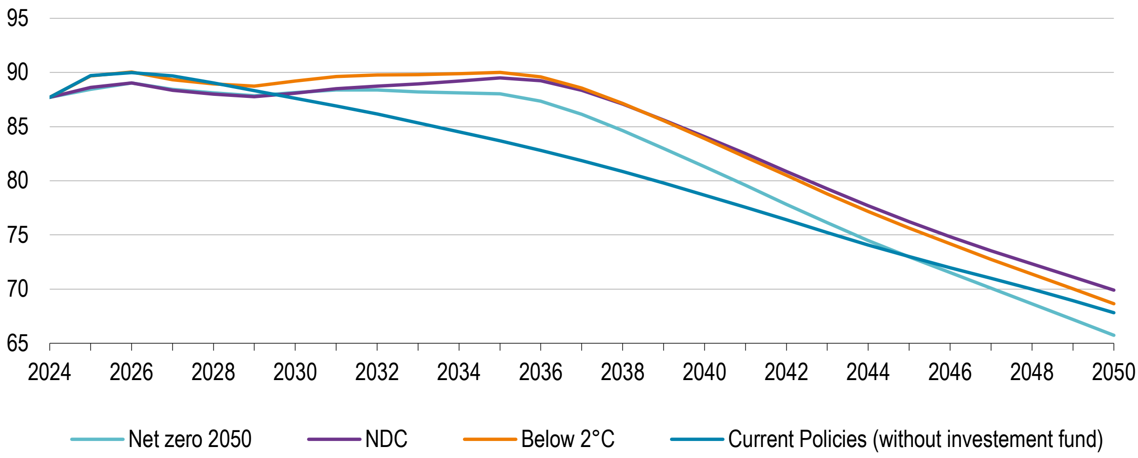
Even after the investment program ends in 2034, a sustainably higher GDP is being projected in all three scenarios, and GDP continues to remain higher in the long term compared to the scenarios without the investment program. By 2050, the *Net Zero 2050* path (as well as the other two ambitious climate adaptation paths) proves to be even more advantageous when combined with the European investment fund. Instead of GDP being 3% higher compared to the *Current Policies* scenario, the implementation of the investment fund leads to nearly a 5% positive deviation by mid-century. This positive long-term effect is largely due to the investment fund raising potential GDP via its positive effect on the capital stock. When additionally taking into account the acute physical risks resulting from extreme weather events, the increase compared to the *Current Policies* scenario could even amount to nearly 10% by mid-century.

Similar to the findings of the investment fund in the standard NiGEM model in section 2, the inflationary effect of the investment fund is again found to be very limited according to our simulations (Figure 7b). Compared to the simulated inflation resulting solely from the implementation of a higher carbon tax (see section 3.1), the additional investment activity leads to a projected inflation rate that is higher by just a few tenths of a percentage point in the first years of the simulation. However, even during the ongoing investment program after 2030, the inflation rate in all scenarios falls below the 2% target. In fact, due to the public investment fund increasing productive capacity, inflation is found to be somewhat lower for much of the time. This holds compared to the *Current Policies* scenario without investment fund (Figure 7b) as well as compared to the carbon tax transition scenarios (Figure 3b).

Finally, in terms of public debt sustainability, we observe an increase in average government debt ratio in the euro area shortly after the start of the EU public investment program (Figure 8). However, the debt ratio only increases by a few percentage points, reaching up to 90% of GDP in the mid-2030s. The investment program leads to largely stagnant debt ratios in all three scenarios during its duration. After its end, the simulation results show declining debt ratios in the long-term, which fall to or below 70% in all scenarios by 2050, gradually approaching the reference line of the *Current Policies* Scenario without the investment fund. In the case of the *Net Zero 2050* scenario, the debt ratio even falls below this reference line in 2045. As such, whilst a debt-financed EU investment fund would necessarily increase the euro area debt-to-GDP ratio in the short-term, long-term debt sustainability would not be endangered according to our simulations.

Against this backdrop, it is problematic that current European fiscal rules are based on debt-to-GDP ratio forecasts that do not take economic damages arising from climate change into account. Debt sustainability considerations should therefore – by themselves – not impede investments in the green transformation of the European economy, since inaction would equally lead to higher debt ratios than usually predicted (Sigl-Glöckner, Steitz and Ziesemer 2025). However, we should close this subsection by acknowledging the uncertainty around our simulations.

Figure 8: Average Government Debt Ratio in the euro area with EU investment fund (in % of GDP)



Source: IMK simulations using NiGEM and based on NGFS.

3.4 Climate adaption as a global task

A common question is whether Europe's efforts alone, with less ambitious climate policies in the rest of the world, would be ineffective. An exemplary simulation of a scenario can help illustrate this, where the European Union countries were to follow the *Net Zero 2050* path, while the rest of the world only implements the emissions reductions already set at the national level according to the *Nationally Determined Contributions (NDC)* scenario. In this *mixed* scenario both the transition costs driven by CO2 taxation to reduce emissions and the chronic physical damages corresponding to the global temperature rise are incorporated into the simulation. We simulate this mixed scenario both with and without the EU investment fund and compare the simulation results to the previously established global *Net Zero 2050* case.

Figure 9 shows the results. The comparison between the *net zero* and *mixed* scenarios shows that a globally coordinated effort would be a favorable way to keep costs low and long-term benefits high for European economies – with or without an EU investment fund. In the *mixed* scenario without the EU investment Fund, there is a significantly worse GDP development for the euro area compared to the case where all countries follow the *Net Zero 2050* policies. In comparison to the *current policies* scenario assumed for the entire world, euro area GDP is projected to be lower until as long as 2040, then only being almost on par for the period 2041-45. Only at the very end of the simulation horizon will GDP in the euro area be slightly above its level of the *Current Policies* scenario. If, however, the EU investment fund is being implemented, this point in time will occur much earlier, already at the beginning of the 2030s, when euro area GDP in the *mixed* scenario is higher than in the *current policies* scenario.

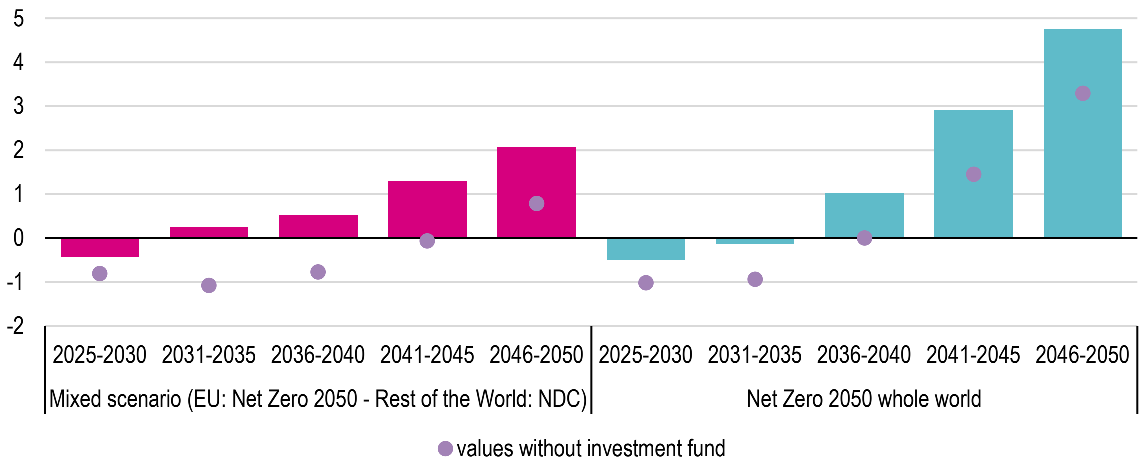
In contrast, if the *Net Zero 2050* policies were followed by the entire world (as assumed and presented in sections 3.2 and 3.3) euro area GDP would be about 3% higher by the mid-century without and about 5% higher with the EU investment fund (compared again against the *current policies* scenario for the entire world). This is due to the fact that in the assumed *mixed* scenario, the European economy is negatively affected by the higher transition costs of the ambitious *Net*

Zero 2050 taxation pathway, while at the same time it can only reduce its own climate damages to a very limited extent, as these depend by and large on the carbon emissions of the entire world, of which the EU accounts for only a small portion.[13]

This highlights that combating climate change by reducing greenhouse gas emissions to limit global temperature rise is a global task. Only with the involvement of all or at least the largest emitters will the green transformation succeed in reducing global warming such that everyone in the world will be able to benefit from the significantly reduced economic costs otherwise caused by climate change (Wolf 2024).

Nonetheless, Figure 9 nicely illustrates that these higher transition costs can be significantly reduced through an EU investment fund, highlighting the positive economic growth effects for Europe even if only Europe was to pursue ambitious climate targets. The EU Investment Fund should thus present a crucial component of the toolbox for achieving the green transition with a favorable growth path. If the policy focus was instead only on carbon pricing, the temporary costs of decarbonization would be felt in Europe well into the 2040s.

Figure 9: Euro area GDP deviation from Current Policies scenario (in %) in mixed scenario with EU Investment fund



Source: IMK simulations using NiGEM and based on NGFS.

[13] In 2020 EU CO2 emissions accounted for about 8% of world CO2 emissions (Source: Our World in Data).

4 Conclusion

This policy brief has examined the macroeconomic effects of a green European public investment fund, utilizing both the standard and climate versions of the NiGEM model. The climate version was used to address the dual challenges of accounting for climate transition costs as well as long-term physical damages arising from climate change. Our simulations underscore the critical trade-offs between short-term economic adjustments and the far more severe consequences of inaction on climate change.

Key findings reveal that while CO2-taxation does impose transitional GDP losses and inflationary pressures, these costs are in most cases dwarfed by the long-term economic benefits of ambitious climate policies. The *Net Zero 2050* scenario, despite its higher initial transition costs, ultimately delivers a GDP gain of nearly 3.5% by mid-century compared to a *Current Policies* trajectory, with even greater benefits (possibly up to 8%) when also accounting for acute physical risks from extreme weather events.

An EU investment fund, modelled with debt-financed additional public investment of 1% of GDP annually from 2027 to 2034, proves instrumental in mitigating these transitional costs. By reducing carbon prices through targeted green investments, the fund not only cushions short-term GDP losses but also enhances Europe’s long-term growth potential, while debt sustainability is largely maintained.

Our analysis also discusses the limits of unilateral action. When the EU pursues *Net Zero 2050* independently while other regions of the world adhere to their less ambitious *Nationally Determined Contributions*, the EU’s GDP gains are diminished, emphasizing the importance of global cooperation to more effectively curb the temperature rise. Importantly, however, our results show these transition costs can be significantly reduced by the implementation of an EU investment fund.

Finally, these results also carry important implications for EU fiscal policy and its newly reformed rules-based framework. Current debt sustainability analyses, which ignore climate-related damages and transition costs, risk misjudging the fiscal space needed for green investments (Sigl-Glöckner, Steitz and Ziesemer 2025). As the reformed EU fiscal rules take effect, policymakers must recognize that climate inaction is not a fiscally neutral option -- it is a path to higher debt and lower growth. The EU’s Recovery and Resilience Facility has demonstrated the viability of debt-financed EU-level investment; our simulations indicate that scaling this model for the green transition is both economically prudent and imperative to avert far costlier futures.

References

Bańkowski, K. / Benalal, N. / Bouabdallah, O. / Stefani, R. de / Dorrucci, Ettore / Huber, C. / Jacquinot, P. / Modery, W. / Nerlich, Carolin / Rodríguez Vives, M. / Szörfi, B. / Zorell, N. / Zwick, C. (2024): Four Years into Next Generation EU: What Impact on the Euro Area Economy. 362. Aufl. European Central Bank.

Bilal, A. / Känzig, D. (2024): The Macroeconomic Impact of Climate Change: Global vs. Local Temperature, Cambridge, MA.

Copernicus Climate Change Service / World Meteorological Organization (2025): European State of the Climate 2024. https://climate.copernicus.eu/esotc/2024.

Draghi, M. (2024): The future of European competitiveness – A competitiveness strategy for Europe. Part A | A competitiveness strategy for Europe. https://commission.europa.eu/document/download/97e481fd-2dc3-412d-be4c-f152a8232961_en?filename=The%20future%20of%20European%20competitiveness%20_%20A%20competitiveness%20strategy%20for%20Europe.pdf, aufgerufen am 11.12.2024.

European Central Bank (2023): The macroeconomic implications of the transition to a low-carbon economy. In: ECB Economic Bulletin., Issue 5, S. 83-104.

European Central Bank (2024a): Assessing the macroeconomic effects of climate change transition policies. Prepared by Marien Ferdinandusse, Friderike Kuik and Romanos Priftis. In: ECB Economic Bulletin., Issue 1, S. 51-62.

European Central Bank (2024b): Mind the gap: Europe's strategic investment needs and how to support them. The ECB Blog. By Bouabdallah, Othman; Dorrucci, Ettore; Hoendervangers, Lucia; Nerlich, Carolin. https://www.ecb.europa.eu/press/blog/date/2024/html/ecb.blog240627~2e939aa430.en.html, aufgerufen am 08.08.2024.

European Commission (2019): The European Green Deal. 2019. Aufl. Brussels 11.12.2019.

European Commission (2025): White paper for European defence – Readiness 2030. ReArm Europe. https://commission.europa.eu/document/download/e6d5db69-e0ab-4bec-9dc0-3867b4373019_en?filename=White%20paper%20for%20European%20defence%20%E2%80%93%20Readiness%202030.pdf.

Heimberger, P. / Lichtenberger, A. (2023): A Permanent EU Investment Fund in the Context of the Energy Crisis, Climate Change and EU Fiscal Rules. 63. Aufl. Wiener Institut für Internationale Wirtschaftsvergleiche (wiiw).

Institut Rousseau (2024): Road to net zero. Bridging the greend investment gap.

Koch, C. / Biegon, D. / Fleckenstein, F. / Krüger, L. / Rohde, J. P. / Korinek, L. / Bertram, L. / Mühlbach, C. / Wiese, K. / Schuster, F. / Carvalho, L. M. R. (2024): Ein EU-Zukunftsfonds. Warum und wie? - Hintergrundpapier des Netzwerks Progressive EU-Fiskalpolitik. 2024. Aufl. FES Studie Wirtschaft und Finanzen.

Kotz, M. / Levermann, A. / Wenz, L. (2024): The economic commitment of climate change. In: Nature, Jg. 628, H. 8008, S. 551-557.

Michels, A. / Ciriaci, D. / Rueda-Cantuche, J. M. / Pedauga, L. / Ferreira, V. / Kattami, C. / Schulz, D. / Pilati, M. (2025): Economic Impacts of the Recovery and Resilience Facility: New Insights at Sectoral Level and the Case of Germany. European Economy Discussion Paper 221. Publications Office of the European Union.

Millard, S. (2025): A Macroeconomic Analysis of the Impact of the EU Recovery and Resilience Facility. NIESR Discussion Paper No. 564.

NGFS (2024a): Damage functions, NGFS scenarios, and the economic commitment of climate change. An explanatory note.

NGFS (2024b): NGFS Climate Scenarios Technical Documentation: V5.0. Network for Greening the Financial System.

NGFS (2024c): NGFS long-term scenarios for central banks and supervisors. Scenario Phase V Lunch Event Slides. https://www.ngfs.net/system/files/import/ngfs/medias/documents/ngfs_scenarios_main_presentation.pdf.

Paetz, C. / Watzka, S. (2024): The New Fiscal Rules. Another round of austerity for Europe? IMK Policy Brief No. 176.

Sigl-Glöckner, P. / Steitz, J. / Ziesemer, V. (2025): The baseline is wrong. How debt sustainability analyses used in eht EU ignore climate change. 25. Aufl.

Vogt-Schilb, A. / Hallegatte, S. (2014): Marginal abatement cost curves and the optimal timing of mitigation measures. In: Energy Policy, Jg. 66, S. 645-653.

Watzka, S. / Watt, A. (2020): The macroeconomic effects of the EU Recovery and Resilience Facility. A preliminary assessment. IMK Policy Brief No. 98.

Wein, T. (2025): Zertifikatehandel ist das am besten geeignete Instrument der Klimapolitik. In: Wirtschaftsdienst, Heft 1, S. 64-68. https://www.wirtschaftsdienst.eu/inhalt/jahr/2025/heft/1/beitrag/zertifikatehandel-ist-das-am-besten-geeignete-instrument-der-klimapolitik.html?

Wolf, M. (2024): Global climate crisis needs a global solution. In: Financial Times, 27.11.2024.

Imprint

Publisher
Macroeconomic Policy Institute (IMK) of Hans-Böckler-Foundation, Georg-Glock-Str. 18,
40474 Düsseldorf, Germany, phone +49 211 7778-312, email imk-publikationen@boeckler.de

IMK Policy Brief is an irregular online publication series available at:
https://www.imk-boeckler.de/de/imk-policy-brief-15382.htm

ISSN 2365-2098