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Article

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How Can the European Union Adapt to Climate Change?

Europe must increasingly deal with the harmful impacts of climate change, regardless of its success in reducing emissions. These impacts have significant cross-border effects and threaten to deepen existing divisions. Cooperation on adaptation, which is mostly seen as requiring local or regional efforts, may be useful, but the role of the European Union is ill-defined. This article gives an overview of how climate change might transform Europe and how it might affect people and the economy. It also discusses on what grounds adaptation policies should be pursued at the EU level. The article argues that a stronger adaptation governance framework would benefit adaptation efforts and formulates three ideas to strengthen adaptation. The first is a three-layered governance framework based on intensive cooperation to establish binding adaptation plans. Second is an EU-level insurance scheme against damages from climate change, with the size of national contributions tied to the achievement of targets in adaptation plans. The final suggestion is to increase *ex ante* adaptation funding by targeting more spending under EU regional and agricultural policies specifically to adaptation in the most vulnerable regions.

Projections made after the 26th UN Climate Change Conference in Glasgow in 2021 show that even if the European Union's ambitious commitment to climate neutrality by 2050 succeeds, global average temperatures may still rise to 2.4°C above pre-industrial levels by 2100 (Stockwell et al., 2021). The effects of climate change will moreover be felt even in the increasingly unlikely scenario that global warming is limited to 1.5°C. In addition to mitigating climate change, major efforts will therefore have to be made to adapt societies.

Most climate action at the EU level focuses on mitigation. Adaptation – efforts to avoid, limit or manage the harmful effects of climate change on human and natural systems – is mostly a regional and local issue. Nevertheless, the EU is also moving on this front, and with good reason. Science predicts that southern (and south-eastern) EU countries could be affected more significantly than their northern counterparts, exacerbating existing tensions. Furthermore, the broad effects of climate change touch on various policy fields that are within EU competences, and there are many cross-border aspects and instances of scale advantages. It remains, however, difficult to exactly delineate where and how the EU should step in, especially since adaptation to climate change still involves learning-by-doing.

The aim of this paper is to contribute to this debate. To set the scene, we first give an overview of what may be ahead for Europe in terms of physical climate change and economic loss. We then discuss the arguments invoked to warrant EU intervention in terms of adaptation. Finally, we propose ideas to strengthen the governance of climate adaptation efforts in Europe.

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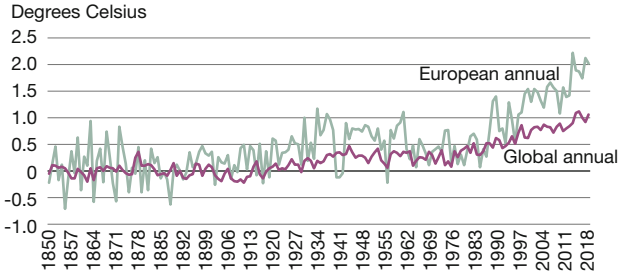
The impact of climate change on Europe

Physical effects

Global average surface temperatures have so far risen by 1.1°C since pre-industrial times (IPCC, 2021). Land temperatures in Europe, however, have been rising much

Figure 1
Global and European average near-surface temperatures relative to pre-industrial period 1850-1900



Source: EEA (2021a), HadCRUT4 (mean) estimates.

faster, to about 2°C above pre-industrial levels (Figure 1). With rising average temperatures, all of Europe is also seeing more frequent and intense extreme weather phenomena today than it did during much of the previous century – more summer heatwaves, heavy precipitation and droughts – as well as rising sea levels (IPCC, 2021).

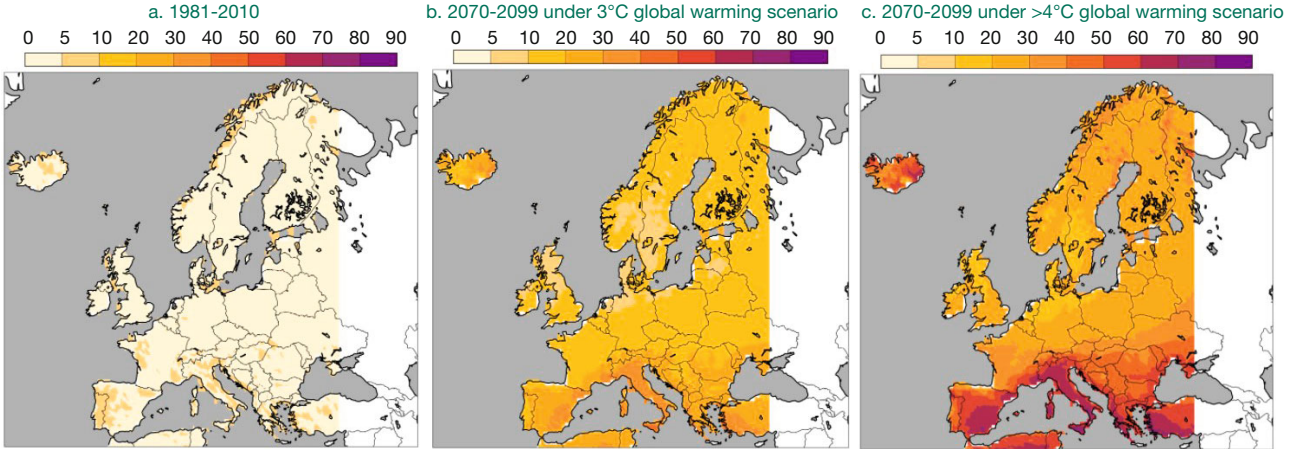
The specific impacts of climate change differ across regions: all regions are seeing higher temperatures today, but the rise of mean temperatures has so far been fastest in central and eastern Europe, and in the very south, with more than 0.4°C of warming per decade on average since 1960 (EEA, 2021a). Unlike the rest of Europe, the south has not seen a clear increase in heavy precipitation and river flooding. Instead, it has suffered more from droughts, as has western Europe (IPCC, 2021).

Projections of different global warming scenarios for Europe indicate three main things about the future: that it matters greatly how successful efforts are to reduce greenhouse gas emissions; that all of Europe will be affected; and that in most scenarios, southern and south-eastern Europe will face the biggest impacts of climate change on multiple fronts.

Average temperatures will increase in all regions throughout this century, but patterns vary depending on the season. Mountainous areas and the northern and southern edges of Europe will experience the largest temperature increases overall, especially in the summer, with mean temperatures that will be between 2°C and 2.5°C warmer than today by the end of this century, even in a scenario in which global warming stays below 2°C (Feyen et al., 2020; Climate-ADAPT, 2022a).[1] Since southern Europe already has a warmer climate, it will be particularly affected by more frequent heatwaves that are harmful to human health (Figure 2).

1 For simplicity we use *likely* upper bounds of global average temperature increases by 2100 to refer to global warming scenarios that were presented in the Fifth Assessment Report of the IPCC (2014a). The 2°C scenario refers to RCP 2.6, a Representative Concentration Pathway in which CO_2 emissions start to decline by 2020 and reach zero in the second half of this century. The 3°C scenario refers to RCP 4.5, in which CO_2 emissions remain at current levels until 2050, after which they start declining. The > 4°C scenario refers to RCP 8.5, in which emissions continue to rise as before.

Figure 2
Annual number of health-affecting heatwave days

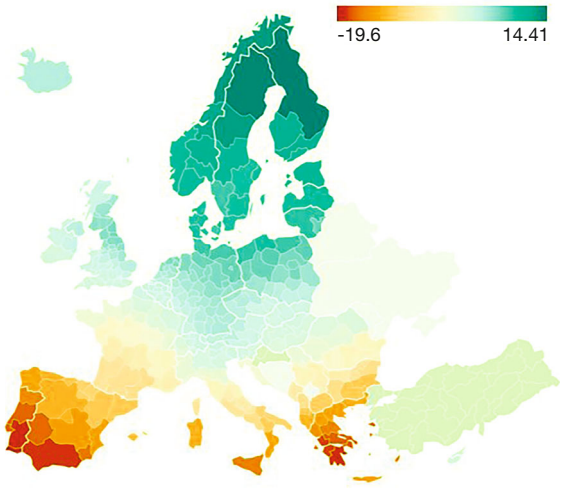


Note: A health-related heatwave is considered to be a period of at least 2 consecutive days on which the maximum apparent temperature (Tappmax) exceeds the 90th percentile of Tappmax and the minimum temperature (Tmin) exceeds the 90th percentile of Tmin. Health heatwaves are calculated for each month of the summer period between June and August. The apparent temperature is a measure of relative discomfort due to combined heat and high humidity.

Source: Climate-ADAPT (2022b), based on Copernicus Climate Change Service data.

Figure 3

Projected percentage change in annual precipitation by mid-century (2041-2070) by region (NUTS2), in a high-emission scenario (> 4°C)



Source: Climate-ADAPT (2022c).

Precipitation will change too. In an optimistic emissions scenario compliant with the Paris Agreement (global warming stays below 2°C), most regions in Europe will see an increase in annual average precipitation, mostly in winter (roughly 5% to 10% more than today). Summer months, however, may become dryer in the south particularly on the Iberian Peninsula. In a high-emission scenario (global warming >4°C), the contrasts will be much starker (Figure 3). The whole south will be much dryer throughout the year, with up to 20% less rainfall than today by the middle of the century and 30% less by 2100. Wildfires and droughts may therefore become increasingly frequent and serious problems for the Mediterranean region. Northern Europe, on the other hand, will become significantly wetter on average, even though in the summer many north-western regions, including France, Benelux, Britain and Ireland, will see less rainfall than today (Climate-ADAPT, 2022c). Rainfall that is more concentrated in time is expected to result in river flooding more often in these regions (EEA, 2021b).

Even the frequency of extreme sea levels and coastal floods is expected to increase much more in the south than in the north. By 2100, sea-level surges that historically would occur once every century may return as much as several times a year along the Mediterranean and Black Sea coasts in a high-emission scenario (>4°C), while they may happen once every one or two years along northern shorelines. In an intermediate scenario (3°C), the probabilities decline to around once a year and a few times each decade, respectively (EEA, 2021c).

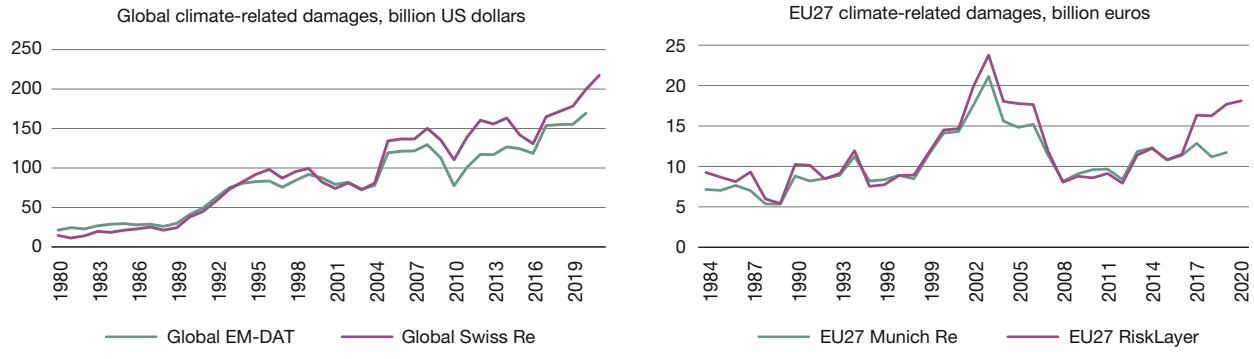
Damages and economic impacts

The fact that climate change is already underway is reflected in a clear upward trend in global estimated losses from climate-related disasters. There is, by contrast, not yet such a trend in the EU, due to the outsized damages from single events in Europe (Figure 4). But the yearly number of reported climate-related disasters in Europe is increasing. It is reasonable to assume that as both the frequency and intensity of extreme weather events grow, so will the material damages from such single disasters, especially as the value of exposed assets grows because of continued building on flood plains, for example.

Figure 4

Historic damages from climate-related natural events worldwide and in the EU

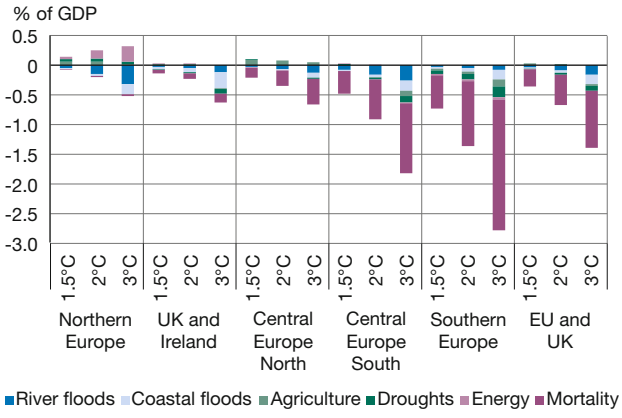
Five-year moving averages



Sources: CRED/UCLouvain (2021), EM-DAT; Swiss Re Institute (2022); EEA (2022).

Figure 5

Estimated welfare loss from future climate impacts if applied to today's economy, by region and level of global warming



Source: Feyen et al. (2020).

Estimates based on a static model by the European Commission's Joint Research Centre (Feyen et al., 2020) show how much welfare loss the current EU economy could suffer if it were subject to different global warming scenarios, compared to today's climate (Figure 5). Feyen et al. (2020) considered general equilibrium effects of damages from river floods, coastal floods, droughts, windstorms and human mortality from extreme heat, as well as declining agricultural yields and the impact of water scarcity on energy supply (see Behrens et al., 2017). Total EU28 (including the United Kingdom) welfare losses per year would be at least €175 billion with a temperature rise of 3°C, €83 billion with 2°C and €42 billion with 1.5°C.

Regions that are more affected by climate change are also likely to suffer greater material losses, particularly if these places are less prepared, as data from, for example, ND-GAIN (2022) suggests. The Commission's results confirm that southern Europe would be affected the most, with a yearly loss of 1.3% of GDP with 2°C of global warming compared to an average for the EU28 of only 0.7%.[2] The results are mostly driven by mortality from extreme heat, without which losses are more similar across different regions. Strikingly, Scandinavian countries could enjoy net economic gains, as increased energy output and agricultural production outweigh the impact of more floods. No region has net gains in a 3°C warming scenario, but the net losses for countries north of the Alps (0.2% to 0.6% of GDP) are clearly less than those incurred by southern and south-eastern countries, which would reach up to 2.8% of GDP.

These impact estimates are conservative according to Feyen et al. (2020). They do not account for all possible climate impacts or tipping points (loss of labour productivity, reduced tourism, destabilised mountainous terrains, ecosystems, etc.), and they only apply estimated climate change effects to today's economic output, without taking into account possible long-term growth effects.[3] Finally, they say nothing about how climate change might disproportionately affect disadvantaged groups (IPCC, 2014b).

Why should the EU act?

The legal basis for action on climate change adaptation is provided by the EU treaties,[4] which state that the EU's environmental policy should also contribute to the protection of human health and the prudent and rational use of natural resources, based on the precautionary principle and on preventive action. The European Climate Law (Regulation (EU) 2021/1119) also calls explicitly for the EU and member states to make progress on adaptation, and it contains provisions about mandatory adaptation strategies, assessments of progress, consistency of adaptation measures and adaptation mainstreaming.[5]

The responsibility for adapting to climate change is thus shared by member states and the EU. According to the subsidiarity principle, the EU should therefore intervene where member state action is not sufficient to achieve the desired objectives, while leaving other decisions as much as possible to citizens. This is typically a question of scale advantages and cross-border spillovers, as well as of how other EU competences are involved. Such considerations are clearly reflected in the EU's most recent climate change adaptation strategy (European Commission, 2021b).

An important example where scale plays a role is in the sharing of scientific knowledge. While local and regional governments have the best insight into local environmental, social and economic circumstances, they often lack the scientific capacity to identify vulnerabilities in the face of climate change, or to develop adequate policy responses. There is a clear benefit in pooling capacities at EU level to expand scientific knowledge on current and future climate impacts through, for example, satellite-based earth observation programmes like Copernicus, which are beyond the capacity of national governments. Knowledge generated at the EU level can then be used as a public good by all, for example through the dedicated

2 Note that these are not projections of damages to assets, but losses in GDP. Estimates of future damages from the same study are higher, e.g. €111 billion per year from coastal flooding alone (EU-wide) in a moderate-emission scenario without adaptation.

3 When accumulated over time, such effects can have a very large impact on welfare, see Burke et al. (2015).

4 Articles 191 and 192(1) TFEU.

5 Articles 5, 6 and 7.

Climate-ADAPT platform, and applied to local situations (top-down). As adaptation interventions are still about learning by doing, there is also an interest in sharing local experiences at the European level in order to accelerate the learning process (bottom-up).

The EU can also use its administrative capacity to develop standardised methods that can be applied by local or regional governments to report damages, carry out cost-benefit analyses of interventions and *ex post* evaluations of policies, and to track adaptation progress. This would facilitate decision-making and enable cross-country comparisons for research and policy purposes.

Emergency response to major climate-related disasters is a very practical example of how scale can make a difference. Adaptation policies in the strict sense are preventive, but not all damages can be avoided, especially those of severe fast-onset events, so adaptation to climate change must entail strengthened capacities to respond to more frequent and severe natural calamities. National response capacities can easily be overwhelmed by large-scale floods or forest fires. Since time is often of the essence, pooling resources for fast and decisive interventions can avoid substantial damages and loss of life. The EU Civil Protection Mechanism was established for this purpose, as well as to assist countries before and after disasters strike.

Adapting to climate change requires cooperation across jurisdictions when effects are not limited to a single area. River management for irrigation, navigation and energy purposes during droughts is best done in cooperation with countries upstream and downstream, as is the management of floods. Vulnerable ecosystems do not stop at borders, and neither do infectious diseases or invasive species.

Finally, some climate impacts are specifically relevant for EU policymakers as they affect the functioning of the single market or the EU budget, for example, when essential transport infrastructure is damaged (ports, bridges, etc.) or supply chains are disrupted. Moreover, different policy fields already within the EU's competences can play an essential role in supporting climate change adaptation, such as regional and agricultural policy, insurance and financial regulations, and even fiscal rules.

Proposals for stronger adaptation governance

EU action on adaptation has already advanced greatly since the first strategy was adopted in 2013, but more must still be done to prepare Europe for a warmer climate. There is a notable absence of binding, precise and measurable targets for both EU-level adaptation policies and for the framework governing national and subnational adaptation action. Adaptation continues to be a secondary priority for some governments according to observers, resulting in weak subnational policy action (European Commission, 2021a). There is also a lack of public and private sector investment in concrete adaptation solutions. Targets are needed to accelerate adaptation efforts by reluctant governments, according to criticism by civil society organisations, which point to similar demands by the European Parliament and the Commission's own assessment that progress is too slow (EEB, 2021). It is also not clear how the EU will address the pressure that climate change could put on existing fault lines between northern and southern/south-eastern member states, as the Commission's strategy rests mainly on developing guidance, standards and best practices, supporting (sub)national policy development, and integrating adaptation into a few regulations. In the following, we therefore set out some ideas to strengthen European adaptation governance.

A multi-layered governance framework to structure cooperation

Under the EU Energy Union governance regulation (Regulation (EU) 2018/1999), EU countries are required every decade to submit ten-year integrated national energy and climate plans (NECPs), which should be updated halfway through each cycle. The regulation also requires progress reports from member states every two years. The European Commission assesses progress and issues recommendations. The regulation contains a requirement to describe adaptation goals, but only insofar as they apply to emission reduction commitments. Adaptation therefore seems to play only a secondary role in the NECPs.

The European Climate Law requires EU countries to adopt and implement national adaptation strategies and plans. These must be regularly updated and communicated every two years in reports dedicated to national adaptation actions. Every five years starting in 2023, the European Commission will then assess collective progress by member states.

Looking at the legal requirements, one can conclude that member states are not asked in any of these reports to set binding, measurable adaptation targets for which they can be held accountable.

A lack of action can also arise because governments at every level must play a role in adaptation. Without a clear division of tasks, governments can avoid responsibility, shifting the burden onto each other. This also happens when local governments are expected to implement adaptation plans without adequate funding, for example,

local building moratoriums that require compensation to be paid to landowners. Matters are made even more complex as horizontal cooperation across neighbouring jurisdictions is often needed to ensure consistency and to avoid maladaptation (for example, when building flood defences creates problems further downstream). Finally, better top-down and bottom-up information flows are needed to make sure that scientific knowledge can be used at local levels, while local experiences can feed back to policymakers higher up or can be shared with other jurisdictions.

A governance framework for adaptation action based on three levels could clarify tasks. It could facilitate and structure cooperation and the exchange of information between jurisdictions and different governance levels and allow for the introduction of binding, verifiable targets.

At the highest level, the European Commission and other relevant EU bodies such as the European Environment Agency should remain mostly responsible for helping to generate, collect and spread scientific knowledge (such as satellite imagery and model simulations). They should provide a platform through which national and subnational governments can share ideas, experiences and adaptation practises in a structured way, so that, for example, local governments can find out easily what similar places (in terms of urbanisation, climate, vegetation, geography, etc.) are doing. The sharing of information and its use for governance purposes would benefit from uniform measurement of damages and risks, and from methods to perform cost-benefit analyses, *ex post* evaluations and assessments of progress. These should therefore also be developed at the European level, preferably in consultation with member states. Disclosure requirements on governments could then be put into place accordingly. The EU should also expand its emergency intervention capabilities and continue to mainstream adaptation into other policy areas.

As the guardian of the general adaptation governance framework, the European Commission should engage with member states, using its expertise to help them establish binding ten-year national adaptation plans with clear and public targets, which are consistent with the plans of neighbouring countries. This would be a step further than what is demanded by European Climate Law.[6]

The Commission has a coordinating and informing role: It is up to countries themselves to decide on the level of ambition and to propose overall targets, such as the degree of private insurance coverage, depending on how they see priorities. This should not mean, however, that no incentives should be put in place to push for more ambition. The Commission should also be allowed to require the inclusion of strategic interventions that have EU-wide relevance, for example, for the protection of key infrastructure.

National adaptation plans should serve as a guide for local government action and should set the ambition level. Detailed knowledge of local circumstances and national/European expertise needs to be combined to formulate very concrete interventions, while avoiding maladaptation because of an excessive focus on single impacts.

This framework is meant to be flexible and cooperative rather than overly rigid and hierarchical. However, agreed adaptation plans should be formal, and we propose a link to an insurance instrument.

An EU insurance and solidarity fund to incentivise and help member states

The framework from the previous section would impose binding targets to enhance accountability but would allow member states to choose their own ambition levels. To push lagging member states and regions towards more decisive action than seen at present, we propose an incentive scheme, acknowledging that EU countries are unlikely to be willing to accept large and structural fiscal transfers to compensate for long-term climate-induced damages.

To reduce the threat of a climate divide, the fiscal risk of damages after climate-related disasters could be shared. The European Commission estimates that without adaptation, annual damages in Europe from floods alone could reach up to €144 billion by 2100 (from €9.2 billion today), even with only 2°C of warming (Feyen et al., 2020). Damages will be partly covered by private insurance, but it often falls to governments (sometimes by law) to contribute significantly to compensation spending, even in countries with extensive and mandatory coverage.

Expected government payments vastly exceed the capacity of the current European Solidarity Fund for post-disaster assistance, some €500 million in grants per year (2011 prices). It can therefore only compensate a small share of total non-insurable damages. Significantly enlarging the fund's capacity to cover an agreed set of public costs can soften the fiscal blow for affected countries. EU member states are all exposed to various extreme

6 We do not propose to integrate them into NECPs because adaptation is not secondary to mitigation but should be consistent with it. We therefore think the revising and reporting schedule (five- and two-yearly) should be aligned with that of the NECPs, while the Commission should publish individual progress assessments every five years, rather than the current EU-wide assessment mandated by the regulations.

impacts, creating a rationale for all to be insured against catastrophic impacts. The returns on repairing infrastructure and providing emergency housing and aid are also much more obvious to voters than those on climate adaptation investments, even if the latter may in fact be quite significant (Global Commission on Adaptation, 2019). Committing more funds here might therefore be much more feasible politically.

The fund should be financed by national contributions, based on a conditional mechanism which incentivises adaptation investments *ex ante*. Countries that do not implement adaptation measures would pay more into the fund than countries that implement strong adaptation measures. When a disaster occurs, the affected member state can be reimbursed.

An exact recommendation for the fund's capacity is hard to give as it would depend on the agreed scope of eligible damages, but one might imagine an annual capacity of several billion euros by 2030, growing with nominal GDP (which means more exposed value). However, it does not need to be large enough to compensate for all damages in particularly bad years, and a certain percentage of self-payment should always be required.

If compensated damages in a certain year (as legally defined) exceed the fund's basic capacity, the EU could issue bonds to cater to such systemic shocks. The interest and repayment burden can be distributed between member states in the same way as the financing of the fund itself.

The advantage of combining a fund with a borrowing capacity for systemic shocks is that markets will only be called upon for insurance against massive climate risks. If climate risks become more frequent, the fund will become increasingly important and intertemporal insurance will become less important relative to constant payments from the fund for incurred and repeated damages.

The mechanism to divide contributions to the fund and interest payments among member states serves the second purpose of this proposal to incentivise countries to invest in climate change adaptation, by making contributions depend on the achievement of targets as set out in the proposed national plans.

Adaptation plans must contain binding and verifiable targets. These could be proposed by countries at the beginning of a ten-year cycle for five-year periods. The Commission could then be asked to give an objective assessment of their level of ambition, after which the plan is approved by the Council. Depending on whether the targets achieve a certain reference level, to be agreed in advance (for example in terms of estimated damages prevented), the Council decision could also tie reductions of a country's contributions to the achievement of the targets. National contributions would initially include a risk premium to reflect countries' actual risk, which would decline as countries take steps to reduce climate vulnerability to a feasible extent. The system could thus evolve from risk-driven to solidarity-driven (e.g. based on GDP).

Financial resources for disadvantaged regions and key interventions

The proposals presented above may still not be sufficient to ensure adequate adaptation action in the most disadvantaged regions, particularly those in the south, which will suffer disproportionately from climate change. Yet, as explained above, political support for sharing the investment burden for *ex ante* adaptation seems unlikely.

Estimated annual investment needs in Europe are anywhere from €35 billion to more than €500 billion (EIB, 2021), whereas numbers from Olesen et al. (2017) suggest that from 2014 to 2020, only between €14 billion and €62 billion in total was allocated to adaptation through the EU's regional and agricultural policies. EU funding alone clearly cannot and should not suffice to make Europe resilient to global warming, and member states and the private sector both have large roles to play. However, the EU could use its regional and agricultural funds to target adaptation more strongly in the next budgetary cycle.

One could, for example, decide to increase the minimal share of climate-related spending, and within that category decide to focus mostly on mitigation in north-eastern regions, while focussing on adaptation in southern regions, including in the Balkans. This would not undermine economic convergence or rural income support, given the supposedly high returns on investment in adaptation and the vulnerability of agriculture. Communicating the two numbers separately would also increase transparency, whereas today it is rather difficult to say exactly how much is dedicated to adaptation. Better still would of course be to pursue the maximum synergies between mitigation and adaptation, for example, through nature-based adaptation solutions.

Another solution could be to propose an EU financial instrument for the protection of a limited list of infrastructure, supply chains, ecosystems and perhaps heritage sites that are of EU-wide relevance, such as seaports, energy linkages or corridors for migrating species. The Commission would then be able to require the inclusion of these elements in national adaptation plans and would provide the necessary funding in return.

Conclusion

As the effects of climate change are becoming more apparent, it is already clear that they can be severe, depending on how far temperatures rise, and that not all EU countries will be affected to the same degree. The drought that affected Italy in the summer of 2022 is an ominous example of what could be in store for most countries south of the Alps. Impacts will also differ between economic sectors and social groups, and they will be counted in percentages of GDP and lives lost.

Adapting to climate change is mostly a matter of regional and local action, but there are several reasons why the EU should also play a role. These involve scale advantages, territorial spillovers and impacts that relate specifically to the EU's other competences, such as ensuring the functioning of the single market. This is reflected in the two adaptation strategies that the European Commission has adopted so far, and in its efforts to create an EU disaster-response capacity.

These strategies have driven progress at the EU level. However, a lack of knowledge, awareness, political priority and funding among some (sub)national policymakers continues to lead to weak policy implementation. The current EU strategy does not address this sufficiently, as binding, measurable targets are absent and not demanded from member states. More cooperation among governments is needed to strengthen policymaking and define tasks. The threat of climate-driven divergence between member states remains unaddressed.

We make three suggestions in response to these problems: First, create a three-layered governance framework based on intensive cooperation and information-sharing to establish binding adaptation plans; second, set up EU-level insurance against damages from climate change, with national contributions tied to the achievement of self-chosen targets in adaptation plans; third, increase *ex ante* adaptation funding by targeting more spending under EU regional and agricultural policies specifically at adaptation in the most vulnerable regions, and by setting up an EU financial instrument for the protection of infrastructure and value chains that are of EU-wide relevance.

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