ECONOMICS FOR DISASTER PREVENTION AND PREPAREDNESS

Financially Prepared: The Case for Pre-positioned Finance

in European Union Member States and Countries under EU Civil Protection Mechanism

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www.worldbank.org

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This report was prepared under the guidance and supervision of Christoph Pusch (Practice Manager, Urban, Disaster Risk Management, Resilience, and Land, Europe and Central Asia), Marina Wes (Country Director for the European Union Countries), and Sameh Wahba (Regional Director for Sustainable Development, Europe and Central Asia). It was developed under the leadership and coordination of Samantha Cook (Senior Financial Sector Specialist) and Zuzana Stanton-Geddes (Senior Disaster Risk Management Specialist), with expert inputs from Jo Kemp (Senior Public Financial Management Consultant), Daniel McGree (Senior Actuarial Consultant), Yiao Yu (Actuarial Consultant), and Nicolas Pondard (Senior Disaster Risk Management Consultant).

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ABBREVIATIONS

AAL	Average Annual Loss
CAT DDO	Catastrophe Deferred Drawdown Option
CCA	Climate Change Adaptation
CCR	Caisse Centrale de Réassurance
CCS	Consorcio de Compensación de Seguros
CSO	Civil Society Organization
DRF	Disaster Risk Finance/Financing
DRM	Disaster Risk Management
EC	European Commission
ECMWF	European Centre for Medium-Range Weather Forecasts
EFFIS	European Forest Fire Information System
EIOPA	European Insurance and Occupational Pensions Authority
EU	European Union
EUSF	European Union Solidarity Fund
GDP	Gross Domestic Product
GEM	Global Earthquake Model
GNI	Gross National Income
ILS	Index-Linked Securities
IMF	International Monetary Fund
JBA	JBA Risk Management
JRC	Joint Research Centre
LADWP	Los Angeles Department of Water and Power
MFF	Multiannual Financial Framework
MS	Member State(s)
MTPL	Motor Third Party Liability
NTMA	National Treasury Management Agency
OBR	Office for Budget Responsibility
OECD	Organisation for Economic Co-operation and Development
PAID	Natural Disaster Insurance Pool
PFM	Public Financial Management
PIM	Public Investment management
RRF	Recovery and Resilience Facility
SEAR	Solidarity and the Emergency Aid Reserve
UCPM	Union Civil Protection Mechanism
WHO	World Health Organization
WUI	Wildland-Urban Interface

GLOSSARY

Adaptation: Adjustments or changes in economic, social, or environmental approaches in response to the effect of present or future climate change.

Average annual loss (AAL): The average amount of expected (or potential) loss over many years; calculated as the sum of all modelled or simulated losses expected over a period divided by the number of years in that period.

Average annual loss ratio: AAL relative to the total replacement cost of the building stock.

Contingent liability: A potential payment obligation (or future expenditure) that may be incurred, depending on the outcome of a future event; in the case of disaster risk for governments, the expenditure may be to pay for emergency response or reconstruction in the event of a natural hazard impact. Contingent liabilities can be explicit (underpinned by some form of legal obligation) or implicit (when there is a social expectation that the government will step in as an insurer of last resort).

Cost neutral: Indicates an outcome when the cost is not higher than the revenue it generates.

Disaster risk finance (DRF)/financial resilience (preparedness/protection) to disasters: Financial protection that is planned ahead to better manage the cost of disasters, ensure predictable and timely access to much needed resources, and ultimately mitigate long-term fiscal impacts.

Disaster risk management (DRM): Processes for designing, implementing, and evaluating strategies, policies, and measures to improve the understanding of disaster risk, foster disaster risk reduction and transfer, and promote continuous improvement in disaster preparedness, response, and recovery practices, with the explicit purpose of increasing human security, well-being, quality of life, and sustainable development. DRM investments are understood as investments in risk identification (risk assessments and so on), risk reduction (prevention), early warning, emergency and response preparedness, public awareness, financial resilience (various instruments), and resilient recovery.

Disaster risk: The combination of the probability of an event and its negative consequences—that is, the likelihood of severe disruptions in the normal functioning of a community or a society over a specified period due to hazardous physical events interacting with vulnerable social conditions, leading to widespread adverse human, material, economic, or environmental effects that require immediate emergency response to satisfy critical human needs and may need external support for recovery.

Emergency operations: In the context of this report, this term refers to the immediate response costs.

Ex ante/prearranged risk financing instruments (solutions, mechanisms): In the context of disaster events, instruments (solutions, mechanisms) arranged before the event. Ex ante decisions are decisions made before the event.

Ex post risk financing instruments (solutions, mechanisms): In the context of disaster events, instruments (solutions, mechanisms) arranged after the event. Ex post decisions are decisions made after the event.

Exposure: The situation of people, infrastructure, housing, production capacities, and other tangible human assets located in hazard-prone areas. Exposure includes the number of people or types of assets in an area. These can be combined with the specific vulnerability and capacity of the exposed elements to any particular hazard to estimate the quantitative risks associated with that hazard in the area of interest.

Funding gap: The difference between the available government budget and the probable loss for a given event size (or return period).

Hazard: The potential occurrence of a natural or human-induced physical event that may cause loss of life, injury, or other health impacts as well as

damage and loss to property, infrastructure, livelihoods, service provision, and environmental resources.

Household insurance penetration (in this report): Proportion of households in each country with catastrophe insurance.

Losses: Quantifiable damages of disasters that can be translated into monetary terms. A distinction can be made between direct disaster losses, which refer to directly quantifiable losses (number of people killed; damages to buildings, infrastructure, or natural resources), and indirect losses, which refer to indirectly quantifiable losses (declines in output or revenue, impact on well-being, disruptions to flow of goods and services in an economy).

Reserve fund (contingency fund): An amount of money set aside to finance—usually—unexpected future needs. May be used interchangeably with contingency fund. However, the latter usually refers to general funds set aside to meet all types of unexpected spending, while reserve funds might be targeted (for example, dedicated to disasters).

Resilience: The ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions.

Return period: The estimated time between losses of a certain size occurring. For example, a 1-in-10-year return period refers to losses that are expected to be exceeded once every 10 years—that is, in any given year there is a 10 percent probability of such losses at least as great as this. The estimates do not mean these disasters will occur only once every 10 (or 20 or 50) years.

Total cost: The sum of emergency operations costs and damage.

Vulnerability: The characteristics and circumstances of the built environment and communities that make them susceptible to damaging impacts (or human vulnerability). Vulnerability factors include building construction type and socioeconomic context.

Statement from from the World Bank

We live in a time when crises have become normal. In Europe, the scale of loss and destruction from disaster events is staggering. Recent years recorded multiple concurrent major disasters—including floods, wildfires, heatwaves, and droughts. In 2023 alone, the hottest year on record, economic losses from disasters amounted to €77 billion across Europe.[1]

Europe is warming faster than any other continent in the world. Recent events indicate a disturbing trend—- ongoing global warming driving increasingly intense climate extremes. Projections suggest that economic losses from climate-related events in the EU could soar to €175 billion per year in a 3°C warming scenario.[2]

Globally—and in Europe—disasters have far-reaching effects, with the vulnerable suffering the most.[3] Disasters not only have a direct impact on physical assets and infrastructure, but also increase poverty and exacerbate inequality over the long term. When mechanisms to prevent, prepare, respond, and recover from disasters are missing or inadequate, these events can erode decades of development and deeply affect society's welfare.

Preparing for this new era of climate challenges is critical for safeguarding the well-being of Europe's communities and economies. Many countries in the region have set ambitious goals, which require substantial investment to mitigate and adapt to the projected changes, such as the increased frequency and intensity of extreme weather events. While much needs to be done, financial resources are scarce, with many urgent and often competing priorities.

To respond to these challenges, focused and smart investments are needed in climate adaptation and disaster prevention and preparedness, accompanied by strengthening and adapting infrastructure, institutions, societies, and finance at different levels of government.

Focused – because while Europe has been taking steps to invest in disaster and climate resilience, critical sectors, including those providing civil protection and emergency response, remain highly exposed. If infrastructure fails—because a fire station is destroyed in an earthquake, critical evacuation routes are flooded, or hospitals are evacuated because of wildfires—people, homes and businesses cannot be saved, magnifying the impacts of an event. If public financing is severely affected—or even depleted—due to the impact of major catastrophic events, the government cannot provide timely emergency, recovery and reconstruction support to its populations and the economy.

Smart – because while preventive investments make clear economic sense,[4] more can be achieved using data and information to scale up prevention, preparedness and adaptation efforts in a cost-effective, and targeted manner. In an environment of constrained resources, the region will not be able to

1 Munich Re. 2023. Record thunderstorm losses and deadly earthquakes: The Natural Disasters of 2023. Link.
2 EC (European Commission). 2020. *PESETA IV*. Link.
3 Kerblat, Yann, et all. 2022. Overlooked: *Examining the Impact of Disasters and Climate Shocks on Poverty in the Europe and Central Asia Region*. Link.
4 World Bank and European Commission. 2021. Economics for Disaster Prevention and Preparedness: Investment in Disaster Risk Management in Europe Makes Economic Sense. Link.

successfully manage current and future risks unless investments to prevent and prepare for disasters are prioritized. At the same time, disaster prevention and climate adaptation efforts are closely interlinked and should be integrated to maximize the benefits of socioeconomic development and fiscal sustainability.

At the World Bank Group, we are modernizing our mission and instruments to ensure better support to countries globally and in Europe. In the region, the World Bank Group has been strengthening partnerships, providing financing and sharing knowledge to help communities manage the risks of disasters and climate change. Among these efforts, we support countries to modernize their policy and strategic frameworks, and prioritize, design and finance investments that strengthen disaster and climate resilience, including in critical infrastructure and emergency response services.

This series of analytical reports, produced as part of a partnership with the European Commission, attests to our commitment.

Building on results generated in 2021,[5] this set of reports provides new evidence, tools, and examples for countries in Europe to strengthen their disaster and climate resilience in a focused and smart manner. By highlighting aspects such as prioritized decision-making, understanding the costs of climate change, and risk-informed budgeting, these reports can be instrumental in developing and implementing nuanced policies and strategic investments that are attuned to the diverse hazards facing Europe. By embracing such new tools and approaches, we can ensure that communities are more resilient in the face of ever-evolving climate impacts and help secure a sustainable future for generations to come.

Antonella Bassani

Vice President, Europe and Central Asia
World Bank

5 World Bank and European Commission. 2021. Economics for Disaster Prevention and Preparedness. Link.

Executive Summary

This report was developed as part of the technical assistance program 'Phase 2 - Economics of Prevention and Preparedness (EDPP) in European Union (EU) Member States (MS) and Countries under EU Civil Protection Mechanism' (UCPM). The report has been prepared for the Directorate-General for European Civil Protection and Humanitarian Aid Operations (DG ECHO) and other European Commission (EC) stakeholders. It complements the Phase 1 report that focused on earthquake and flood risk and revealed that losses from these events at the EU level can cost €13–50 billion a year depending on the magnitude of the events. The EDPP Phase 2 considers wildfire and drought hazards and current financing mechanisms and recommends options on how to scale disaster risk financing (DRF) at the national and regional levels.

This report aims to inform discussions on the development of effective national and regional risk financing mechanisms by identifying funding gaps for wildfire and drought response. The identification of funding gaps can be used to inform a risk-layering approach, which combines different financial instruments to provide predictable finance when needed. This also includes the identification of additional regional funding to complement national finances.

Overall, this report reinforces the findings from Phase 1 which highlight that too much of the disaster and climate risk is managed through risk retention (for example, budgetary instruments at the EU and EU MS levels) and more should be done to incentivize transfer risk to the private sector at both the EU and the EU MS levels.

Disaster Risk in the European Union (EU) Member States (MS)

Drought and extreme heat have similar impacts on economies and often occur simultaneously. For example, declines in labor productivity and disruptions to the water-dependent industry such as water-intensive manufacturing, agriculture/forestry, food production, power generation, and water distribution. Extreme heat is additionally associated with added stress on emergency response and health sectors. Due to the relationships between droughts and extreme heat, their impacts are often difficult to separate in historical event reports (that is, extreme heat impacts may be considered part of overall drought impacts; GAR 2021). This report focuses on the financial impacts of drought using the losses reported by the Joint Research Centre (JRC) and discusses potential impacts from extreme heat where appropriate noting that little to no information is systematically collected on the impacts of extreme heat beyond excess hospital admissions and mortality numbers in a few countries (that is, Belgium and Italy).

The number of wildfires has been increasing year on year since 2019 and typically coincides with periods of drought and extreme heat. Damage caused by wildfires in Lithuania, Estonia, Austria, and Greece was particularly acute in 2023 compared to previous years exceeding the historic average damage costs by between 83 and 1,758 percent. In terms of actual costs, the 2023 wildfires estimates of direct damage were equivalent to €2 billion in Greece, €1 billion in Italy, and around €913 million in Spain.

Heatwaves across Europe have affected the health and livelihoods of millions, and this is predicted to get worse due to climate change. In 2022, the World Health Organization (WHO) European region estimated that extreme heat claimed more than 60,000 lives and by 2050 this could rise to 120,000 heat-related deaths per year.[6] The July 2023 European heatwave, analyzed by the European Centre for Medium-Range Weather Forecasts (ECMWF), resulted in widespread conditions of heat stress across the Mediterranean, reaching extremely high levels in some areas of Spain, Italy, and Greece. At present, the EU does not systematically collect data on hospital admissions for heat-related illnesses, nor has the UCPM or the European Union Solidarity Fund (EUSF) been triggered to respond to these events.

Despite the increasing impacts from wildfires, and drought, there is currently no publicly available probabilistic risk model for these hazards in Europe. However, some models are currently in development with multiple providers, with delivery timelines beyond the time frame of this report. It should be noted that wildfire risk, across Europe, has not historically been regarded in the same way as floods and earthquakes, and modeling work has been done in a few countries where corporates have sought to cover their assets at risk. Annex 1 provides further information on the 12 models that are currently available and/or under development.

It is important to recognize that these risks exist alongside flood, earthquake, landslide, and storm risks and in Europe these risks create additional pressure on already constrained response and recovery budgets. Considering all the disaster and climate risks that Europe faces, the financial impacts from earthquakes remain the highest, followed by flood. The size of the funding gap from Phase 1 (earthquake and flood) varies between €13 billion and €50 billion. In comparison, losses from wildfire range from €16 million to €717 million, depending on the scenario and magnitude of the event, while drought saw a consistent funding gap between €13 million and up to €323 million.

The indirect losses associated with wildfire and drought are expected to be far higher and pose impacts for the long-term health of society and ultimately businesses as the potential to reduce the number of working days increases. However, currently, data are not available to substantiate this, and there is a need to start collecting data on these impacts, for example, the number of hospital admissions due to extreme heat and wildfire events. Consequently, the quantification of indirect losses from wildfire and drought was beyond the scope of this study which focuses on addressing the financial needs for response.

A key message from this report is should a drought or a wildfire happen in a year where a major earthquake or flood has already occurred, there may be no funding available at the EU level to respond to a wildfire or drought event. This reinforces the finding from Phase 1 that there is scope for additional financial instruments at the EU level and/or a need to incentivize national governments to invest in DRF.

Current Disaster Risk Financing Mechanisms

A significant increase in budget allocation to the UCPM reflects the series of crises since 2019. Before 2019, the UCPM's budget from the EU Multiannual Financial Framework (MFF) was relatively stable ranging from €39 million in 2018 to €51 million in 2015. A significant increase in the UCPM budget from the MFF from 2019 onward—resulting in an overall increase of 746 percent over 2014–2022—has been due to needs associated with the UCPM revision (including financing of rescEU), COVID-19 (repatriations, medical supplies), Afghanistan repatriations, and the war in Ukraine.[7]

Analysis of the UCPM's budget over time indicates that most of the expenditure has been for response activities of which wildfire activities are equivalent to approximately one-third of response costs, while no expenditures were found for extreme heat. The response budget increased from €13 million in 2014

6 WHO. Link.
7 Link.

to €150 million in 2022. Other notable increases over 2014–2022 include a rise in funding for prevention and preparedness activities (from €9 million in 2014 to €19 million in 2022) and for firefighting (from €1 million in 2014 to €1.67 million in 2022). RescEU was a new budget line that was added to the overall budget from 2019 onward. No expenditures were found for extreme heat; therefore, the analysis will focus on drought.

Established in 2002,[8] the EUSF provides financial assistance to emergency and recovery operations in MS (and accession countries) which complements financing available for response.[9] The EUSF operates outside of the MFF which allows the EUSF to mobilize necessary funds to react to unforeseen events such as crisis and emergency situations. However, as found in the Phase 1 report and EC reviews[10] of the mechanism, access to funding takes time, with applications taking 8–10 weeks and disbursement taking an average of 56 weeks (although advances can be provided before the grant is fully disbursed and it is possible to include retroactive financing). Since 2002, the most common application to the EUSF is for floods, accounting for 49 percent of total applications, and the most costly events are earthquakes, which have received approximately half of the financing provided under the EUSF.

Droughts have had large impacts on economies in MS; since the EUSF was created in 2002 there have been four applications submitted and accepted for droughts. Funding was provided to Cyprus in 2008 and 2016 and to Romania in 2012 and 2022. In 2022, Romania which suffered a loss of over €1 billion in the agricultural sector[11] due to droughts and wildfires in the south-eastern region received almost €34 million from the EUSF[12] to cover some of the losses from the drought and associated wildfires. Currently, MS are not easily able to access EUSF funds to support drought losses, due in part to the challenges in defining the exact start of a drought and the fact that droughts are often connected to extreme heat and wildfires, compounding overall impacts. It is the damage from this combined risk that leads to the application to the EUSF.

The EUSF has been triggered eight times since 2002 for wildfires, in response to damages of €6.1 billion for these eight events. Since its establishment, there have been eight successful applications to the EUSF for support costs associated with wildfires, which have received €207.1 million in financing.[13] There are no reported applications for extreme heat events given that the limited physical damage associated with these events is unlikely to breach the threshold of damage in excess of either 0.6 percent of the affected State's gross national income (GNI) or €3 billion in 2011 prices, to submit an application to the EUSF. These events are typically ineligible despite high emergency response, and information on medical costs associated with these events is unavailable. The EUSF is not typically used to support MS following wildfires, in part, due to the low amount of eligible direct damage costs for EUSF funding.

Wildfire and Drought Emergency Response Financing Gap

Considering the scale of the risk that EU countries face from wildfires and drought, it is critical to assess the financing gap between available budget and the potential costs associated with emergency response from a given event. The funding gap analysis here considers the national reserves held by MS, the MFF budget lines associated with emergency response activities under the UCPM, and the EUSF based on record between 2002 and 2020. The resulting funding gap will need to be covered by (i) budget reallocation, (ii) debt, or (iii) bilateral donor assistance; otherwise, the cost of response will fall on the affected populations, for example, farmers who lost crops as a result of drought.

8 Revisions in 2014, 2020, and 2023.
9 Council Regulation (EC) No 2012/2002 of 11 November 2002 establishing the European Union Solidarity Fund (OJ L 311, 14.11.2002, p. 3), Link.
10 Review of the European Union Solidarity Fund, 2021 Link.
11 Link.
12 Almost €34 million in European Solidarity Funds awarded to Romania to repair damages caused by severe drought in 2022 Link.
13 EC. *EU Solidarity Fund: Supporting Disaster Recovery 2002–2022*. Link.

The estimated cost of wildfire emergency response operations ranges between €41 million and €752 million, depending on the scenario assessed and the year observed. This estimate is derived from calculating the average cost per hectare burned and applying it to the total number of hectares documented in the European Forest Fire Information System (EFFIS) database[14] and then using a proportion of the cost to represent emergency response operations with 13 percent as the low estimate/scenario and 35 percent as the high estimate/scenario.[15]

The average cost of emergency response operations is estimated to be between €105 million (low scenario) and €294 million (high scenario) per year. Between 2014 and 2019, there was an average funding gap of €84 million a year based on the midpoint scenario, which suggests that there was insufficient funding available within national reserves and relevant UCPM budget allocations.

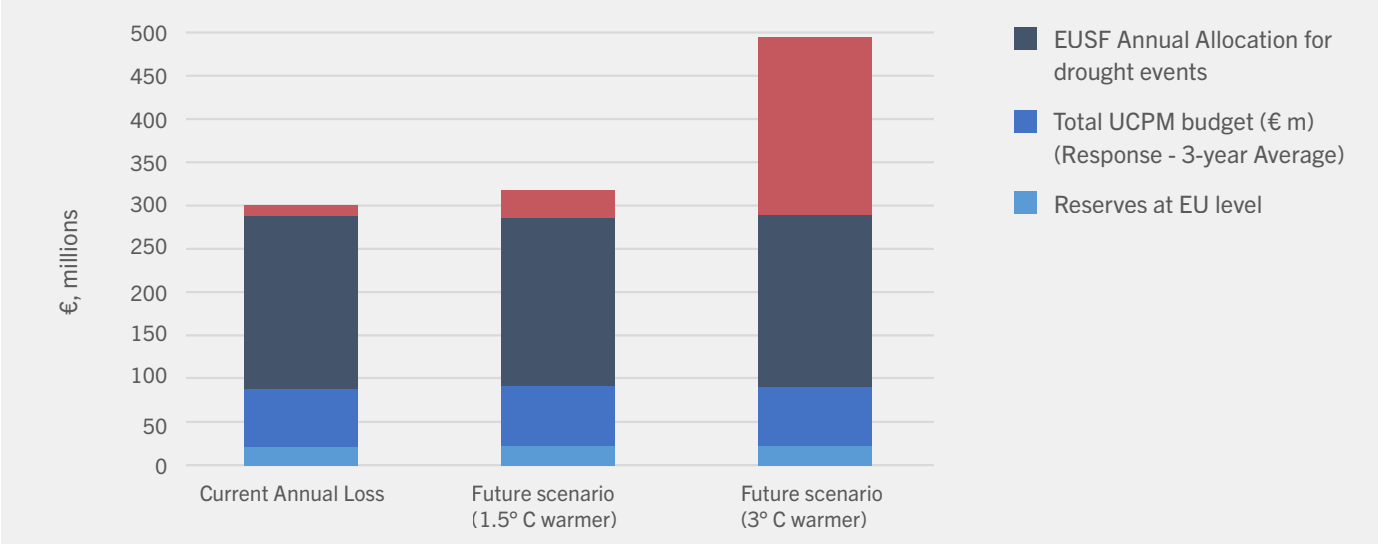
A repeat of the 2017 wildfire season in the future would require a 70 percent increase in the 2023 UCPM budget[16] to completely cover emergency response operation costs. The year 2017 saw extensive wildfires in Italy, Spain, and Portugal, resulting in a significant increase in area burned and associated emergency response costs. Considering these scenarios and existing financing mechanisms between 2014 and 2023, the largest funding gap of €301 million was in 2017. This funding gap was caused by a combination of high losses (€337 million midpoint estimate, range of €233–717 million) and a modest level of UCPM funding at the time (€36 million).

A funding gap for wildfires of around €190 million per year could occur based on the assumptions from the high scenario. Given the uncertainty surrounding the loss estimates for wildfire, this could better reflect future loss. However, given the limited number of events over a short time frame, the three-year average between 2019 and 2022 may better represent future loss, which indicates that enough finance is available to cover all emergency operation costs, although this varies depending on the assumed level of emergency operation costs in proportion to the overall cost.

The estimated funding gap at the EU level related to emergency response to drought is €13 million per year based on current drought losses. That is, if the UCPM and EUSF were used to cover all public and private sector costs associated with drought hazards for EU MS, the remaining €13 million would need to be covered by the EU MS or the private sector or households within each country. Figure 1 illustrates the potential funding gap using the midpoint estimate for current annual drought losses and potential losses under two future scenarios (1.5°C warmer and 3.0°C warmer).

14 JRC EFFIS. Link.
15 The estimates were developed using data from the EC – cohesion data (Link.) which include total direct damage estimates and emergency operation cost estimates per event in addition to the EUSF.
16 Considering the 2023 UCPM budget of €177 million.

Figure 1: Drought funding gap (midpoint scenario)



Source: World Bank.

The projected growth of the funding gap for drought over time, aligning with anticipated temperature increases in the region, reveals a potential funding gap between €29 million and €323 million annually, depending upon the climate warming scenario used. Using the estimates derived for the 1.5°C warmer scenario, the midpoint for the annual funding gap estimate increases by 125 percent to €29 million annually (low-range estimate: no gap; high-range estimate: €29 million). Under the 3.0°C warmer scenario, the midpoint annual funding gap estimate increases 15-fold compared to the current annual loss, reaching €206 million annually (low-range estimate: €150 million; high-range estimate: €323 million). While these numbers remain low, it should be noted that this analysis was based on the midpoint scenario and may underestimate the risk. In addition, the increase in the projected funding gap over time suggests that the financial demands for addressing drought-related costs are likely to escalate significantly in the future.

It should be noted that it is not possible to combine the results from EDPP Phase 2 with the Phase 1 funding gap analysis, for three reasons: (i) there are limited observations of wildfire and drought events compared to the number of observed earthquakes and floods; (ii) the limited observations impede the development of probabilistic risk models for wildfire in particular and drought models face challenges in identifying the event duration, that is, identifying the start and end date of the drought; and (iii) the asset exposure differs greatly. For example, residential, commercial, and industrial assets were analyzed in Phase I whereas Phase II looks at the damage and loss incurred from firefighting, reforestation, damage, and cleanup. This is due in large part to the geographic locations where wildfire occurs and is expected to occur. Noting the above, it is expected that the analysis conducted in this report underestimates the amount of risk from wildfire and drought.

Results of the Country Case Studies

Five countries were selected for national case studies in the funding gap analysis: Greece, Italy, Romania, Croatia, and Bulgaria. The approach to the country-level funding gap analysis considers overall economic losses incurred as a closer representation of the contingent liabilities member countries will face in the wake of wildfire events.

The Bulgaria analysis indicates that there is no immediate funding gap under the midpoint scenario, although potential gaps may arise in extreme years, particularly under the high-range scenario. In 2023, estimated reserves and contingency funds sufficiently covered the estimated costs, but a shortfall of €22 million would occur if recent three-year average losses from 2021 to 2023 were considered but could be covered by the inclusion of UCPM and EUSF funds.

Notably, if high-range assumptions are applied to historical cost estimates, a funding gap of €130 million would emerge.

Croatia faces no funding gap under the midpoint scenario, with reserves and contingency funds covering estimated costs in 2023. However, if high-range assumptions were applied to historical cost estimates, a funding gap of €220 million would arise.

Greece faces a funding gap across all scenarios due to limited reserves and contingency funds relative to estimated costs. Despite additional financing options from the UCPM and EUSF, the shortfall remains high, ranging from €259 million under the three-year average between 2021 and 2023 to €1.4 billion under the high-range assumptions.

Italy shows no funding gap in any scenario due to ample reserves and contingency funds compared to estimated costs. Even in scenarios that consider the year with the highest historical cost estimates, reserves and contingency funds remain sufficient.

Romania also demonstrates no funding gap across scenarios due to sufficient reserves and contingency funds relative to estimated costs. In 2023, these funds covered estimated costs, with similar results under recent three-year average losses and high-range assumptions.

Options for Consideration

This report reinforces the findings from Phase 1 confirming that financial instruments to manage disaster risk are limited to risk retention instruments such as the UCPM and EUSF and more should be done to incentivize risk transfer at both the EU and EU MS levels. At present, there are no risk transfer products at the EU level or in the case study countries. Risk transfer instruments can be expensive and require the payment of a premium regardless of whether a payment is received from the instrument. Risk transfer serves to smooth expenditures over years where no disaster occurs, yet the instrument has a cost. When a disaster occurs, a payment that corresponds to the magnitude of the event is received.

The above findings suggest that more can be done at the national and EU levels to promote DRF solutions and close funding gaps. Table 1 presents some options for consideration; not all need to be pursued or implemented at the same time. Some of these options were presented in Phase 1 but remain relevant today based on the analysis and findings of Phase 2.

Table 1: Summary of options for consideration

EU-LEVEL OPTIONS	DETAILS	TIME FRAME
1. Develop an EU-level overarching DRF strategy	• Clearly establish and articulate EU-level priorities that can be awarded finance from the EU-level instruments to delineate what the EU expects countries to cover from national resources.	Short to medium term
2. Increase the allocation for the UCPM and EUSF	• Increase the amount of funding proportionate to the risk appetite of the EU, that is, identify and articulate how much of the total cost that the EU intends to cover.	Short to medium term
3. Introduce risk transfer instruments	• Linked to option 2, the introduction of risk transfer provides a mechanism to bring in finance when it is needed most. • This could be most highly effective as a means to manage cross-border events or where several countries in the region experience concurrent disasters.	Medium to long term
4. Improve data on DRF	• Start the systematic collection of hospital admissions and/or on the number of people requiring treatment following wildfire, drought, and extreme heat events to help quantify the health impacts on the population. As these events are expected to become more frequent it is highly recommended that this is rectified to explore whether there is a need to provide additional financial support through health insurance and/or directly to hospitals.	Short to medium term

NATIONAL-LEVEL OPTIONS	DETAILS	TIME FRAME
5. Develop national DRF strategies	• To ensure financial preparedness to disasters. • Determine national priorities in strengthening DRF (such as focusing on households, the poorest members of society, government budget, and so on). • In developing the strategy there is a need to improve data on DRF such as the collection of data on hospital admissions to feed in the EU-level data aggregation.	Short to medium term
6. Consider the introduction of sovereign risk transfer instruments	• Explore whether risk transfer could present a cost-effective way to manage select risks, for example, earthquake and flood in the first instance. • Once risk models are available, leverage their outputs to determine whether the risk from wildfire is a viable option to finance response.	Medium to long term
7. Increase penetration of insurance	• For both households and public assets. • This could also be considered at the sector level, for example, agriculture insurance for drought.	Medium to long term
8. Strengthen risk-based budgeting	• Create incentives to invest in DRF by introducing a risk-based budgeting approach to ensure that MS understand and prepare for the risks they face.	Medium to long term

1. Introduction

This chapter presents key findings from the Phase 1 report and information on the hazards analyzed in this paper (wildfire and drought). It also sets out the methodology used to determine the funding gaps and analyze national-level disaster risk financing instruments.

This report was developed as part of the technical assistance program 'Phase 2 - Economics of Prevention and Preparedness (EDPP) in European Union (EU) Member States (MS) and Countries under EU Civil Protection Mechanism' (UCPM). The report has been prepared for the Directorate-General for European Civil Protection and Humanitarian Aid Operations (DG ECHO) and other European Commission (EC) stakeholders. EDPP Phase 2 analyzes the hazards of wildfire and drought and considers how finance for disaster risk can be brought to scale at the national and regional levels.

Disaster risk financing (DRF)[17] **is defined as the strategies and instruments used to manage the financial impact of disasters. As noted in the 2021 EU peer review DRF assessment report, a thorough understanding of risk exposure and risk-bearing capacity, as well as institutional arrangements creating favorable** regulatory and market infrastructure are the major components of a comprehensive disaster financing strategy.

This report is structured as follows: Chapter 1 introduces the report, outlining its context and the methodologies used to elicit findings. Chapter 2 provides updated information from the Phase 1 report on DRF instruments currently in use at the regional and national levels. Chapters 3 and 4 detail risk-based budgeting and risk transfer instruments, respectively. Chapter 5 discusses the current funding gap, and Chapter 6 concludes with key findings and options for consideration.

This report aims to inform discussions on the development of effective national and regional risk financing mechanisms by identifying funding gaps for wildfire and drought. The identification of funding gaps can be used to inform a risk-layering approach, which combines different financial instruments to provide finance when needed. The identification and quantification of funding gaps can demonstrate the case for additional regional funding to complement national finances.

17 OECD. 2012a. *Disaster Risk Assessment and Risk Financing: A G20/OECD methodological framework.*

1.1. Context

EDPP Phase 1 focused on the analysis of fiscal and economic impacts of earthquakes and floods at the regional and national levels and provided high-level recommendations to reduce contingent liabilities from these risks. The key findings from that report are as follows:

- DRF across the EU MS is limited. Penetration rates of insurance for public and residential assets are low, reserve funds are limited, and other types of risk transfer and contingency funding are not widely used. Around 40 percent of countries lack prearranged funding to manage combined emergency response costs for 1-in-10-year flood and earthquake events, that is, for events that occur relatively frequently (EDPP Phase 1 report).

- Only a few countries in the EU have dedicated disaster reserve funds. General contingency funds might be largely unavailable, especially if a disaster happens toward the end of the fiscal year. There is a 10 percent probability in any given year that the EU region will experience earthquake or flood events severe enough to produce losses exceeding countries' national reserves. On average, damage to residential buildings accounted for over 50 percent of the total loss for both flood and earthquake risks, which points to an urgent need to increase access to and uptake of catastrophe household insurance. For earthquake risk alone, residential building damage may be even higher; in many countries, residential losses account for over 50 percent of total loss.

- The sum of the European Union Solidarity Fund (EUSF), reserve funds, and contingency funds available to EU MS covers on average less than 4 percent of total government liabilities each year when analyzed from an EU perspective (with disasters aggregated for both earthquake and flood and for all EU MS). This suggests that there is scope for additional instruments at the EU level and/or there is a need to incentivize national governments to invest in DRF more seriously.

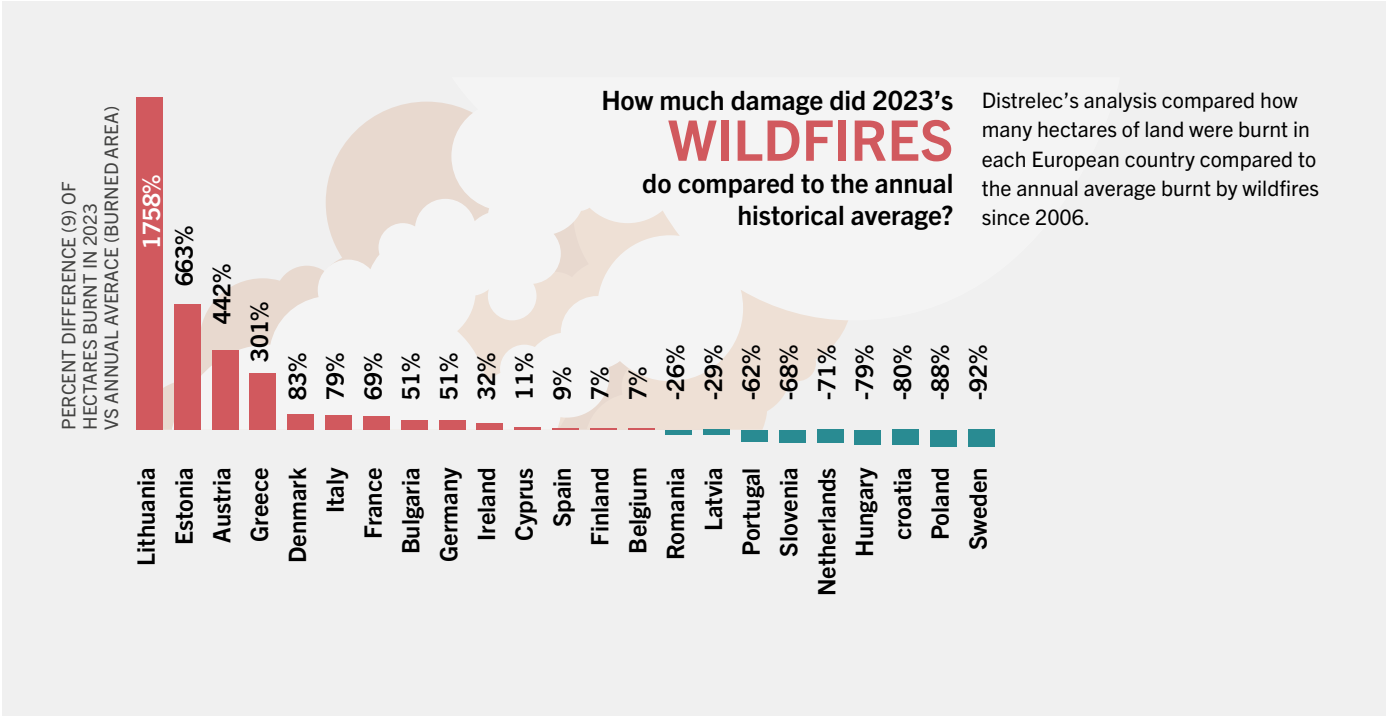
This report, under Phase 2, complements the analysis of Phase 1 by analyzing wildfire and drought. It provides insights into how much finance is required to respond to these events at the regional and country levels. However, it is not possible to combine the results with the Phase I analysis, for three reasons: (i) there are limited observations of wildfire and drought events compared to the number of observed earthquakes and floods; (ii) the limited observations impede the development of probabilistic risk models for wildfire in particular and drought models face challenges in identifying the event duration, that is, identifying the start and end date of the drought; and (iii) the asset exposure differs greatly. For example, residential, commercial, and industrial assets were analyzed in Phase I whereas Phase II looks at the damage and loss incurred from firefighting, reforestation, damage, and cleanup. In large part this is due to the geographic locations where wildfire occurs and is expected to occur.

Wildfires tend to damage natural habitats, pollute watersheds, destroy biological diversity, and increase air pollution with serious health effects. Agricultural, forestry, transportation, trade, and industry sectors tend to record the highest economic losses from forest fires by the resulting breaks in the supply chain that outweigh the value of damaged assets, for example, a productive plantation that is burned will not have high damage in terms of the trees lost but the impacts on the construction sector (for example, project delays and potential loss of jobs) connected to that plantation could be far higher from the resulting delays while the reforestation occurs.

The number of wildfires has been increasing year on year since 2019. Figure 2 shows the percentage difference in the hectares burned by wildfires across Europe in 2023 compared to the annual average burned by wildfires since tracking started in 2006. As illustrated in this figure, the damage caused in Lithuania, Estonia, Austria, and Greece was particularly acute in comparison to previous years. Figure 3 provides details on the hectares burned by wildfires in 2023. In 2023, wildfires caused damages

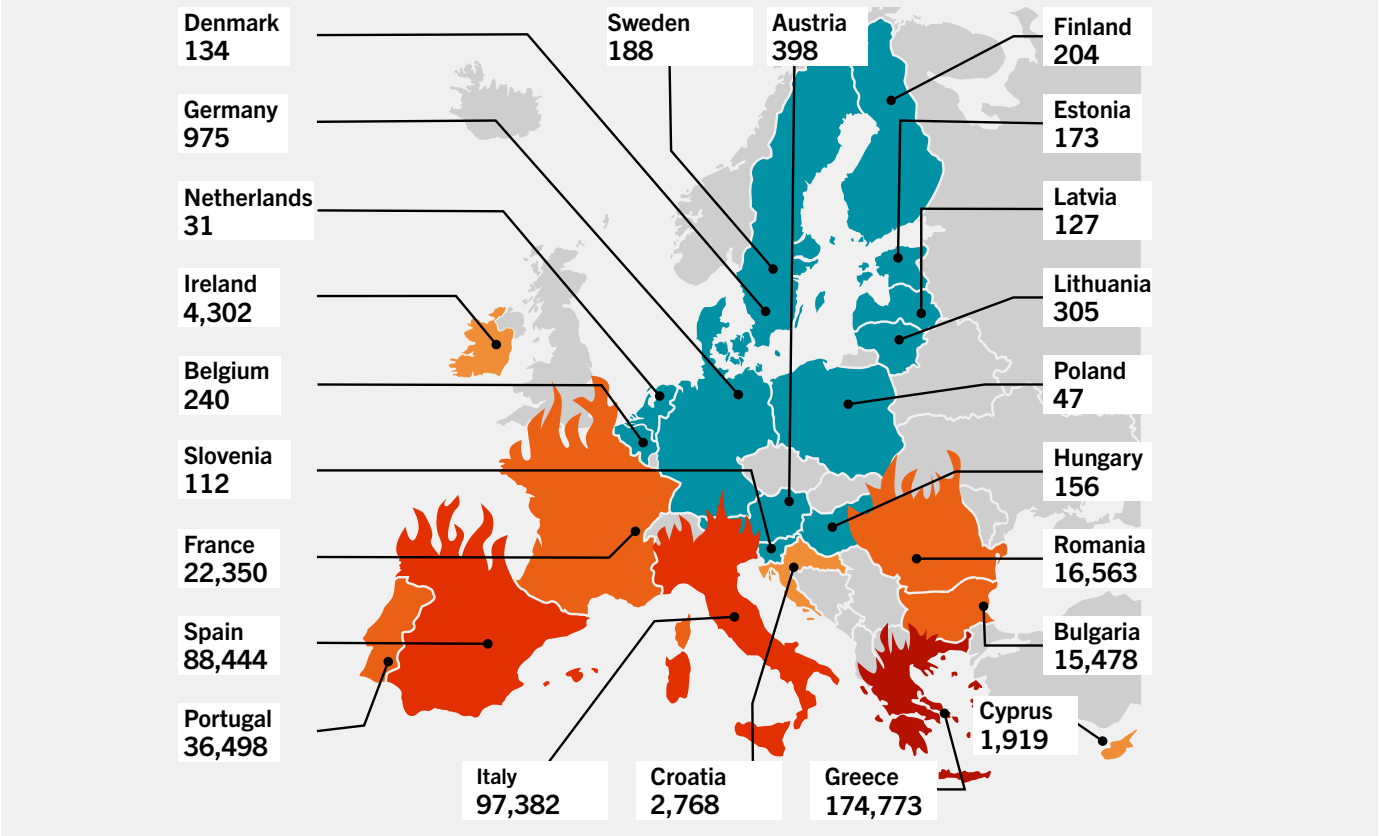
costing €2 billion in Greece, €1 billion in Italy, and around €913 million in Spain. Figure 4 presents data on the cost of Europe's wildfires in 2023 by looking at the average global costs per hectare burned.

Figure 2: How much damage did 2023's wildfires do compared to the average historical average?



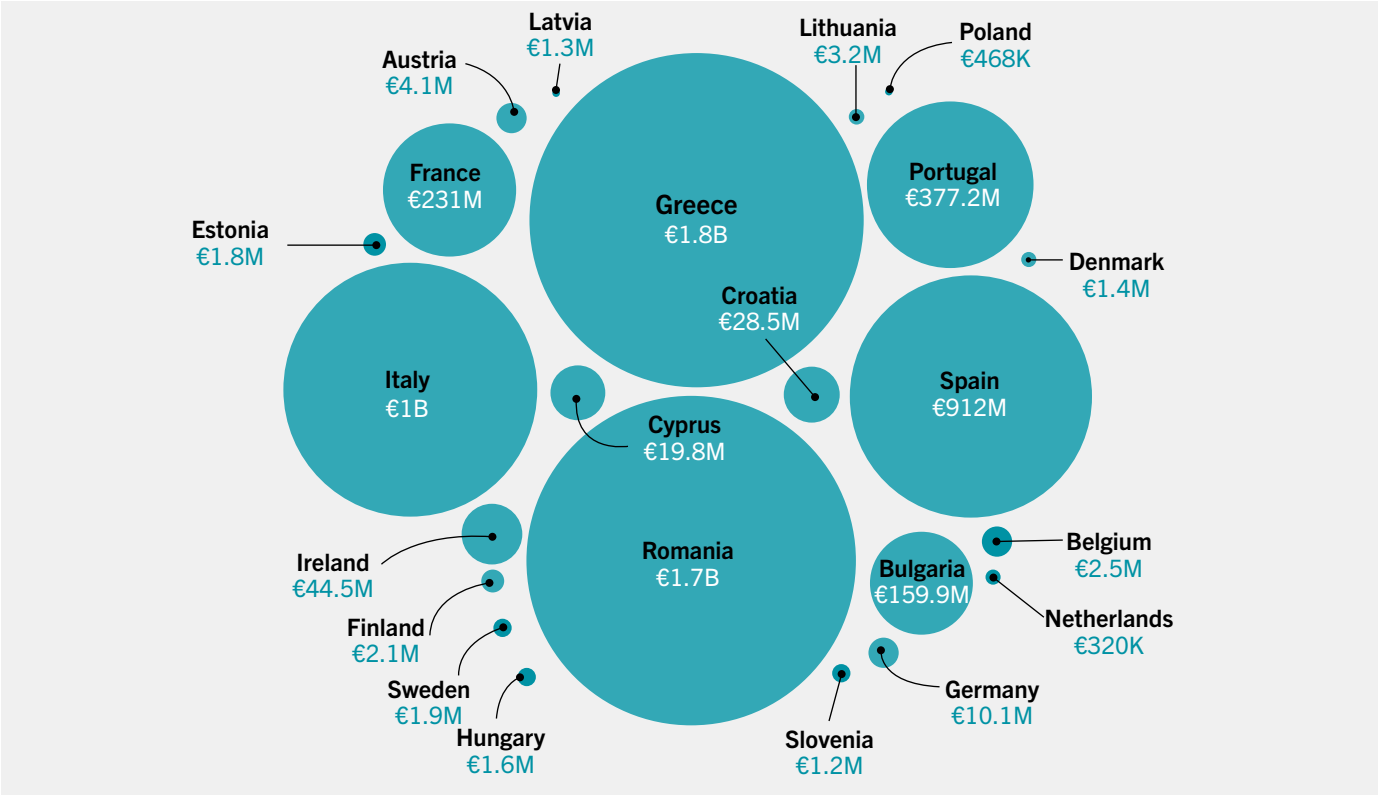
Source: European Forest Fire Information System (EFFIS) data analyzed by Distrelec.

Figure 3: Hectares burned by wildfires in 2023



Source: EFFIS analysis by Distrelec.

Figure 4: The cost of Europe's wildfires in 2023



Source: EFFIS analysis by Distrelec.
Note: Financial cost calculated using average global cost per hectare. 'M' refers to million euros and 'B' refers to billion euros.

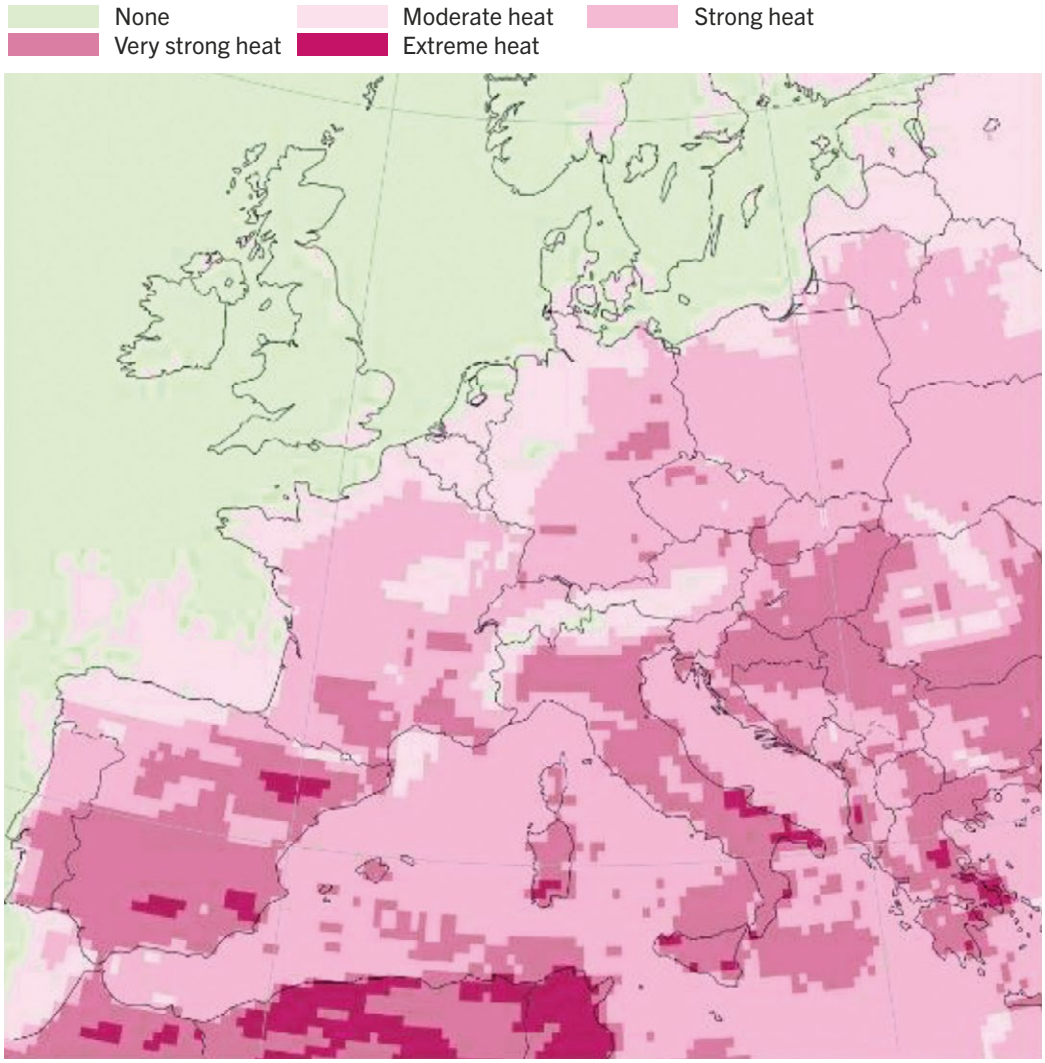
Droughts and extreme heat are among the most complex climate-related hazards, with wide-ranging and cascading impacts across hazards, ecosystems, and economies. Due to the relationship between droughts and extreme heat, their impacts are often difficult to separate in historical event reports (that is, extreme heat impacts may be considered part of overall drought impacts).[18] Furthermore, extreme heat and drought are interconnected because episodes of extreme heat tend to occur during drought periods, and both hazards can affect economies through relatively similar channels, such as (i) the direct impact on the health sector, (ii) a decline in labor productivity, and (iii) disruption from the water-dependent industry such as water-intensive manufacturing, agriculture/forestry, food production, power generation, and water distribution.

Heatwaves across Europe have affected the health and livelihoods of millions, and this is predicted to get worse due to climate change. In 2022, the World Health Organization (WHO) European region estimates that extreme heat claimed more than 60,000 lives and by 2050 this could rise to 120,000 heat-related deaths per year.[19] Climate change is increasing the risk of heatwaves, and extreme heat in the summer months is becoming the norm, not the exception. The July 2023 European heatwave analysis by the European Centre for Medium-Range Weather Forecasts (ECMWF) shows widespread conditions of heat stress across the Mediterranean, reaching extremely high levels in some areas of Spain, Italy, and Greece (see Figure 5). The heatwaves in recent years are indicative of a potentially hazardous health/heat environment where it is imperative for one to cool down immediately and take actions to avoid heatstroke. Going forward, this will likely increase the number of people who need treatment for these symptoms and health service providers should be prepared to cater for this increase.

18 GAR 2021.
19 WHO, Link.

Extreme heat gives rise to direct costs on the health sector and increased energy expenses due to heightened cooling demands. It also causes indirect costs through a decline in labor productivity and impacts on critical infrastructure, such as power plants or roads which may experience service disruptions. At present, the EU does not systematically collect data on the direct and indirect costs of extreme heat. In particular, it does not systematically collect data on hospital admissions for heat-related illnesses nor has the UCPM or the EUSF been triggered to respond to these events. Data on heat stress are however collected in other countries, for example, the United States. For instance, the New Mexico Environmental Public Health Tracking Program develops, monitors, and analyses indicators of heat stress to document changes in morbidity and mortality across different locations and time. One of the heat stress morbidity indicators that is tracked—disaggregated by sex, age, and month—is hospitalization for heat stress[20]. Some EU countries collect data on hospitalizations for heat stress, for example, Belgium and Italy,[21] but not all countries do this, and it is not currently possible to access EU-wide data.

Figure 5: Heat stress during the July 2023 heatwave



Source: ECMWF. 2023. *Heat stress and the European heatwave of 2023*. Link.
Note: The map shows locations where the highest conditions of heat stress occurred between July 15 and 27, 2023, in Europe.

20 NM-Tracking - Summary Health Indicator Report - Heat Stress Hospitalizations
21 *See* Link. for Data from Belgium and Link. for data from Italy.

1.2. Methodology

ANALYSIS OF WILDFIRES AND DROUGHTS

EDPP Phase 1 focused on the impacts of earthquakes and floods at the regional and national levels. The risk modelling was conducted using two regionally consistent probabilistic disaster risk models: the JBA Risk Management (JBA) model for fluvial and surface water flood and the Global Earthquake Model (GEM) for seismic risk. Both models are fully probabilistic based on a model of individual flood or seismic events that account for the often-complex correlation structures reflecting the physics of the natural peril damages. They are well regarded in the catastrophe risk modelling community and are part of an ecosystem of commercially available vendor-developed models as well as proprietary models (within the insurance sector) to assess, manage, and transfer the risk of these perils. The broad set of modelling tools reflects the long-standing recognition that these perils are key aggregation risks with potential solvency implications for insurance companies, that is, so-called 'catastrophe risks'.

Commercially available risk models for wildfire have been limited to peak (worldwide) insurance concentrators. For example, the wildfire models for California have only recently been expanded to provide US-wide solutions. However, wildfire risk in Europe has not historically been regarded in the same way as floods and earthquakes, with modeling done in limited countries where corporates have sought to cover their assets at risk. The sophistication of the models available is also limited, with wildfire models typically considered 1st or 2nd generation solutions compared to approximately 5th generation earthquake models. The sub-peril damage mechanisms such as smoke damage have only been included in commercial solutions in the last couple of years.

The existing models on wildfire do not focus on the generation of 'full' event-based catastrophe risk modelling approaches, and therefore the analysis here will differ from that conducted under EDPP1. While there are specific technical challenges to the design and development of wildfire risk models, the lack of availability and sophistication of financial solutions is not a reflection of technical capabilities but a market view that wildfire is not a key aggregation risk unlike windstorms, floods, and seismic events. Risk modelling capabilities have focused on primary insurance applications such as risk maps or scores which can be used for pricing the risk and exposure management applications that are useful to corporates with many assets in a particular area. However, these models do not provide information on the correlation of damages between locations or support estimation of a full risk profile (that is, the probability of observing different levels of damages/losses in any given year).

At the time of writing, there were no fully probabilistic disaster risk models available for wildfire in Europe, but some models are currently in development with multiple providers, with delivery timelines beyond the time frame of this report. Annex 1 provides further information on the 12 models that are currently available and/or under development.

In the absence of a probabilistic model, a straight-forward methodology has been employed to calculate the funding gap associated with wildfires. This involves calculating the average cost per hectare burned and applying it to the total number of hectares documented in the EFFIS database.[22] On the financing side, two separate scenarios are analyzed based on accessibility to different funding tiers:

- **Tier 1:** Estimates of national reserves held by EU MS combined with the UCPM budget allocation associated with emergency operations costs for wildfire events.

- **Tier 2:** Tier 1, combined with an estimation of the EUSF annual allocation for wildfire events.

22 Link.

The funding gap analysis is first applied to the region (all EU MS). The analysis of the UCPM budget over time indicates that most of the expenditure has been on emergency response activities. Therefore, the analysis focuses on estimating these costs but recognizes that other costs associated with these hazards will emerge to represent the full cost. The funding gap analysis considers the Multiannual Financial Framework (MFF) budget lines associated with emergency response activities and the EUSF based on records between 2002 and 2020. The analysis assumes that the resulting funding gap will be covered by (i) budget reallocation, (ii) debt, or (iii) bilateral donor assistance. Due to data limitations, the analysis does not review alternative DRF strategies that include sovereign risk transfer.

In addition, five selected national case studies are analyzed in the funding gap analysis: Greece, Italy, Romania, Croatia, and Bulgaria. The approach to the country-level funding gap analysis takes into account overall economic losses incurred as a closer representation of the contingent liabilities member countries will face in the wake of wildfire events. To facilitate the analysis and assess the potential funding gap related to overall estimated contingent liabilities, three scenarios were developed focusing on emergency operation costs and damages:

- **The low-range scenario assumes** that 35 percent of wildfire damages are classified as public sector contingent liabilities (€1.6 billion per year on average based on historical experience between 2014 and 2023), and 2.2 percent of total wildfire costs are covered by the EU MS reserves, UCPM, and EUSF (€35 million per year on average for the same period).

- **The midpoint scenario assumes** that 50 percent of wildfire damages are classified as public sector contingent liabilities (€2.3 billion per year on average based on historical experience between 2014 and 2023), and 2.3 percent of total wildfire costs are covered by the EU MS reserves, UCPM, and EUSF (€53 million per year on average for the same period).

- **The high-range scenario assumes** that 80 percent of wildfire damages are classified as public sector contingent liabilities (€3.7 billion per year on average based on historical experience between 2014-2023), and 3 percent of total wildfire costs are covered by covered the EU MS reserves, UCPM, and EUSF (€118 million per year on average for the same period).

It should be noted that the results from this funding gap analysis differ significantly from those produced in EDPP1. This is in part because of the different asset types held in the affected areas. For example, in EDPP1, the losses were predominantly driven by the household sector which accounted for over 50 percent of total loss. The areas historically affected by wildfires have less residential assets due to their location so there will be underlying differences in the asset's values being analyzed. In addition, the flood and earthquake models are fully probabilistic. As noted above, it was not possible to combine the results with Phase I due to (i) the differences in the number of observed events, (ii) the lack of probabilistic models, and (iii) the differences in exposure. However, where possible the team has tried to draw parallels.

To calculate the funding gap associated with drought, the analysis relies on the estimate provided by the Joint Research Centre (JRC), which suggests that current annual losses from drought in the EU and United Kingdom amount to approximately €9 billion.[23] These losses include various impacts, including diminished public water supplies, agricultural losses, damage to buildings and infrastructure from soil subsidence, decreased inland water transportation, and reduced energy production. Although some of these losses may not be considered contingent liabilities for the EU MS, no adjustments have been made to the loss estimates. This is due to the lack of sufficient information available to make accurate assessments of these contingent liabilities or the proportion of impacts within the United Kingdom or other non-EU MS.

23 JRC 2020. *Global Warming and Drought Impacts in the EU*. Technical Report. PESATA IV Project - Task 7 - Drought. Link.

According to the JRC, if the future climate affects present-day society, the overall drought damage in the EU and United Kingdom will experience a slight rise with a 1.5°C global warming (reaching €9.7 billion annually). However, this damage escalates significantly with further warming, reaching €17.3 billion per year at 3°C. These estimates form the basis for providing loss estimates under different scenarios in the funding gap analysis. Further information on the methodology used is provided in Section 5.3.

ANALYSIS OF NATIONAL-LEVEL DRF INSTRUMENTS

Structured interviews were conducted in two case study countries—Romania and Croatia—with the Ministries of Finance, other relevant line ministries which play a part in disaster risk finance, and insurance providers and regulators. These interviews were designed to deepen the knowledge and understanding of DRF instruments built under Phase 1. For example, specific attention was paid to existing reserve funds and public asset insurance to provide a more informed view of the level of risk the case study countries can finance.

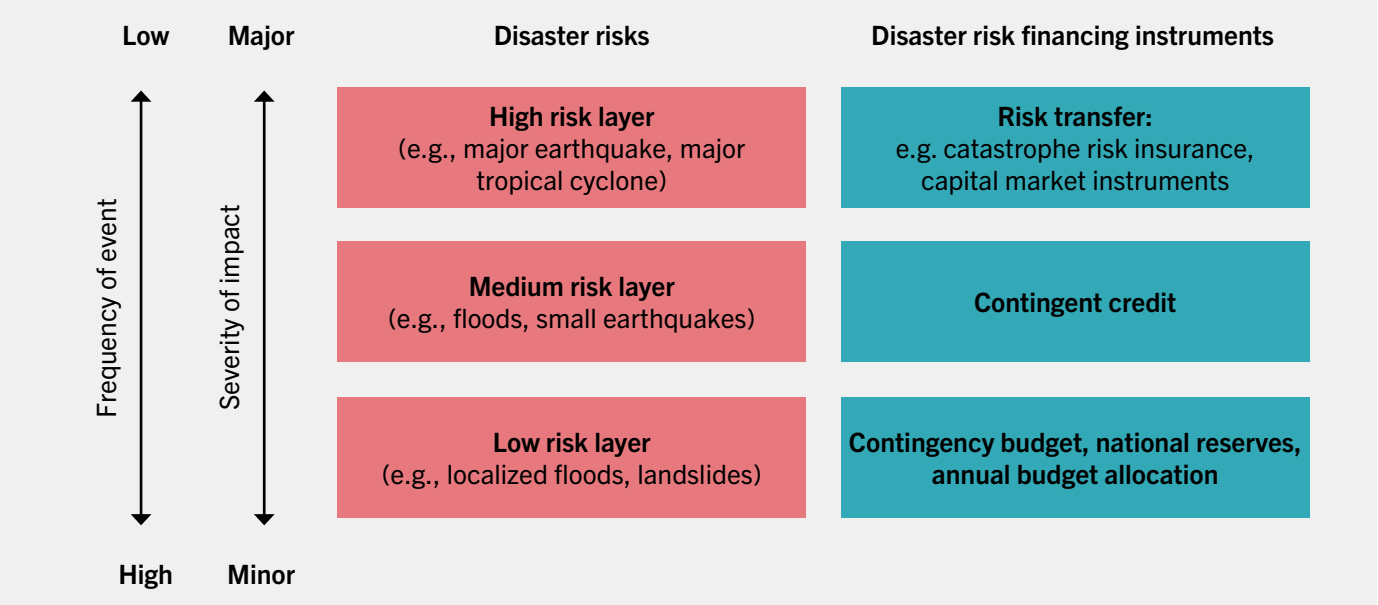
2. Risk Retention Instruments in Europe

This chapter reviews different financing instruments available in the EU MS to manage disaster costs. It also provides a basis for the funding gap analysis presented in this report. The review focuses on national-level DRF instruments and EU-level DRF mechanisms (EUSF and UCPM) which can provide in-kind assistance and support emergency response in the EU MS (and across the world). A key finding is that financial instruments to manage disaster risk are primarily focused on risk retention and more should be done to incentivize risk transfer at both the EU and EU MS levels. Developing an EU overarching DRF strategy and national DRF strategies could help strengthen financial preparedness to disasters.

As noted in the 2021 EU Peer Review Framework report, DRF embraces a variety of instruments aimed at and capable of achieving different outcomes. Each of these instruments can efficiently handle only a certain type of risk, depending on its frequency, intensity, and impacts. Consequently, a strategy that builds upon a diversified pool of mutually complementing financial tools and institutions is better equipped to cope with and respond to a variety of natural and man-made hazards. However, as noted in Phase I, there are still significant gaps.

The use of DRF instruments should ideally be guided by a strategy that selects risk retention and risk transfer instruments for events of different magnitudes (see Figure 6). No single DRF instrument can cover all losses; a combination of instruments is needed. From a cost perspective, the use of budgetary instruments is, for instance, more suitable for high-frequency, low-severity events in EU MS. The use of risk transfer market-based instruments is more suitable for high-risk events that occur less frequently. This chapter considers certain instruments at the regional and national levels, noting that high-frequency and low-impact events are more closely aligned with the profile of past events that have occurred in EU MS. Regional instruments are at present primarily risk retention related. Subject to further analysis, there may be merit in exploring whether there are some appropriate and cost-effective risk transfer instruments which the EU may wish to consider. This recommendation is given on the basis that, at present, there is a heavy dependency on risk retention instruments across the EU.

Figure 6: Risk layering



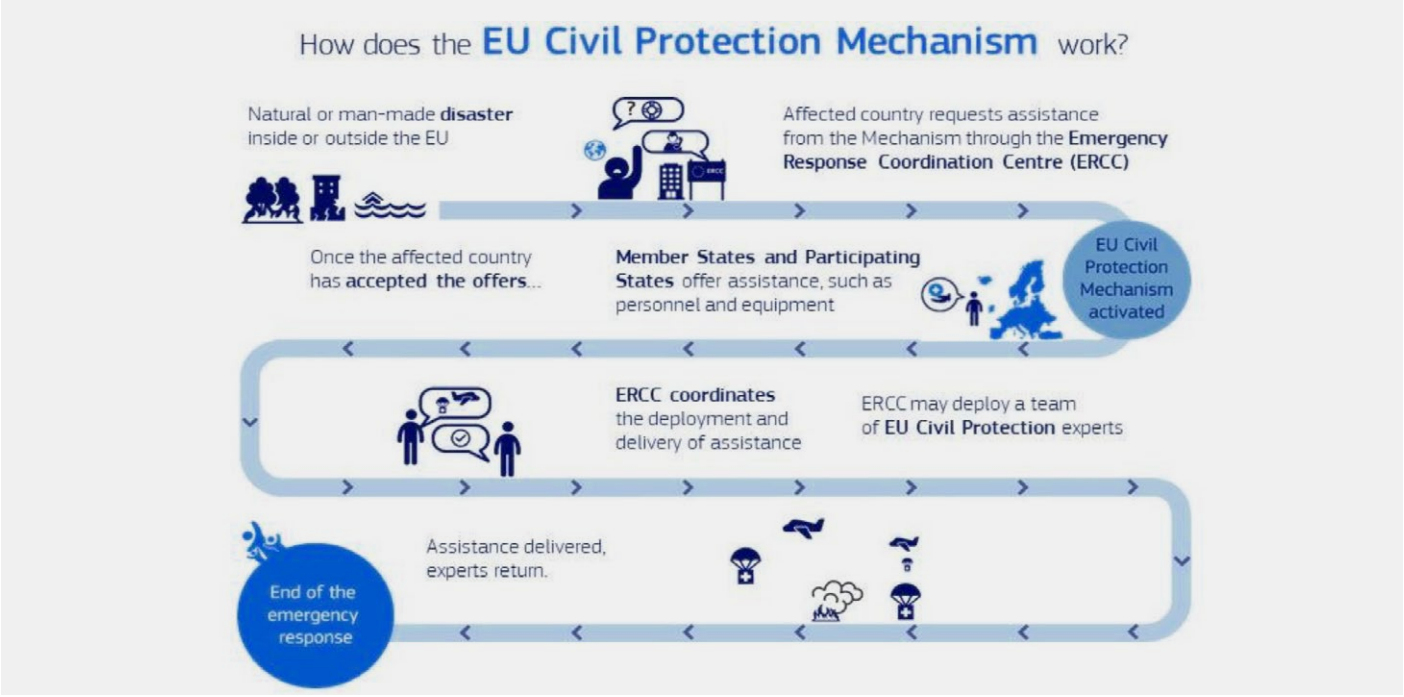
Source: World Bank.

2.1. Regional Instruments

UCPM

The UCPM can provide in-kind rapid assistance to EU MS after disasters (mobilizing support within a few hours/days after a disaster strikes). The UCPM includes a number of mechanisms to support affected countries, such as pre-positioning of response goods, financing of transportation costs, deployment of expert and specialized teams after disasters, and provision of grants. Figure 7 provides an overview of how the UCPM works.

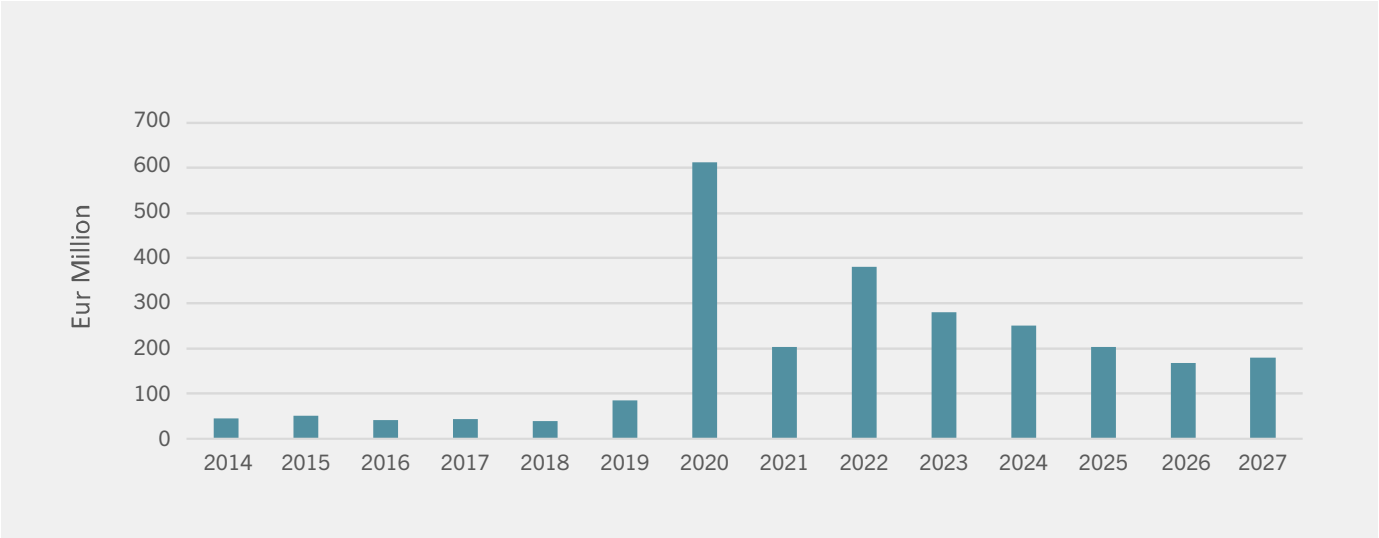
Figure 7: How the UCPM works



Source: EC, "EU Civil Protection Mechanism," Link.

Before 2019, the UCPM's budget from the EU MFF was relatively stable, ranging from €39 million in 2018 to €51 million in 2015 (see Figure 8). There has, however, been a significant increase in the MFF's budget from 2019 onward, resulting in an overall increase of 746 percent from 2014 to 2022. The increase in budget allocation from 2019 has been due to UCPM revision (including rescEU), COVID-19 (repatriations, medical supplies), Afghanistan repatriations, and the war in Ukraine.

Figure 8: Total MFF budget, 2014–2027

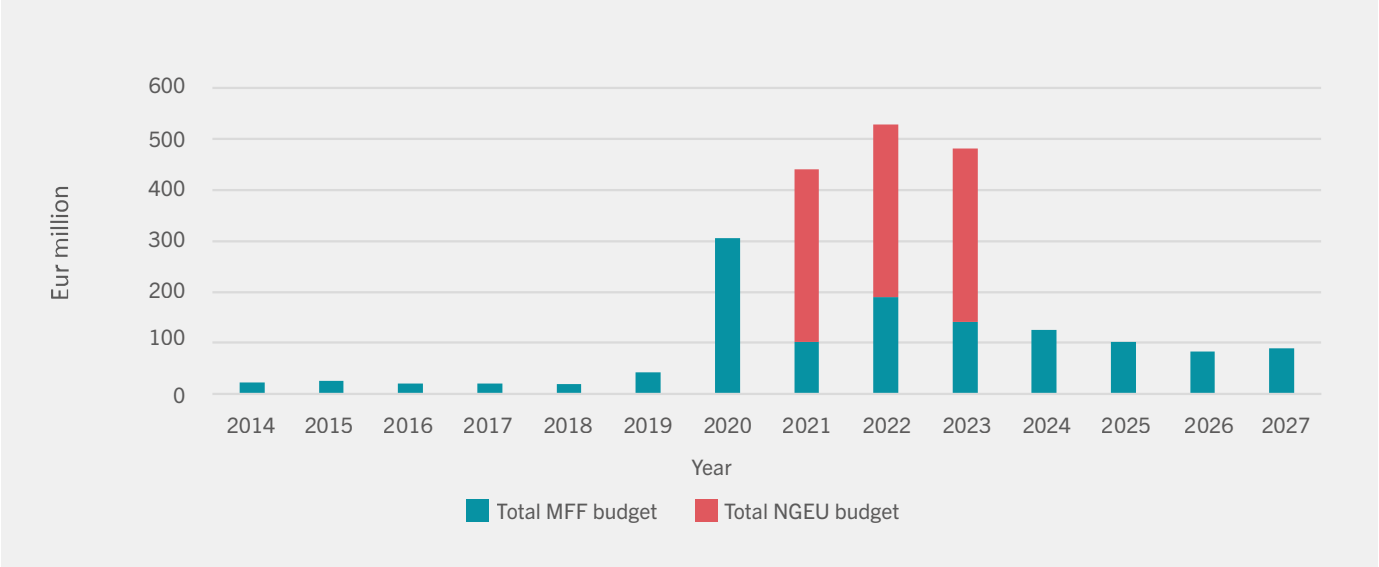


Source: World Bank analysis of UCPM data.

As per Council Regulation 2024/765 (February 29, 2024), it was agreed that the existing Solidarity and the Emergency Aid Reserve (SEAR) would be split into two separate instruments with a guaranteed amount per instrument. The European Solidarity Reserve (the budget line from which the EUSF is funded) will have €1,016 million per year in total (in 2018 prices), with an increase of €216 million per year (in 2018 prices), for assistance to respond to emergency situations covered by the EUSF. The Emergency Aid Reserve will have €400 million per year with an increase of €108 million per year (in 2018 prices), that is, €508 million per year (in 2018 prices), for rapid responses to specific emergency needs within the EU or in third countries. Annual amounts not used for either instrument will be made available for use in the flexibility instrument in the following year.

Since 2021, the UCPM's budget has been covered through the MFF and NextGenerationEU (NGEU) (see Figure 9). NGEU is the EU's €800 billion temporary recovery instrument to support the economic recovery from the coronavirus pandemic and build a greener, more digital, and more resilient future. NGEU's budget represented 77 percent of the total UCPM budget in 2021, 64 percent in 2022, and was 71 percent of the total UCPM budget in 2023. The UCPM's total budget for 2021–2027 is €3.7 billion.

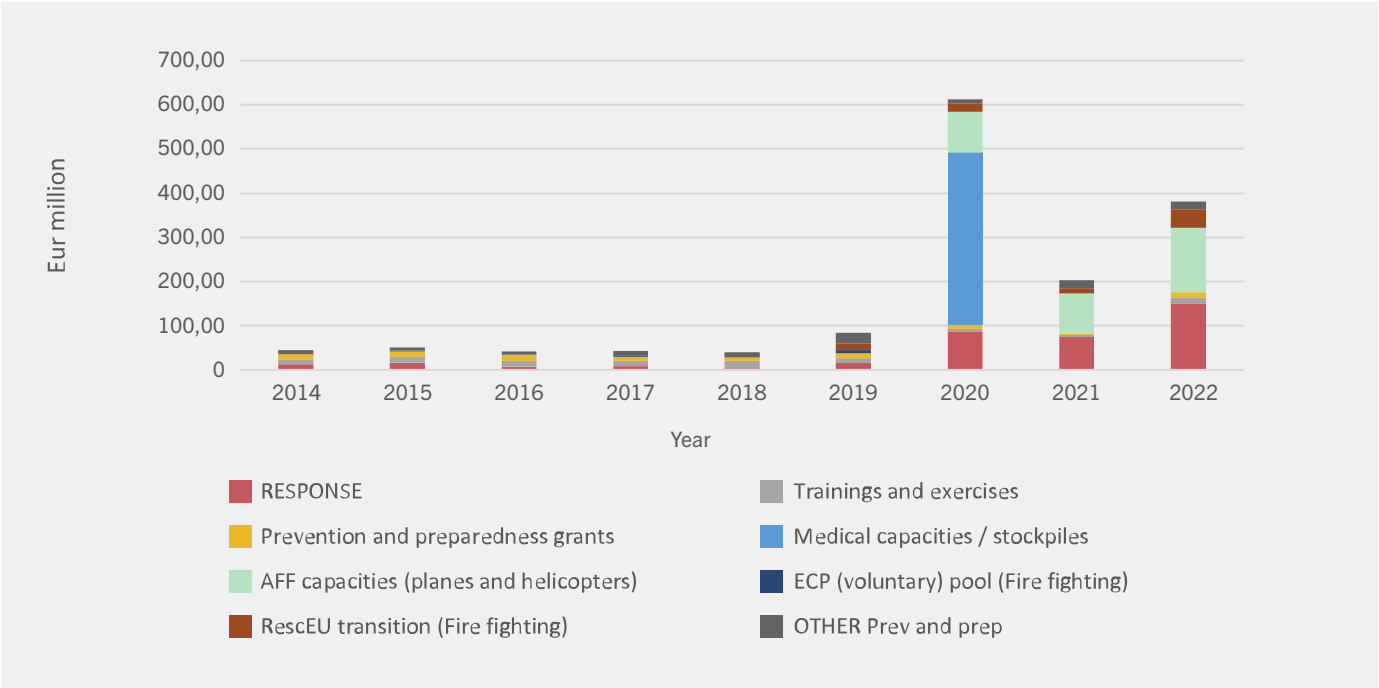
Figure 9: UCPM budget, 2014–2027



Source: World Bank analysis of UCPM data.

Analysis of the UCPM's budget over time indicates that most of the expenditure has been for response activities of which wildfire activities are equivalent to approximately one-third of response costs, while no expenditures were found for extreme heat. The response budget increased from €13 million in 2014 to €150 million in 2022. Other notable increases over 2014–2022 include a rise in funding for prevention and preparedness activities (from €9 million in 2014 to €19 million in 2022) and for firefighting (from €1 million in 2014 to €1.67 million in 2022; see Figure 10). RescEU was a new budget line that was added to the overall budget from 2019 onward. No expenditures were found for extreme heat; therefore, the analysis will focus on drought.

Figure 10: UCPM budget by category, 2014–2022



Source: World Bank analysis of UCPM data.

In 2022, €150 million was allocated for the UCPM's response activities, firefighting capacities (planes and helicopters—€145 million), and rescEU transition (firefighting—€40 million). The remaining amount of the annual MFF (€47 million) was allocated for 'other' prevention and preparedness work (€19 million), training and exercises (€15 million), and prevention and preparedness grants (€12 million).

EUSF

Established in 2002 with revisions in 2014, and 2020, the EUSF provides financial assistance to emergency and recovery operations in MS (and accession countries), but, due to the time it takes to mobilize funds, it is best suited for recovery.[24] The EUSF is one of the mechanisms that operates outside the multiannual framework (MFF). This allows the EUSF to mobilize necessary funds to react to unforeseen events, such as crisis and emergency situations. However, as found in the Phase 1 report, access to funding takes time, with applications taking 8–10 weeks and disbursement taking an average of 56 weeks (although advances can be provided before the grant is fully disbursed).

The amount of aid from the EUSF for a given disaster is determined on the basis of the total direct damage caused by that disaster in relation to the relative wealth of the affected State as reflected by the threshold.[25] The threshold is the level of total direct damage defined by the regulation that must be exceeded to trigger the intervention of the fund for "major disasters" and is specific to each eligible State. It is defined as damage in excess of either 0.6 percent of the affected State's gross national income (GNI) or €3 billion in 2011 prices, whichever is lower.

Assistance from the EUSF takes the form of a grant to supplement public spending by the beneficiary State and is intended to finance essential emergency and recovery measures to alleviate damage which, in principle, is non-insurable. Measures eligible for funding are as follows:

- The restoration to working order of infrastructure and facilities providing energy, drinking water, wastewater disposal, telecommunications, transport, health care, and education.
- The provision of temporary accommodation and the funding of rescue services, to meet the needs of the population affected.
- The consolidation of preventive infrastructure and protection of cultural heritage sites.
- The cleaning up of disaster-stricken areas, including natural zones.
- Rapid assistance, including medical, to the population affected by a major public health emergency, and the protection of the population from the risk of being affected.

Since 2002, the EUSF has mobilized a total of almost €8.6 billion for 110 natural disasters and 20 interventions as a response to public health emergencies. It has supported 24 MS (plus the United Kingdom) and four accession countries (Albania, Montenegro, Serbia and Türkiye). Italy is by far the biggest beneficiary of the fund, having received more than €3 billion after a devastating earthquake in 2016, followed by Germany, which received over €1.6 billion for flood, and Croatia, which received over €1 billion after the two major earthquakes in 2020. In that period, flooding was by far the most frequently occurring disaster affecting European countries, followed by storm. However, the EUSF paid out a similar amount for earthquakes, but the number of earthquakes was five times less than the number of floods. From 2002 to the mid- 2024, 181 applications were made to the EUSF; 130 were successful, 47 were rejected, and 4 were withdrawn.[26]

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24 Council Regulation (EC No 2012/2022 of 11 November 2002 establisching the European Union Solidarity Fund (OJ L 311, 14.11.2002, p. 3), Link.
25 EC. EU regional and urban development - Regional Policy, Solidarity Fund. Link.
26 EUSF data on disaster aid provided: Link.

Analysis of EUSF data indicates that over the 20-year period from 2002, the number of natural disasters requesting EUSF funding has remained roughly the same, but the direct damages reported to the EUSF for these disasters have tripled.[27] This may be partially due to improved assessment of damages; however, it could also be that the average cost of damages is increasing. If the average severity of losses utilizing EUSF funding is increasing, this indicates that the ability for the EUSF to continue to support MS will reduce.

Droughts have had large impacts on economies in MS; since the EUSF was created in 2002 there have been four applications submitted and accepted for droughts. Funding was provided to Cyprus in 2008 and 2016 and to Romania in 2012 and 2022. In 2022, Romania which suffered a loss of over €1 billion in the agricultural sector[28] due to droughts and wildfires in the south-eastern region received almost €34 million from the EUSF[29] to cover some of the losses from the drought and associated wildfires. Currently, MS are not easily able to access EUSF funds to support drought losses, due in part to the challenges in defining the exact start of a drought and the fact that droughts are often connected to extreme heat and wildfires, compounding overall impacts. It is the damage from this combined risk that leads to the application to the EUSF.

The EUSF has been triggered eight times since 2002 for wildfires, in response to damages of €6.1 billion for these eight events. Since its establishment, there have been eight successful applications to the EUSF for support costs associated with wildfires, which have received €207.1 million in financing.[30] There are no reported applications for extreme heat events given that the limited physical damage associated with these events is unlikely to breach the threshold of damage in excess of either 0.6 percent of the affected State's gross national income (GNI) or €3 billion in 2011 prices, to submit an application to the EUSF. These events are typically ineligible despite high emergency response, and information on medical costs associated with these events is unavailable. The EUSF is not typically used to support MS following wildfires, in part, due to the low amount of eligible direct damage costs for EUSF funding.

EU INSTRUMENTS FOR DRM PREVENTION AND PREPAREDNESS INVESTMENTS

This report primarily examines risk retention tools and advocates for the strategic use of pre-positioned finance. However, it is important to acknowledge the existence of additional funding mechanisms available to EU MS to strengthen resilience against future disasters by investing in mitigation and adaptation activities. The EU's 2021–2027 MFF offers a range of opportunities for investment in disaster risk management (DRM) and climate change adaptation (CCA).[31] Furthermore, the EU Green Deal, which prioritizes CCA and DRM, also aligns with these objectives.[32] An overview of the opportunities within the 2021–2027 MFF is depicted in Figure 11.

The EU created specialized funds after the recognition of the magnitude of the COVID-19 pandemic including, the Recovery and Resilience Facility (RRF)[33] and NGEU initiative. While these instruments are a direct response to the pandemic's far-reaching economic and social impacts, they focus on the provision of finance for mitigation and adaptation activities. The RRF, in particular, was designed to support MS in their recovery efforts, by fostering resilience against future shocks. Additionally, funding has been earmarked for sectors critical to the EU's strategic interests, including the single market, innovation, and digital; cohesion,

27 EUSF data on disaster aid provided: Link.
28 Link.
29 Almost €34 million in European Solidarity Funds to Romania to repair damages caused by severe drought in 2022 Link.
30 EC. *EU Solidarity Fund: Supporting Disaster Recovery 2002-2022*. Link.
31 *See Forthcoming* World Bank and European Commission. 2024. *From Data to Decisions: Tools for Making Smart Investments in Prevention and Preparedness.* The report serves as a guide for European policymakers, equipping them with the necessary tools and case studies to prioritize initiatives that enhance resilience.
32 EC. 2019. *The European Green Deal COM/2019/640*. Link.
33 EC. 2023c. *The Recovery and Resilience Facility*. Link.

resilience, and values; natural resources and environment; and international partnerships. These allocations reflect the EU's investment in resilience of the Union. The emergence of these funds from a period of crisis underscores the strategic importance of pre-positioned finance as having these instruments in advance would have saved time and undoubtedly lives during the pandemic.

Figure 11. Instruments for DRM prevention and preparedness investments

Single market, innovation and digital	Horizon Europe	InvestEU
	Connecting Europe Facility	Other: Euratom Research & Training, ITER European Space Program
Cohesion, resilience and values	European Regional Development Fund	Recovery and Rsilience Facility (inc. Technical Support)
	Cohesion Fund	
	REACT EU	Union Civil Protection Mechanism
	European Social Fund+	EU4Health
Natural resources and environment	European Agricultural Fund for Rural Development	European Agricultural Guarantee Fund
	Just Transition Fund	Programme for Environment and Climate Action – LIFE
Neighborhood & the world	Neighbourhood, Development & Intl. Cooperation Instrument	Humanitarian Aid
	Comon Foreign & Security Policy	Pre-accession Assistance

Source: World Bank.
Note: ITER = International Thermonuclear Experimental Reactor; REACT EU = Recovery assistance for cohesion and the territories of Europe.

2.2. National Level

National governments have several financing instruments at their disposal to respond to a disaster. National-level instruments are typically used by EU MS before accessing regional instruments. National-level instruments are as follows:[34]

Reserve funds

Setting aside an adequate amount of budget annually to meet post-disaster needs can help mitigate disaster impacts and reduce the need for budget reallocation in the event of an emergency, in turn lessening the negative impact of budget reallocations on economic development. The availability of rapid liquidity (or the lack of it) may have implications for timeliness of disaster response and immediate recovery.

While it is generally assumed that most of the EU MS have some form of a contingency budget or "rainy day fund", only four EU MS (Austria, France, Hungary, and Italy) have a dedicated disaster reserve fund and the funds are not earmarked for particular hazards. Moreover, Phase 1 found that only 10 EU MS have general contingency funds that explicitly cover disaster relief.

34 Further information on national financing instruments can be found at Link.

Budget allocations to relevant budget users/ budget lines

To meet needs after a disaster, governments may choose to allocate funds in advance to dedicated budget lines within relevant ministries. These funds may then be spent and reported in line with guidelines and relevant legislations.

BOX 1: NATIONAL FIRE MANAGEMENT FUND, ARGENTINA

In Argentina, a national fire management fund has been established, which after being modified by Law #27.591/21 has secured a stable source of income of 0.3 percent of all insurance premiums except those of life insurances. With an estimated annual income of around US$70 million, this fund has enabled an increase in support to local governments' fire management actions, including the pilot of new technologies for early fire detection and warning. The establishment of disaster reserve funds, earmarked or not for particular hazards such as in Argentina, may be one avenue to explore in strengthening MSs' ability to finance needs after a disaster.

Budget reallocations ex post

To meet unplanned needs, governments may use budget reallocations between budget lines or users. In times when budget reallocations are the most effective means of meeting unplanned needs, it is necessary to ensure that policies to guide reallocation decisions are transparent and adhered to. Having a plan and process in place can reduce the time required for reallocations and the opportunity costs of cancelled or delayed returns from planned expenditures. Chapter 3 provides more information on risk-based budgeting which can be used to strengthen budget allocations to relevant budget users, budget lines, and reserve funds and make informed budget reallocations ex post.

Contingent lines of credit

Contingent credit arrangements offer rapid liquidity that is disbursed following an event of a pre-agreed magnitude or based on a pre-agreed trigger (for example, declaration of a national emergency situation). Contingent credits can be fungible or conditional by design. As with other sources of credit, the amount available will depend on the development status of the country and the debt-servicing ratio. The advantage of contingent credit is its rapidity and capacity to cover a financing gap between a reserve fund and more expensive or longer-disbursing sources of funds (such as insurance).

Contingent credit can be offered by the private sector or development institutions. For example, the World Bank Catastrophe Deferred Drawdown Option (CAT DDO) provides a line of credit to countries upon successful completion of some policy actions that are agreed in advance. The release of the finance is contingent upon a disaster event happening and sequential national declaration of disaster/statement of emergency. For example, Serbia used a CAT DDO of €66.1 million to strengthen post-disaster reconstruction and disaster and climate risk management and reduce the fiscal impact of disasters.

Insurance (sovereign, asset, and/or sector or stakeholder specific)

Risk transfer solutions help in mobilizing private sector capital (which often exceeds available public funds) and can be structured in various ways, for example, as (i) sovereign insurance or capital market instruments (protecting government budgets), (ii) public asset insurance, or (iii) property insurance for households. Chapter 4 provides more information on insurance.

3. Risk-based Budgeting

This chapter discusses risk-based budgeting as one way to increase a country's resilience to shocks. It describes how it can be applied, its potential benefits and how it is currently being applied in some EU MS. Risk-based budgeting practices currently vary across EU MS and more could be done to utilize the benefits of risk-based budgeting.

Risk-based budgeting is the consideration of disaster risk throughout the government budget cycle. This enhances a country's financial resilience to shocks. A broad term, it may be interpreted and implemented differently by EU MS. Associated terms include risk-informed budgeting, crisis budgeting, and disaster-resilient and disaster-responsive public financial management (PFM).

Risk-based budgeting in DRF is a relatively new area of research. There is some guidance on expectations of risk-informed budgeting, but the exploration of disaster risk across the budget cycle and practices across countries is still evolving. For instance, the International Monetary Fund (IMF) proposes a three-tier classification for risk disclosure and analysis,[35] with specific fiscal risks such as disasters encouraged to be regularly monitored and disclosed.[36] The Organisation for Economic Co-operation and Development (OECD) also provides recommendations and principles for fiscal risk assessments.[37] OECD's principle 9 on budgetary governance requires fiscal risks to be identified, explained, and classified by type. Fiscal risks should also be quantified and reported in the context of the annual budget. Discussions are currently ongoing to potentially amend the EU's directive (2011/85/EU) on budgetary frameworks of the MS. The amendment calls for the publishing of disaster and climate-related contingent liabilities and the assessment and publishing of information on the losses incurred and fiscal costs due to disasters and climate-related shocks as well as the instruments used to mitigate or cover them.

The consideration of disaster risks can occur in all stages of the budget cycle. The entry point a country chooses to adopt will depend on capacity and priorities as well as the preexisting PFM system. Early progress is likely to focus on budget preparation, but advanced countries may also consider disaster risks during budget authorization, budget execution, and/or budget accountability functions. How a country may consider disaster risk in each stage of the budget cycle is detailed in Table 2. Risk-based budgeting may take place at the national, sectoral, or subnational levels.

35 The three layers include basic practice (specific risks to the fiscal forecast are disclosed in a summary report and in qualitative terms), good practice (specific risks to the fiscal forecast are disclosed in a summary report along with estimates of their magnitude), and advanced practice (specific risks to the fiscal forecast are disclosed in a summary report along with estimates of their magnitude and, where practical, their likelihood).

36 IMF, 2018. *Fiscal Transparency Handbook*. Link.

37 OECD. 2020. *OECD Best Practices for Managing Fiscal Risks.* Link.

Table 2: Risk-based budgeting activities

BUDGET ACCOUNTABILITY	BUDGET PREPARATION
• Tracking and reporting disaster expenditure • Evaluating the impact of disaster expenditure • Auditing disaster risk and expenditure • Publishing disaster expenditure for civil society organization (CSO) engagement	• Identifying and quantifying disaster-related contingent liabilities • Integrating risk into medium-term forecasts • Mainstreaming risks into annual budgets • Budgeting for DRF instruments • Risk-informed public asset management • Risk-informed revenue budgeting
BUDGET EXECUTION	**BUDGET AUTHORIZATION**
• Emergency procurement procedures and protocols • Risk-informed budget reallocation processes • Design effective disbursement mechanisms for DRF instruments	• Ensure Parliament has sufficient information related to disaster risks • Build capacity of relevant parliamentary committees to scrutinize the management of disaster risks

The implementation of risk-based budgeting can strengthen financial resilience. For instance, considering disaster risks in medium-term forecasts and annual budgets creates greater certainty on how unexpected costs may be financed, and risks managed. Information produced through risk-based budgeting can also support development of a disaster risk-layering strategy; an approach to cost-effectively combine different sources of funding to manage the financial impacts of disasters. Table 3 shows some of the benefits in implementing the risk-based budgeting activities, as means to enhance financial resilience, at various stages of the budget cycle.

Table 3: Benefits of risk-based budgeting across the budget cycle

BUDGET ACCOUNTABILITY	BUDGET PREPARATION
• Supports the transparent tracking and reporting of disaster expenditure • Supports the production and use of established guidelines and procedures for the allocation and use of funds	• Helps address expenditure and revenue risk across different time scales • Creates greater certainty around what disaster costs may be and how they will be financed. • Supports government budget planning and the management of financial risks, including the design and use of DRF instruments
BUDGET EXECUTION	**BUDGET AUTHORIZATION**
• Helps link budgeting to implementation (for example, emergency procurement) • Can create a predictable funding source that is separate from regular budget allocations, which may reduce the opportunity cost of in-year adjustments • Supports the effective and efficient use of resources	• Links appropriate sources of funding with predefined priority activities • Expediates the funding approval process, resulting in faster release of funds • Provides greater transparency for parliament and budget users on how funds may be utilized after a disaster

Risk-based budgeting practices vary across EU MS. A recent EC report,[38] for instance, notes that despite its considerable relevance, the analysis of climate-related risks has "often been absent from fiscal sustainability frameworks of official institutions, notably due to inherent difficulties in conceptualizing and quantifying such aspects." However, some positive developments are noted in a recent EC report:[39] More could be done to utilize the benefits of risk-based budgeting.

- **Georgia:** Inclusion of fiscal risks from natural disasters and climate change in fiscal risk statement. The statement provides a historical perspective on financial losses and numbers of people affected by disaster, a forward-looking assessment of annual expected damages at different periods, and an overview of budgetary instruments for DRF.

- **Spain:** The Spanish fiscal council is working to incorporate climate change into macroeconomic projections.

- **Finland:** Disaster-related fiscal risks are considered in long-term projections.

- **Germany:** Estimates of disaster damages by 2030 for individuals, companies, and critical infrastructure have been provided for the German Environment Agency.

- **Belgium:** Establishment of a coordinating body, the Centre of Excellence on Climate, to analyze and evaluate climate-related risks.

At the EU level, notable initiatives on fiscal matters and climate change relate to ongoing work on 'green budgeting' and inclusion in the 2019 Debt Sustainability Monitor on how to encompass climate change impacts on growth and public finances in the standard EC's Debt Sustainability Analysis. Box 2 provides further examples of risk-based budgeting activities being undertaken by countries outside of the EU.

38 EC. 2022a. *Fiscal Sustainability Report 2021, Volume 1.* Link.
39 EC. 2022b. "Disaster Risk Financing: Limiting the Fiscal Cost of Climate-Related Disasters." Discussion paper 174. Link.

BOX 2: EXAMPLES OF RISK-BASED BUDGETING PRACTICES OUTSIDE THE EU[40]

- **Budget preparation: Contingent liability management in Colombia.** Colombia's annual medium-term fiscal framework includes contingent liabilities related to disasters (La Niña and earthquakes). This information feeds into projections for revenue, expenditure, and debt dynamics. Mitigation instruments and financing sources are also identified for each contingent liability. For disasters, the Ministry of Finance has identified the national fund, agricultural insurance, CAT DDO and CAT bond, and the financial protection strategy as core mitigation and financing instruments.
- **Budget authorization: Office for Budget Responsibility (OBR) in the United Kingdom.** The OBR was established in 2010 to provide an independent examination on the sustainability of public finances. It has provided a biennial report on fiscal risks since 2015. For instance, its 2021 Working Paper No. 17 report focused on three catastrophic risks—COVID-19, climate change, and the cost of dorThis report noted that the projected medium-term legacy costs of the pandemic are likely to be £10 billion per year, which are currently unfunded in the government budget. In 2023, the OBR, published Discussion Paper 4, which details the work done to date to understand and analyze the fiscal impacts of climate change on the budget.
- **Budget execution: Advance procurement agreements in Japan.** The 2011 earthquake and tsunami caused US$43 billion damage to infrastructure and public utilities. Rapid reconstruction was key to supporting relief activities and saving significant indirect costs. To support rapid reconstruction efforts, the government enters into pre-disaster agreements with the private sector for construction, engineering, surveying, telecommunications, and broadcasting.[41]
- **Budget accountability: Disaster budget tagging in Ethiopia.** Ethiopia has undertaken numerous stand-alone expenditure reviews on disaster risk reduction/climate change spending, but its accounting structure makes it difficult to carry out regular assessments. A budget tagging system has therefore been introduced to flag adaptation/mitigation spending as well as spending on the whole disaster cycle. A dual tagging system has been put in place to reflect synergies between climate and disaster risk reduction. The budget tagging system will be embedded into the Integrated Financial Management Information System, with reporting included in the 2023/24 budget.

40 For further information and case studies, see World Bank. Forthcoming. *Disaster Risk Based Budgeting: Introduction and Options for Operationalization.*

41 Link.

4. Risk Transfer Instruments

Risk transfer solutions help in mobilizing private sector capital to complement limited public funds and can be structured in various ways, for example, as (i) sovereign insurance or capital market instruments (protecting government budgets), (ii) public asset insurance, or (iii) property insurance for households. These instruments can be developed on a hazard-by-hazard basis or using a multi-peril approach. This chapter presents a general discussion of the instruments to clarify the basis on which these products can be developed. More could be done to incentivize risk transfer at both the EU and the EU MS levels.

4.1. Sovereign Insurance or Capital Market Instruments

The risk of disaster losses can be transferred to the private insurance market (or to capital markets in the case of CAT bonds) via sovereign insurance—that is, an insurance policy where a government (the sovereign) is the policyholder. Together with risk retention instruments such as budgetary reserves and contingent credit, sovereign risk transfers can be a key part of a comprehensive DRF strategy.[42]

At present there are no risk transfer products at the EU level or in the case study countries, and consideration should be given to their incorporation in future DRF strategies. There is a trade-off with risk transfer products as the initial premium is to be paid up front regardless of payouts. However, in extreme loss years, the payouts from a risk transfer product can be many times the premium. Parametric products, in particular, can provide fast payouts in a matter of days or weeks and the proceeds can be used for emergency relief.

Sovereign insurance can be structured in different ways, such as indemnity products or parametric products which are based on an index or modelled loss. Indemnity-based products require extensive loss assessment processes before a payout can be confirmed but have the advantage that payout is closely tied to the loss that occurs, so that basis risk[43] is minimal. Typical household insurance, for example, follows an indemnity approach. A modelled loss–based product relies on the assessment of loss using an agreed independent risk model, with a payout occurring if a modelled loss threshold is exceeded. A parametric index is a simplified version of this

42 World Bank, "Sovereign Catastrophe Risk Pools: A Brief for Policy Makers," Link.

43 Basis risk is the level of potential risk that exists when a calculated loss of a model or insurance index differs from the actual incurred loss. Any mismatch between the two will result in a discrepancy in the payout received. This could mean either that a payout is higher than the actual loss incurred (positive basis risk) or that the payout is lower than the actual loss (negative basis risk).

approach and uses formulas to estimate loss from an event that has occurred. Parametric products pay out when an event occurs that meets a pre-agreed definition (in terms of type, location, and hazard intensity threshold). Thus, they typically offer faster payouts than other types of sovereign insurance but are subject to the greatest basis risk. Parametric products can be a useful tool for budget support or as a backstop into existing reserve funds for a government.

Governments can also transfer their disaster risk through capital market instruments. For example, a CAT bond is a risk transfer capital market instrument that allows the issuer to raise funds in case of a natural disaster and does not count against a country's debt ceiling. CAT bonds are high-yield debt instruments that pay out only if a specific event such as an earthquake or a flood occurs. If the insured event occurs and triggers the payment to the bond issuer, the principal will be used to cover a part of the losses. Investors who are ready to take this kind of risk target CAT bonds because they offer attractive rates of return that are usually higher than other fixed-income securities. In addition, because losses on CAT bonds are not correlated with those of other capital market instruments, they offer portfolio diversification for large investors.

BOX 3: EUROPA RE

Europa Re was launched in 2009 as a public-private partnership reinsurer for property and casualty risks, specializing in catastrophe risks, but the take-up from countries has been low. As of 2020, there are three participating countries—Albania, North Macedonia, and Serbia—who are shareholders of this entity.

4.2. Public Asset Insurance

Some of the biggest risks from climate shocks, like drought, extreme heat, and wildfire, come from their impacts on critical systems—food systems, supply chains, and infrastructure. These so-called systemic risks can potentially cause cascading impacts on people and economies. These types of risk can be much more difficult to assess, but their impacts can be substantial. Many countries are now increasingly aware of the importance of strengthening the resilience of their critical infrastructure and are looking for ways to go about making the decision on which critical infrastructure to protect and how.

Public asset insurance, as part of a comprehensive disaster management strategy, can smooth expenditures by helping avoid budget shocks through transferring the risk to the private insurance sector. It can provide benefits by pooling multiple assets into an insurance scheme, thereby diversifying the risk and reducing the premium cost per asset. Insurance cover for public assets may be voluntary or compulsory, and products may be indemnity-based (payout determined by the assessed losses), parametric (payout based on the occurrence or severity and location of a hazard event), or a hybrid; each has its own benefits and challenges. Financial management of public assets can be complemented by risk retention instruments.

As found in Phase 1, data on penetration of public asset insurance in Europe are limited. Bräuninger et al. (2011) mention that only one-third of private and public assets in the EU are insured against floods and drought (with public assets generally uninsured).[44] Fire is usually included as the norm unless explicitly stated overwise. Bulgaria has a legal requirement for municipalities to buy insurance for their assets (excluding against floods in high-flood-risk areas), but the extent to which this law has been implemented is unclear.

44 Bräuninger et al. 2011. *"Application of Economic Instruments for Adaptation to Climate Change."* Link.

4.3. Household Insurance

Catastrophe insurance for households can be offered in different ways. Globally, household insurance against disasters is offered by private sector insurers, but the number of public or private-public schemes is growing. Catastrophe insurance (usually referred to as 'natural catastrophe' or 'NatCat' cover) is offered as a stand-alone product, as part of a general property damage policy or as an add-on to such a policy. It can be either compulsory or voluntary (or voluntary with some elements of obligation, for example, through mortgage contracts). Depending on the country, flood, storm, or earthquake cover (or some combination of these) is commonly provided as standard in a household policy[45] in addition to standard cover such as fire, and payout is usually on an indemnity basis, requiring assessment and adjustment of losses after an event.

Property insurance policies often cover damage caused by wildfires as this is included under the traditional fire policies. For most EU countries, wildfire insurance coverage for homeowners is mandatory either by law or through mortgage requirements by banks.[46] Nevertheless, insurance penetration is lower for agricultural sites or forests. Also, several parametric insurance schemes have become available over the past years. However, in well-established wildfire insurance markets like California, primary insurers have been challenged by the current inflationary environment and the resistance of regulators to allow rate increases that would cover the estimated cost of this risk in relation to inflation.[47] This has seen some insurers raise insurance rates by more than 30 percent or cease offering new home insurance policies altogether, prompting a discourse on the feasibility of private insurability and the need for adequate insurance rates and regulatory environment.[48]

The penetration of private sector catastrophe insurance varies largely between EU MS, and governments should be careful not to disincentivize its uptake. The consensus among insurers on the low penetration is that the government will support citizens when there is a large disaster and therefore there is a lack of will to purchase insurance. It has been suggested from multiple insurers that this provides an argument to make earthquake insurance coverage mandatory. This would need to be coupled with awareness creation on the importance of financial resilience. The ad hoc payouts from the government will also affect uptake in other sectors of insurance such as in agriculture insurance which is particularly pertinent for drought.

The following are some examples of catastrophe insurance for households in Europe:

- **Wildfire coverage.** It It is generally the case that household fire policies would include damage from wildfires in most EU MS. However, the team is aware that reinsurers such as Munich Re provide specific cover for wildfire in Greece and Portugal where there is sufficient volume of assets at risk.

- **Agriculture insurance.** Another area which can affect government contingent liabilities is crops or livestock which are destroyed from a natural disaster. It is common in many countries for local and central governments to offer support to farmers after a disaster event. Having agriculture insurance, whether for the farmer, agriculture-lending institutions, or local/central government, could support ex ante planning for this sector instead of making ad hoc payments after the event. Understanding the government's exposure to agriculture losses, that is, where ad hoc payments are being made to farmers after an event, would be the first step in understanding where government-subsidized agriculture schemes might be a more cost-effective intervention. The Common Agricultural Policy paved the way for increased

45 EU JRC 2012. Link.
46 Link.
47 Link.
48 Bloomberg news. Link.

crop insurance support through premium subsidies (Regulation (EU) 2021/2115), and consequently, there was a sharp rise in publicly funded insurance in EU MS from €133 million to €386 million in 2020.[49] It is expected that this trend will continue, with a forecast indicating these subsidies will increase to €523 million by 2027, in recognition of the fact that insurance can serve as an important risk management tool in a sector facing high and increasing risks due to climate change.

4.4. Market Overview

WILDFIRE RISK TRANSFER-LEVEL INSTRUMENTS

Catastrophe bonds are increasingly being used to cover the liability risk associated with the risk of wildfires. Many utility companies are now seeking to use CAT bonds to manage their liability risk from wildfires, recognizing that faults in their equipment could cause a fire and a fire could equally damage their utility plants.[50]

The 2023 EU Wildfire Peer Review assessment further notes that a financing strategy for wildfire risk should be based on an integrated, multi-hazard approach and cooperation across levels of government and with relevant stakeholders should be established, with the necessary resources and expertise to manage the financial impacts of severe and large-scale events. To further strengthen the financing of wildfire events, the 2023 report made several recommendations:

- Potential risks to public finances posed by wildfires should be evaluated to manage the impacts of disasters on public finances. An approach to managing those financial needs should be developed, including mechanisms for estimating, accounting, and disclosing contingent liabilities associated with losses to critical sectors.
- The National NatCat insurance system, if in place and effectively enforced, should cover the risk of wildfire.
- A variety of funding sources should be used at the national, subnational, and local levels. The EU funding instruments, such as the Resilience and Recovery Facility, Cohesion Policy Funds, Agriculture and Rural Development Fund, the LIFE program, the Technical Support Instrument, the EU Mission on Adaptation to Climate Change, and UCPM funding programs, should be fully exploited in the event of wildfires and other disasters.[51]

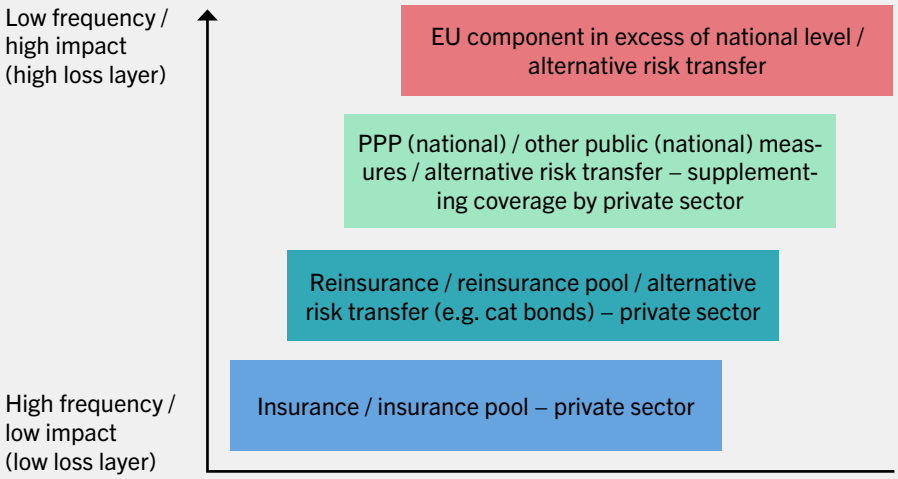
BOX 4: LINKING PARAMETRIC INSURANCE TO ECOSYSTEMS

Combining ecological action with financial protection can make good economic and financial sense and help overcome the pricing issues associated with wildfire risk. For example, an ecological forestry approach linked to parametric wildfire losses could reduce losses for the insurance and reinsurance sector. A study by the Nature Conservancy and Willis Towers Watson (2021) found that residential insurance premiums could decrease by 41 percent when ecological forestry techniques such as forest thinning and prescribed burning were applied to a relevant area. Without such ecological measures, the risk of wildfire continues to grow.

49 Link.
50 Cook, S., and S. Holliday. 2022. *Insuring Nature's Survival: The Role of Insurance in Meeting the Financial Need to Preserve Biodiversity.* Link.
51 Opportunities for DRM investments are discussed in World Bank and European Commission. 2024. *From Data to Decisions: Tools for Making Smart Investments in Prevention and Preparedness.*

The economic costs of wildfires within the EU are carried through different vehicles, with some novel approaches gaining traction over more common traditional (re)insurance schemes. Figure 12, developed by the European Insurance and Occupational Pensions Authority (EIOPA), presents a summary of different disaster risk schemes that could be used to manage climate risk and includes a similar recommendation to that made in EDPP Phase 1 to introduce a risk transfer scheme at the EU level that could be connected to either the UCPM and/or EUSF.

Figure 12: The ladder approach to catastrophe insurance



Source: EIOPA, European Central Bank.[52]

In the reinsurance market, reinsurers tried to reduce their wildfire exposure over the past few years due to the recent spike in (re)insurance claims, that is, from the megafires in Portugal (2017) or Greece (2021) that caused more than €1 billion damages.[53] This led to increasing reinsurance prices. Compared to the United States (especially California), CAT bonds as a risk transfer mechanism are less common in the EU and should be further explored once risk models are available to see if this could provide a cost-effective option to manage the risk of wildfires.

BOX 5: GOVERNMENT SUPPORT TO WILDFIRE INSURANCE SCHEMES

In some countries, the government provides financial assistance to help cover the costs of wildfires that exceed the capacity of insurance policies. One example would be the Consorcio de Compensación de Seguros (CCS) in Spain or the publicly owned Caisse Centrale de Réassurance (CCR) in France. Furthermore, governments might support disaster struck regions and communities, such as Portugal in 2017. However, these financial resources need to be made available through a reallocation of government funds.

Given the prominence of infrastructure assets located in or around a forest, a specific wildfire instrument for these assets may be beneficial for the EU, and lessons could be learned from California.[54] For example, the Los Angeles Department of Water and Power (LADWP) secured US$30 million of wildfire insurance cover from its second CAT bond issued via Power Protective Re. Ltd. The product embeds liability protection in this CAT bond deal and recognizes that the assets insured

52 Policy Options to reduce the Climate insurance protection Gap Link.
53 S&P Global. Link.
54 Cook and Holliday 2022.

may themselves cause wildfires. However, it should be noted that while wildfire insurance or reinsurance capacity is available from the Index-Linked Securities (ILS) market, agreeing on pricing may be difficult, as ILS funds and investors are demanding higher returns for the California wildfire peril after recent losses. That said, this is a new peril and pricing may change as we learn more on the risk itself.

RISK TRANSFER MECHANISMS FOR EXTREME HEAT AND DROUGHT

Limited risk transfer mechanisms are available for extreme heat and drought, particularly compared to other climate extremes such as floods, storms, or wildfires. As noted earlier, extreme heat gives rise to costs in four ways: (i) direct impacts on the health sector; (ii) a decline in labor productivity both indoors and outdoors; (iii) increased energy expenses due to heightened cooling demands; and (iv) direct and indirect effects on critical infrastructure, such as power plants or roads, which may experience service disruptions. Similarly, droughts increase costs through (i) a decline in productivity from the water-dependent industry such as water-intensive manufacturing, agriculture/forestry, food production, power generation, and water distribution and (ii) direct impact on the health sector.

There could be cases where certain economic consequences can be transferred to insurance via business interruption, for example. Business interruption policies can address risks related to nuclear power plants when the cooling water temperature rises excessively or to outdoor work when the temperature reaches hazardous thresholds for workers. Additionally, weather derivatives are employed to hedge against revenue losses within the energy sector in the United States.[55] Lastly, emerging parametric insurance products for extreme heat are entering the market to safeguard the income of (informal) workers against salary losses in India.[56]

Parametric risk transfer solutions are increasingly being used to cover the risk associated with droughts. Identifying the drought typologies that drive impact in each EU country (that is, hydrological, meteorological, and/or agricultural droughts)[57] helps determine the associated metrics to consider when designing a risk transfer mechanism, based on information on (i) water security and vulnerability in the context of surface water, ground water, and rainfall reliance as well as on (ii) critical impacts.

Testing and determining parametric triggers in support of a drought risk transfer mechanism requires engagement with key country stakeholders. These engagement needs include, but are not limited to, addressing questions around the key preferred (sectoral) impact focus to determine the final drought definition and relevant metrics (for example, agriculture/crops, water) as well as further meteorological and hydrological data and as an assessment of their relationship at the individual country and subcountry levels.

An assessment of EU countries regarding the cost for immediate response measures helps determine the dominant driver of drought response (for example, distribution of relief supplies) and support discussions around coverage needs. Consideration should be given to (i) testing the feasibility of existing social protection schemes to ensure no opportunities are missed; (ii) building efficient and rapid payout delivery structures to increase the value for money of insurance payouts and thus the return on investment of EU countries premium payments; and/or (iii) combining early action and rapid response interventions to capitalize on the multiplier effects (for example, by designing a two-step trigger mechanism), which combines the initial release of early action resources and later release of rapid response funds into one parametric coverage. Further research may help decrease overall payout and thus coverage needs, thereby supporting premium affordability as well.

55 Link.
56 Forbes. Link.
57 GAR 2021.

5. Funding Gap Analysis

This chapter outlines the estimated contingent liabilities related to wildfires and droughts that can be budgeted for, based on existing cover from financial instruments held by the EC and selected EU MS. It provides an indication of what proportion remains to be financed, commonly referred to as the funding gap. Analyzing the funding gap provides a tool to help countries build their DRF strategies. There is an increasing need for informed financial decision-making on how much funding to allocate before disasters, how to evaluate risk transfer instruments, and how much to spend on risk reduction.

The funding gap analysis is first applied to the region (all EU MS). The analysis of the UCPM budget over time indicates that most of the expenditure has been on response activities. Therefore, the analysis focuses on estimating these costs but recognizes that other costs associated with these hazards will emerge to represent the true cost. The funding gap analysis considers the MFF budget lines associated with emergency response activities and the EUSF based on records between 2002 and 2020. The analysis assumes that the resulting funding gap will be covered by (i) budget reallocation, (ii) debt, or (iii) bilateral donor assistance. Due to data limitations, the analysis does not review alternative DRF strategies that include sovereign risk transfer.

In addition, five selected national case studies are analyzed: Greece, Italy, Romania, Croatia, and Bulgaria. The approach to the country-level funding gap analysis considers overall economic losses incurred as a closer representation of the contingent liabilities member countries will face in the wake of wildfire and drought events. These case studies demonstrate how combining different risk financing instruments can affect the amount of finance available for damage incurred and how the amount of finance required differs across countries. To facilitate the analysis and assess the potential funding gap related to overall estimated contingent liabilities.

A fundamental assumption underpinning this analysis lies in the ratio of public sector costs compared to total costs. Recognizing the inherent uncertainty and observed fluctuations in the cost metric, the analysis assesses two additional scenarios to highlight the potential variability based on existing EUSF budget data information:

- **The low scenario** assumes that 30 percent of total cost is attributed to the public sector.
- **The high scenario** assumes that 80 percent of total cost is attributed to the public sector.

The scenarios demonstrate the potential range of the financial impact associated with different proportions of public sector costs, and these are applied to both emergency operation costs and damages separately.

Two case study countries—Croatia and Romania—are supplemented with information from discussions with the respective governments. The case study discussions of both countries contextualize the funding gap within the broader picture of what financing instruments are currently available to each MS.

The approach to assessing the loss profile and contingent liabilities varies considerably compared to other hazards. For example, wildfires result in varying damage to different types of assets and occur in different locations compared to those affected by other perils like earthquakes and floods. In EDPP1, the losses were predominantly driven by the household sector which accounted for over 50 percent of total loss. The areas historically affected by wildfires have a lower penetration of assets across the sectors (for example, residential, commercial, industrial, health, and education) due to their location so there will be underlying differences in the asset values being analyzed. Other factors associated with risk management, preparedness, and reduction measure in MS will have a bearing on the overall emergency cost associated with these events and the extent to which these are effective will likely vary across countries. Furthermore, the cost estimates are based on economic losses which encompass firefighting, reforestation, damages, and cleanup.

Wildfires, extreme heat, and droughts are complex perils to model, due to the broad range of factors and conditions influencing their occurrence and severity. Therefore, unlike earthquakes and floods, there are currently no fires, extreme heat, and drought loss models available in Europe. However, loss data exist for historical events, with detailed event reports (for example, EFFIS). Therefore, wildfire, extreme heat, and drought impacts can be derived using damage and loss ratios comparable to historical events. In the case of wildfires, models are currently under development to give probabilistic estimates (for example, CIMA). As mentioned in Section 1.2, existing models on wildfire do not focus on the generation of 'full' event-based catastrophe risk modelling approaches and there are no probabilistic models which can be used to estimate future loss, so the analysis here will differ from that conducted under EDPP1. In the absence of probabilistic modelling, a straightforward methodology has been employed for each hazard.

5.1. Wildfire Results of the EU-Level Analysis

METHODOLOGY

The methodology applied involves calculating the average cost per hectare burned and applying it to the total number of hectares documented in the EFFIS database.[58] Details on this methodology are included in Annexes 6 and 7. On the financing side, two separate scenarios are analyzed based on accessibility to different funding tiers:

- **Tier 1:** Estimates national reserves held by EU MS combined with the UCPM budget associated with emergency operations costs for wildfire events
- **Tier 2:** Tier 1, combined with an estimation of the EUSF annual allocation for wildfire events.

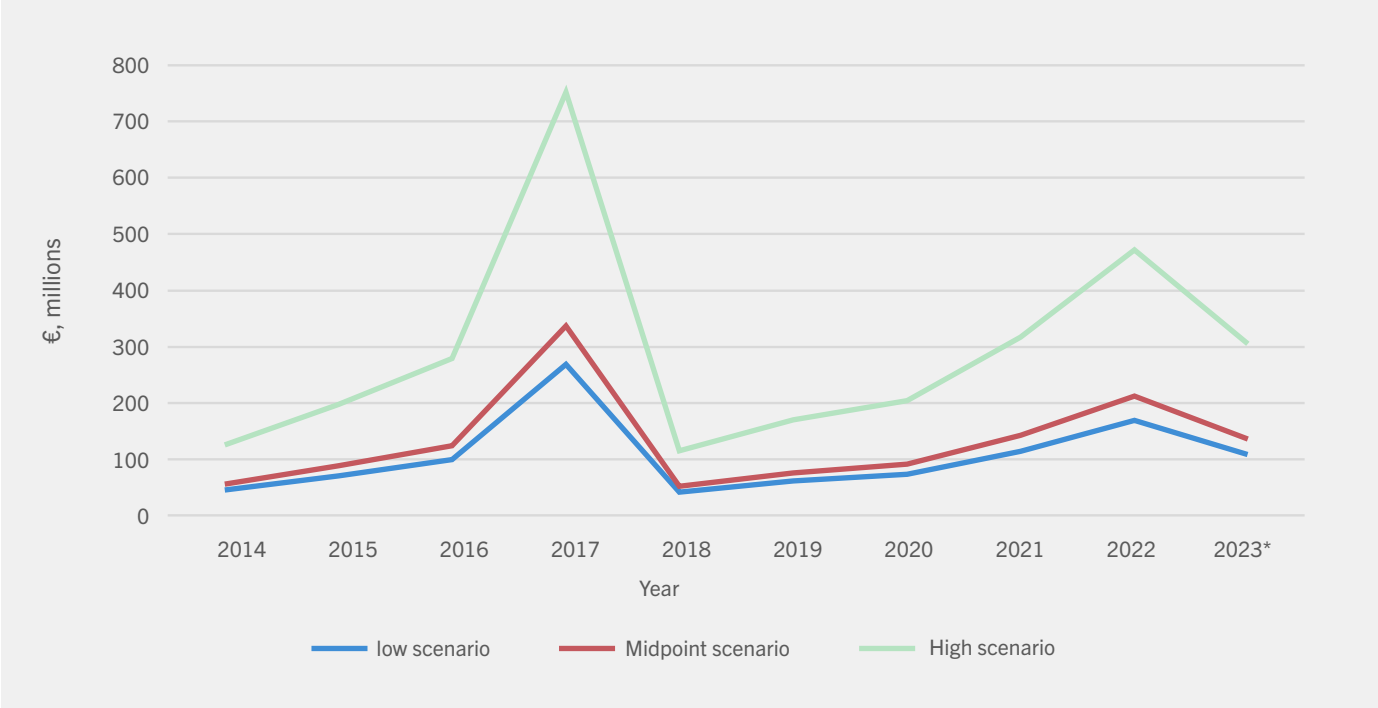
EMERGENCY OPERATIONS COST

The total cost for emergency operations associated with wildfire events ranges between €41 million and €752 million depending on the scenario assessed and the year observed (Figure 13). The proportion of costs associated with emergency operations varies across all events but is estimated to be between 13 percent (low estimate) and 35 percent (high estimate)[59] of total costs of the contingent liabilities

58 JRC EFFIS. Link.
59 The estimates were developed using data from EC - cohesion data (Link.) which include total direct damage estimates and emergency operation cost estimates per event in addition to the EUSF.

from each year. The spike observed in 2017 corresponds to the wildfires in Italy, Spain, and Portugal, resulting in a significant increase in the area burned and associated emergency response costs. On average, the cost of emergency operations is estimated to be between €105 million (low scenario) and €294 million (high scenario).

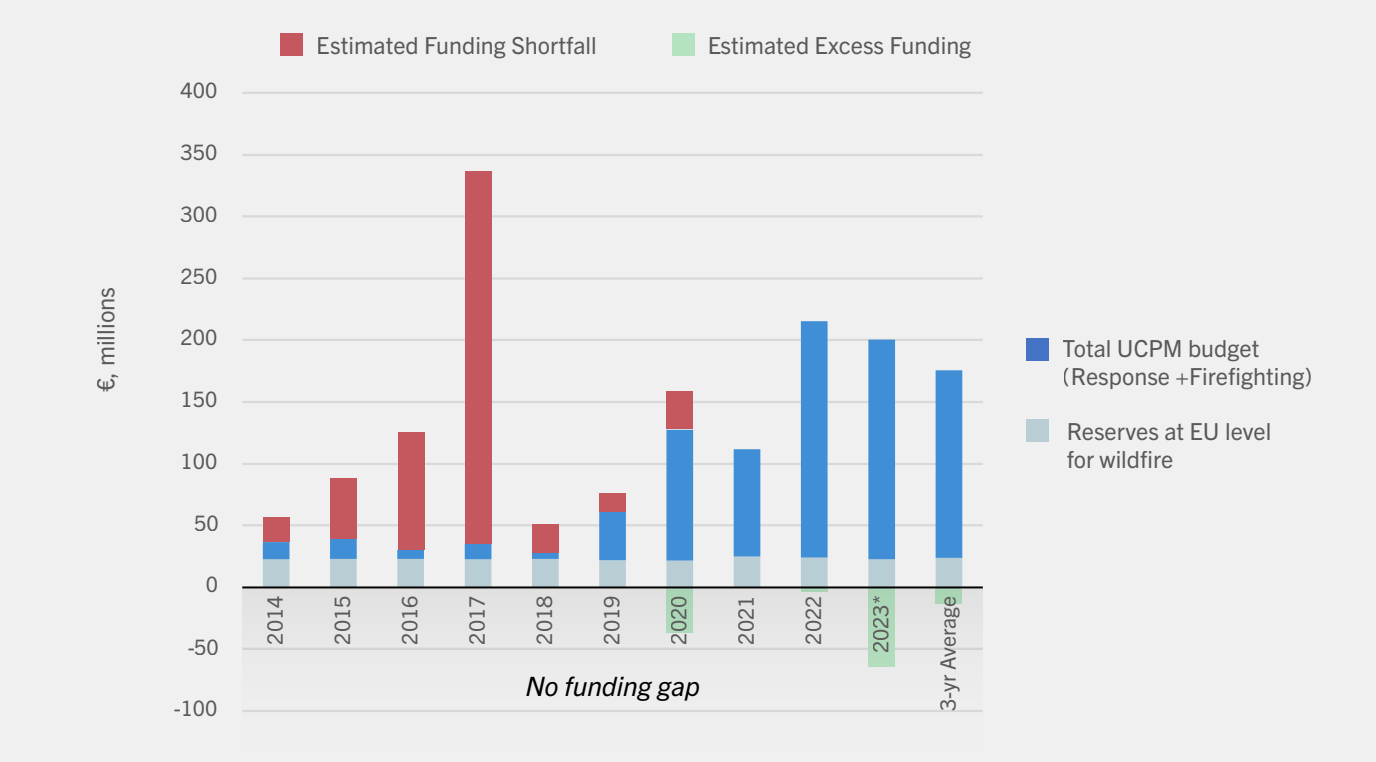
Figure 13: Estimated emergency operation costs



Source: World Bank.

An initial assessment compared Tier 1 allocations to estimated emergency operation costs, indicating that the recent rise in UCPM budget for wildfire emergencies has reduced the funding gap since 2019. Figure 14 shows the estimated funding gap based on historical emergency cost estimates for wildfire events across EU MS and Tier 1 funding arrangements and an estimate based on the most recent three-year (2021–2023) average costs and budget allocations, respectively. The funding gap is visually represented by the red columns in the graph, while the green columns indicate years where it is "estimated that no funding gap existed (that is, sufficient funds were available to cover emergency operation costs).

Figure 14: Wildfire emergency funding gap - Tier 1 funding



Source: World Bank.
*Note:** Estimates based on area burned by wildfires in Europe as of September 2023.

Analysis of the national reserves held by the EU MS combined with the UCPM budget associated with emergency operations costs for wildfire events shows no funding gap was estimated based on the average of the last three years (2021–2023). This is due, in part, to the increase in the amount allocated to the relevant UCPM budget lines between 2019 and 2022.[60]

During the historical period between 2014 and 2023, the largest funding gap of €301 million was estimated in 2017, and would require a 70 percent increase to the 2023 UCPM budget to cover similar losses in future years. This funding gap was caused by a combination of high losses (€337 million midpoint estimate, range of €233–717 million) and a modest level of funding at the time (€36 million). Comparing the emergency response costs in 2017 to the 2023 UCPM budget of €177 million shows that a 70 percent increase in the 2023 UCPM budget would be necessary to cover losses in similarly severe years.

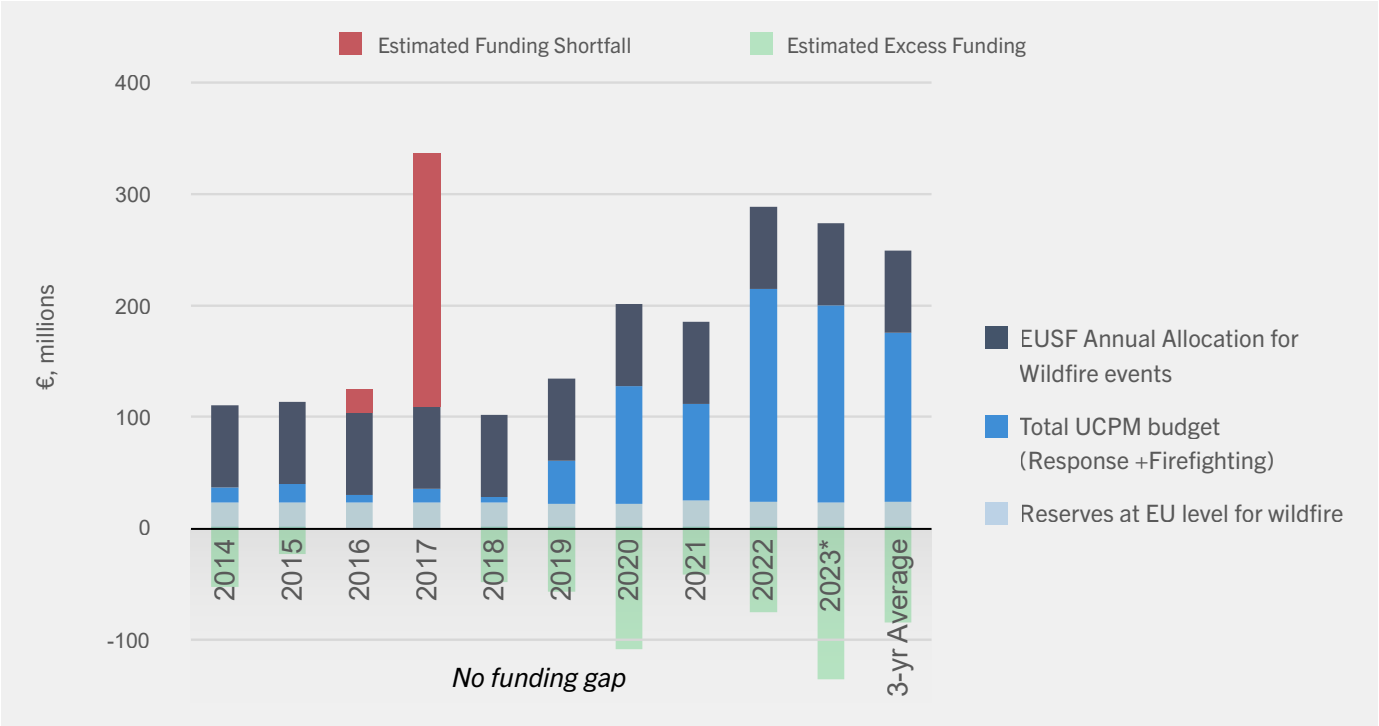
Between 2014 and 2019, there was an average funding gap of €84 million based on the midpoint scenario (range of €59–235 million). This indicates that there was insufficient funding was available within national reserves and relevant UCPM budget allocations (Tier 1).

A funding gap of around €190 million could occur based on the assumptions from the high scenario. Given the uncertainty surrounding the loss estimates for wildfire, this could better reflect future loss. However, the three-year average between 2019 and 2022 may better represent current practices, which indicates that enough funds are available to cover all emergency operation costs, although this varies depending on the assumed level of emergency operation costs in proportion to the overall cost.

60 Data from the UCPM indicate an overall increase of €294.9 million between 2019 and 2022. Specifically, in 2022, €149.5 million was allocated for response activities (a 20 percent increase since 2019), and €39.9 million was allocated to the rescEU transition (firefighting) (an 8 percent increase since 2019) within the MFF sub-budget from 2019 to 2022.

The initial analysis of emergency operation costs was revised to demonstrate the impact of adding the EUSF annual allocation to fund (or reimburse) emergency operation costs. The addition of the EUSF into the analysis was done to represent the additional support that could be granted to EU MS from the regional level. The results of this analysis are shown in Figure 15.

Figure 15: Emergency funding gap - Tier 2 funding



Source: World Bank.

The addition of the EUSF funding source indicates that adequate funding was available to cover emergency operation costs for wildfire each year except 2016 and 2017, which required €21 million and €227 million, respectively. However, there are limitations on the speed of disbursement from the EUSF, and funding from the EUSF is not guaranteed[61] for wildfires or any other hazard. In all other years between 2014 and 2023, funding covered wildfire events, although there is a chance that resources could have been depleted by earthquakes or floods. Furthermore, the additional resources provided by the EUSF reduced the 2017 funding gap estimate from €301 million to €227 million. Incorporating the EUSF in the three-year average between 2021 and 2023 would raise the funding buffer from €12 million to approximately €86 million, in excess of estimated losses.

TOTAL COST (THE SUM OF EMERGENCY AND DAMAGE COSTS)

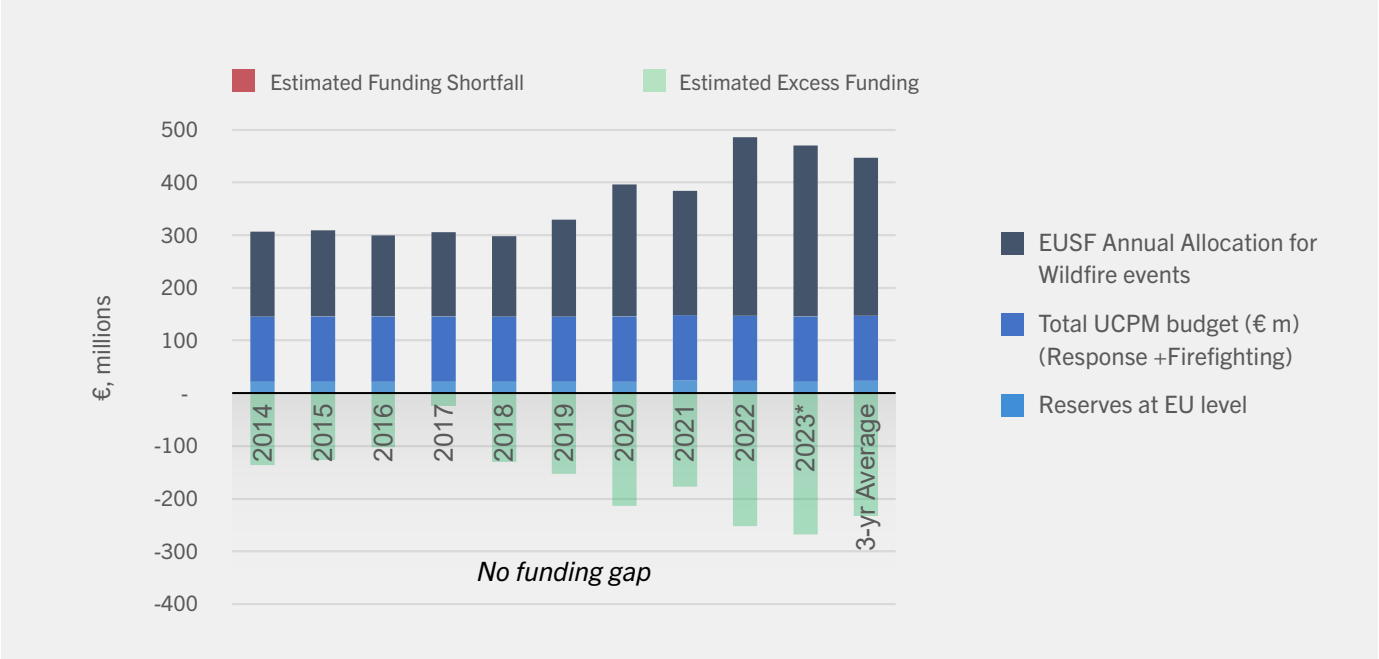
Additional analysis was undertaken to evaluate the adequacy of Tier 2 funding arrangements that increase costs to account for emergency costs and damage incurred. The extent of public sector damages fluctuates based on the occurrences of events in any given year. According to EUSF budget data, public sector damages typically constitute around 50 percent of total damages but can range from as low as 0.5 percent to as high as 83 percent. To accommodate this uncertainty, the low scenario assumes public sector damages to be 30 percent of total damages, while the high scenario increases this estimate to 80 percent.

61 The EUSF can only be activated at the request of the applicant state within the deadline of 12 weeks from the first damage occurred, demonstrating that the total direct damage exceeds the thresholds specified in Article 2 Regulation (EC) No. 2012/2002.

The Tier 2 arrangements are not intended to cover the entirety of public damages; hence a funding gap is expected. The purpose of this analysis is to emphasize the residual portion to develop the case for pre-positioned finance, that is, where pre-positioned DRF instruments could have offered additional financial protection. It also aims to quantify the historical magnitude of protection that may have been required. Additional assumptions were introduced to ascertain the proportion of total costs that these Tier 2 instruments will address.

Historically, the EUSF has covered a relatively small fraction of total costs, approximately 2.3 percent of estimated damages from wildfires (equivalent to €26 million per year on average) and has consistently hovered in the range of 2–3 percent. However, the outcomes of the analysis are highly sensitive to this assumed value. If a decision were made to increase EUSF allocations, even by a few percentage points, to cover a greater proportion of total costs, it could significantly reduce the funding gap. This underscores the importance of allocating resources based on where the need is greatest, whether for recovery (generally provided by the EUSF) or relief efforts (generally provided by the UCPM). Figure 16 shows the results of this analysis.

Figure 16: Total annual cost - funding gap midpoint scenario



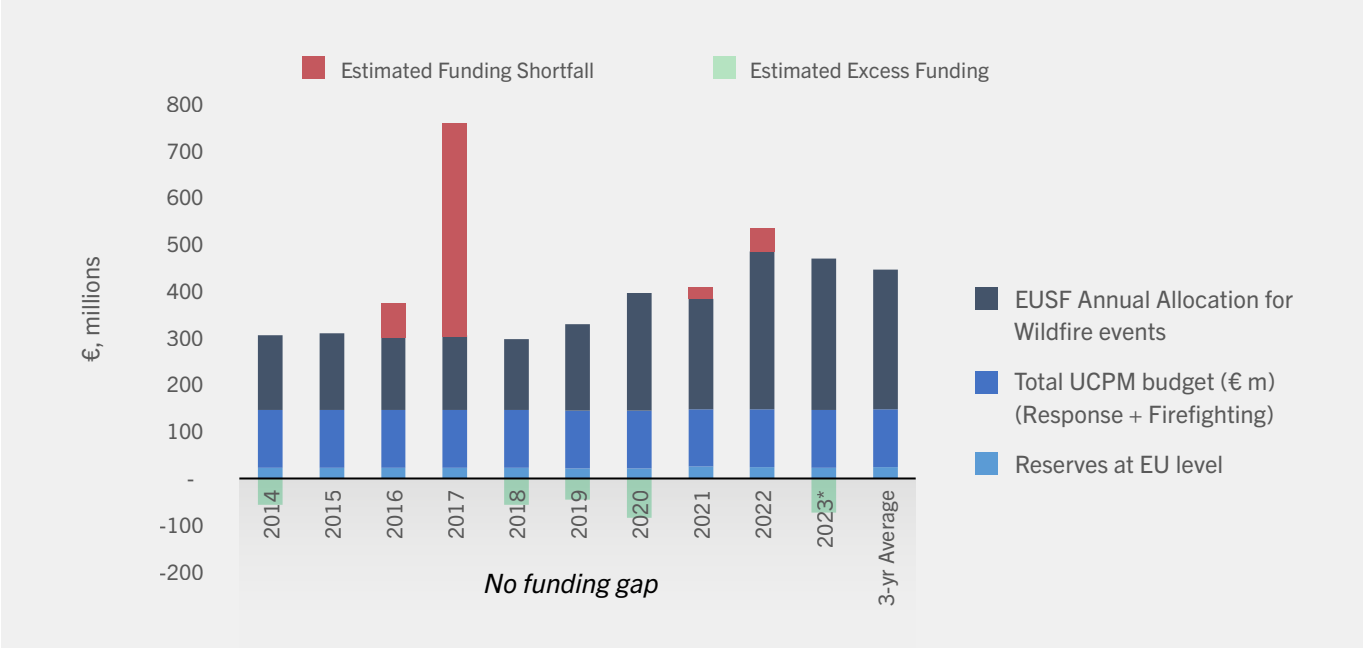
Source: World Bank.

The analysis suggests that Tier 2 instruments can sufficiently cover 2.3 percent of total costs from wildfire including 2017, meaning that 97.7 percent of the cost needs to be met from other financial instruments at the MS level. Based on the average experience from 2021 to 2023, continuing this practice would result in estimated excess funds ranging between €153 million and 255 million. However, this approach implies that the remaining 97.7 percent would need to be covered by other resources available to the EU MS affected by the event. This simplified analysis indicates potential flexibility for increased allocations from the EUSF to fund total costs related to wildfires, providing additional protection to EU MS and alleviating a significant financial burden. Further analysis is necessary to comprehend the implications of such a change, considering the variable nature of wildfire events and EUSF allocations for costs associated with other hazards. In addition, the EU should decide upon its risk appetite to inform what proportion of the damage should be covered at the regional level.

A 6.5-fold increase in funds for the UCPM and EUSF would result in a cost-neutral outcome where the three-year funding gap (2021–2023) is expected to

be zero based on the midpoint estimate; this could be targeted to reduce the funding gap. By adjusting the percentage of total costs that the EUSF and the UCPM could cover, it was found that if these instruments covered 10.6 percent of total costs the anticipated funding gap based on the midpoint (€299 million) would be zero, with a range of €99 million (surplus) in the low scenario and a €366 million funding gap in the high scenario. Figure 17 illustrates the potential shift in the funding gap profile (midpoint estimate) if this adjustment were implemented. This adjustment results in a more evenly distributed pattern of deficits and surpluses over the observed years. It is important to note that this calculation aims to neutralize the funding gap based on the three-year average, leading to larger cumulative deficits compared to cumulative surpluses over the observation period (primarily due to the large losses in 2017). Similarly, if the objective were to smooth expenditures for a cost-neutral outcome over the observation period (2014–2023), the EUSF and UCPM allocations would be designed to cover a slightly lower percentage of total costs, specifically 9.3 percent.

Figure 17: Total cost funding gap - midpoint scenario (10.6 percent of total costs)



Source: World Bank.

5.2. Drought results of the EU-Level Analysis

METHODOLOGY

The analysis relies on the estimate provided by the JRC, which suggests that current annual losses from drought in the EU and United Kingdom amount to approximately €9 billion.[62] These losses span various impacts, including diminished public water supplies, agricultural losses, damage to buildings and infrastructure from soil subsidence, decreased inland water transportation, and reduced energy production. Although some losses in these categories may not be considered contingent liabilities for the EU MS, no adjustments have been made to the loss estimates. This is due to the lack of sufficient information available to make accurate assessments of these contingent liabilities or the proportion of impacts

62 JRC. 2020. *Global Warming and Drought Impacts in the EU.* Technical Report. PESETA IV Project - Task 7 - Drought. Link.

within the United Kingdom or other non-EU MS. However, a consistent approach has been upheld by referencing historical data on the estimated proportion of damages covered by the respective financing instruments for wildfires. This methodology helps determine the potential extent to which total drought-related costs may be covered by these financing instruments.

According to the JRC, if the future climate affects present-day society, the overall drought damage in the EU and United Kingdom will experience a slight rise with a 1.5°C global warming (reaching €9.7 billion annually). However, this damage escalates significantly with further warming, reaching €17.3 billion per year at 3°C. These estimates form the basis for providing loss estimates under different scenarios in the funding gap analysis.

Regarding drought-related financing, the budget within the UCPM allocated to address drought-related expenses is assumed to equal the average allocation designated for emergency response activities between 2020 and 2022 (€104 million). This is slightly lower than that for wildfire estimates due to the specific allocations earmarked for firefighting purposes. The EUSF has never provided support for drought - only events, partly due to the complexities in defining the beginning and end of such events.[63] To address this, we hypothetically consider the following scenario: given that 15 percent of the annual allocation in the EUSF is designated for wildfire support[64] and the average annual total cost of wildfire events amounts to €1.14 billion, while the average annual total cost of drought is approximately €0.650 billion,[65] we assume that the EUSF would theoretically allocate 8.6 percent to drought events based on these figures (€69 million).

Considering the nature of drought hazards, and the challenges in identifying the exact time frame of the impact, it is not feasible to determine an emergency cost component and only total cost will be analyzed. Therefore, the analysis conducted here focuses solely on coverage for the total cost component to be covered by the relevant Tier 2 instruments. These include estimated national reserves held by EU MS combined with the UCPM budget allocated for general emergency response activities, along with an estimate of the EUSF annual allocation for drought-related events. This approach overlooks the timing of potential fund disbursements, which could potentially increase as the severity and duration of the drought escalates.

5.3. Total Drought Cost

METHODOLOGY

The analysis evaluated the adequacy of the Tier 2 funding arrangements to finance the total costs of drought events across the EU and United Kingdom. The analysis provides a comparison of average total costs from droughts with financing instruments. However, given that these instruments are not designed to cover all costs, funding gap arises as expected. Further research is needed to isolate the public sector portion of these costs and focus on the timing, considering the chronic and extensive nature of drought hazards.

Similar to the wildfire analysis, three scenarios were created to address the uncertainty regarding how much of the total costs the UCPM and EUSF will cover for drought events. Including these scenarios in the analysis compensates for the lack of any assumption regarding what portion of the total costs represents contingent liabilities, given the relatively small funding provided compared to the magnitude

63 There have been two successful applications for droughts (2012 in Romania and 2016 in Cyprus) however these have been classified as droughts and fires.
64 Link.
65 Link.

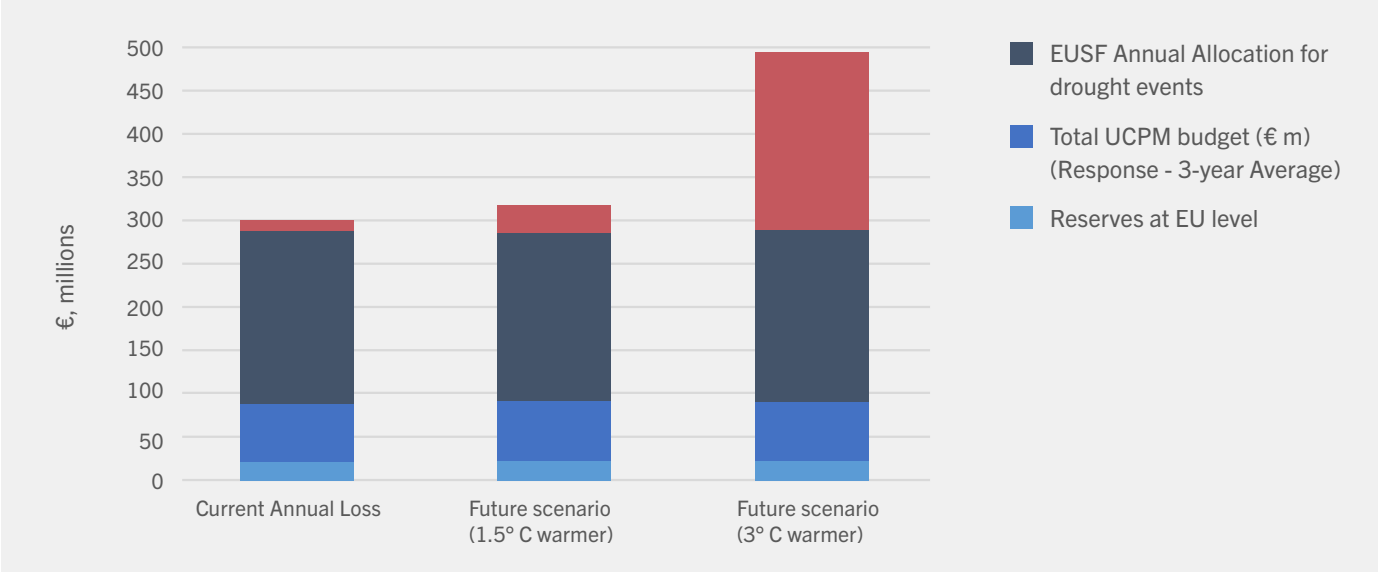
of the estimated losses. The scenarios are as follows:

- **The low-range scenario** assumes 2 percent of total drought costs (equivalent to €180 million per year on average based on current loss estimates).
- **The midpoint scenario** assumes 2.3 percent of total drought costs (equivalent to €209 million per year on average based on current loss estimates).
- **The high-range scenario** uses a value of 3 percent of total drought costs (equivalent to €270 million per year on average based on current loss estimates).

Estimated funding gap

Based on current annual drought losses, the estimated funding gap is €13 million per year. Figure 18 illustrates the potential funding gap using the midpoint scenario for current annual drought losses and potential losses under two future scenarios (1.5°C warmer and 3.0°C warmer). Put simply, if the UCPM and EUSF were used to cover all public and private sector costs associated with drought hazards for EU MS, the remaining €13 million would need to be covered by the EU MS or the private sectors within each country. It is important to note that the loss estimate includes some non-EU MS, such as the United Kingdom, for which there are not enough detailed data to quantify their portion of these losses. However, it is plausible to suggest that their inclusion means the funding gap is lower in reality. When comparing these values to the alternate scenarios, the low-range estimate indicates no funding gap (€16 million of excess funding available on average each year), whereas the high-range estimate suggests that the gap could reach €74 million annually.

Figure 18: Drought funding gap (midpoint scenario)



Source: World Bank.

The projected growth of the funding gap over time, aligning with anticipated temperature increases in the region, reveals potential funding gap between €29 million and €323 million annually depending upon the climate warming scenario used. Using the estimates derived for the 1.5°C warmer scenario, the midpoint annual funding gap estimate increases by 125 percent to €29 million annually (low-range estimate: no gap; high-range estimate: €29 million). Under the 3.0°C warmer scenario, the midpoint annual funding gap estimate increases 15-fold compared to the current annual loss, reaching €206 million annually (low-range estimate: €150 million; high-range estimate: €323 million). This notable increase in the projected funding gap over time suggests that the financial demands for addressing drought-related costs are likely to escalate significantly in the future.

An additional conclusion drawn from the analysis is the limitation of relying solely on averages, which may mask variability in annual outcomes and fail to capture the potential severity of extreme drought events. Without accounting for this variability, the analysis may underestimate the true extent of the funding gap, particularly in years characterized by more extreme climate events or natural fluctuations. Therefore, there is a need for enhanced methodologies that account for variability and extreme scenarios to provide a more comprehensive understanding of the potential financial challenges associated with droughts. This highlights the importance of adopting adaptive and flexible funding strategies capable of responding to the unpredictability and variability inherent in climatic conditions.

The magnitude of losses from wildfire and drought, while marginal in comparison to earthquake and flood, creates additional pressure on already constrained response and recovery budgets. The magnitude of losses from earthquake and floods aggregated varies between €13 billion and over €50 billion for the low liability scenario, where the EU assumes a smaller proportion of the cost. In comparison, losses from wildfire range between €16 million and €717million, depending on the scenario and magnitude of the event, while drought saw a consistent funding gap between €29 million and €323 million (see Table 4).

Table 4: Range of regional-level funding gap from Phase 1 and Phase 2 analysis in millions (€)

	RANGE OF ESTIMATED LOSS EUR € MILLION	TYPE OF MODEL
Phase 2 – Drought	29–323	10-year historical measures
Phase 1 - Earthquake and flood	13,125–49,643	Probabilistic measures

In a year where a major earthquake and flood has already occurred, there would be no funding available at the EU level to respond to a wildfire or drought event. This reinforces the finding from Phase 1 that there is scope for additional financial instruments at the EU level and/or there is a need to incentivize national governments to invest in DRF.

5.4. Wildfire Results: Country Case Studies

METHODOLOGY

The methodology applied to calculate potential wildfire losses for each country case study is consistent with the EU-level analysis. This involves calculating the average cost per hectare burned and applying it to the total number of hectares documented for each country based on the EFFIS database.[66] Details of this overall methodology are included in Annex 5. The case studies concentrate solely on the total cost rather than isolating emergency operation costs, as this represents the overall financial burden on each country from wildfire events. Assumptions regarding the proportion of public asset losses to the total loss are retained to estimate contingent liabilities for each country, though this may fluctuate among countries and wildfire events in any given year. To address this uncertainty, low-range and high-range scenarios are incorporated to provide insight into the sensitivity of the analysis results based on this

66 JRC EFFIS. Link.

assumption. The low scenario assumes public sector damages to be 30 percent of total damages, while the high scenario increases this estimate to 80 percent.

Regarding financing, the case studies rely on a unified estimate incorporating various available financing instruments for each country. This encompasses country-specific estimations of reserve and contingency funds, as detailed in Annex 8. These estimations align with those utilized in EDPP Phase 1, which examined the fiscal and economic impacts of earthquakes and floods. These amounts are combined with the UCPM budget associated with emergency operations costs for wildfire events.

A historical funding gap analysis similar to the EU-level analysis is unfeasible due to limited historical data on reserves and contingency funds across each country. Conducting this type of analysis in the absence of such data could lead to an inaccurate portrayal of the financial capacity to handle losses at the time. In place of this, each case study evaluates potential financial impacts using 2023 total cost estimates and a three-year average (2021–2023) based on historical loss data. Additionally, a scenario is included based on the year where the highest wildfire losses were recorded in each country, as identified in the EFFIS database, which serves as a proxy for gauging potential funding gaps during extreme years.

SUMMARY OF CASE STUDY FINDINGS

Several high-level differences were observed across each of the scenarios that provide some insight into each country's financial preparedness for wildfire events, highlighting areas where additional measures may be necessary to address potential funding shortfalls in extreme circumstances.

Bulgaria: The funding gap analysis for Bulgaria indicates no immediate funding gap under the midpoint scenario, although potential gaps may arise in extreme years, particularly under the high-range scenario. In 2023, estimated reserves and contingency funds sufficiently covered the estimated costs, but a shortfall of €22 million would occur if recent three-year average losses from 2021–2023 were considered but could be covered by the inclusion of UCPM and EUSF funds. Notably, if high-range assumptions were applied to historical cost estimates, a funding gap of €130 million would emerge.

Croatia. Similar to Bulgaria, Croatia faces no funding gap under the midpoint scenario, with reserves and contingency funds covering estimated costs in 2023. However, if high-range assumptions were applied to historical cost estimates, a funding gap of €220 million would arise.

Greece. Greece faces a funding gap across all scenarios due to inadequate reserves and contingency funds relative to estimated costs. Despite additional financing options from the UCPM and EUSF, the shortfall remains high, ranging from €259 million under the three-year average between 2021 and 2023 to €1.4 billion under the high-range assumptions.

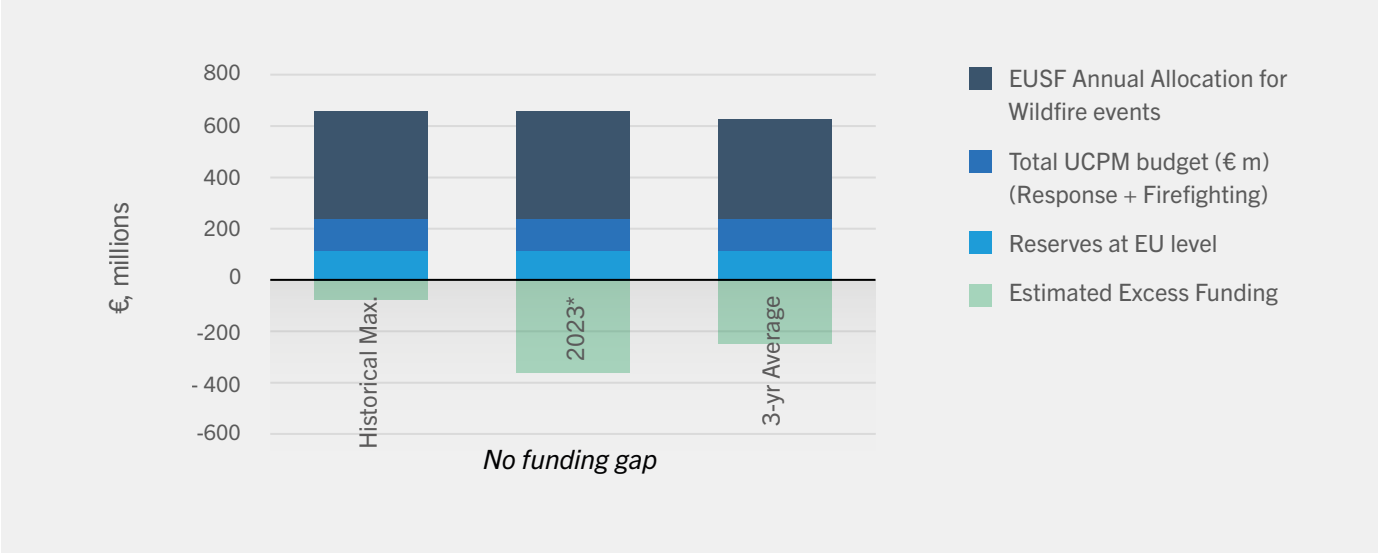
Italy. Italy shows no funding gap in any scenario due to ample reserves and contingency funds compared to estimated costs. Even in scenarios that consider the year with the highest historical cost estimates, reserves and contingency funds remain sufficient.

Romania. Romania, like Italy, demonstrates no funding gap across scenarios due to sufficient reserves and contingency funds relative to estimated costs. In 2023, these funds covered estimated costs, with similar results under recent three-year average losses and high-range assumptions.

5.5. Bulgaria

The funding gap analysis conducted for Bulgaria indicates no funding gap based on the midpoint scenario, but a potential gap may emerge in an extreme year under the high-range scenario. The results of the midpoint estimate analysis are shown in Figure 19. In 2023, the estimated reserves and contingency funds (€116 million) adequately cover the €55 million estimated costs. When considering the recent three-year average (2021–2023) loss (€138 million), these funds would fall short by €22 million, though the additional UCPM and EUSF funding would be sufficient to cover the residual costs. According to EFFIS data, the most severe year was 2000, with 57,406 ha burned, equating to a cost estimate of €340 million. If a similar year were to occur, the combination of financing instruments would suffice to cover these costs based on the midpoint scenario. However, if the high-range assumptions are applied to the cost estimates from 2000, the estimated cost is €546 million and the combined financial capacity across all available instruments would be insufficient to cover the total costs associated with such an event and result in an estimated funding gap of €130 million.

Figure 19: Total Cost - Funding Gap Midpoint Estimate

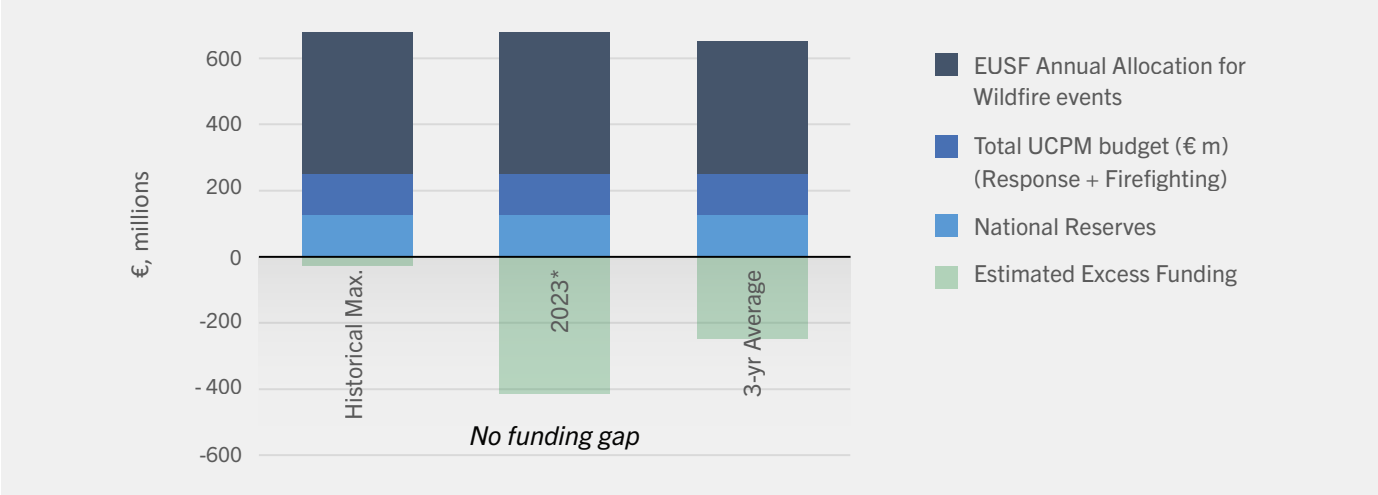


Source: World Bank.

5.6.Croatia

The funding gap analysis conducted for Croatia indicates no funding gap based on the midpoint scenario, but a potential gap may emerge in an extreme year under the high-range scenario. The results of the midpoint estimate analysis are shown in Figure 20. In 2023, the estimated reserves and contingency funds (€128 million) adequately cover the €15 million estimated costs. When considering the recent three-year average loss (€107 million), these funds are still sufficient to cover the total costs with no requirement for additional financing from the UCPM and EUSF. According to EFFIS data, the most severe year was 2000, with 68,171 ha burned, equating to a cost estimate of €403 million. If a similar year were to occur, the reserves and contingent funds would be insufficient to cover the entirety of these costs based on the midpoint scenario, but the additional financing available from the UCPM and EUSF would cover the shortfall. However, if the high-range assumptions are applied to the cost estimates from 2000, the estimated cost is €649 million and the combined financial capacity across all available instruments would be insufficient to cover the total costs associated with such an event and result in an estimated funding gap of €220 million.

Figure 20: Total Cost - Funding Gap Midpoint Estimate



Source: World Bank.

To finance expenditure after a disaster, Croatia utilizes funds from the budget reserve and dedicated budget lines.[67] A budget reserve is set aside each year for unforeseen purposes; it is not earmarked for disasters and may be used for a range of different purposes. The budget reserve may amount to 0.5 percent of planned budget revenue in any given year. Dedicated budget lines that may also be used include item A539025 "compensation for damages caused by natural disasters" and A539020 "assessment of damages from natural disasters." Table 5 indicates the amount allocated to item A539025 over 2013–2018.

Table 5: Amount allocated for item A539025, 2013-2018 (€, millions)

YEAR	CONFIRMED DAMAGE (€, MILLIONS)	THE AMOUNT OF ASSISTANCE ALLOCATED FOR THE REPAIR OF DAMAGE (€, MILLIONS)						
		2013	**2014**	**2015**	**2016**	**2017**	**2018**	**Total**
2013	27.14	2.63	0.05	—	—	—	—	2.68
2014	236.99	—	4.67	2.57	—	—	—	7.25
2015	246.5	—	—	—	—	—	—	0
2016	163.51	—	—	—	2.65	—	—	2.65
2017	330.9	—	—	—	—	13.21	—	13.21
2018	24.02	—	—	—	—	—	2.65	2.65
Total		**2.63**	**4.72**	**2.57**	**2.65**	**13.21**	**2.65**	

Source: Primorac, 2019 with figures converted from kuna to euro.

Table 6 presents analysis of the amount spent from both budget lines over 2013–2018. 1.35 million was paid from the budget reserve in 2015 to the State Office for Reconstruction and Housing Care for the rehabilitation of flood damage and to the Croatian Mountain Rescue Service for the restoration of necessary equipment damaged during the rehabilitation of damage from floods and winter storms in 2014. In 2017, €1.01 million was paid from the budget stock to the Croatian Fire-Fighting Community for work carried out to address wildfires.

67 Assistance after a disaster and related risks are regulated by the Act on Mitigation and Elimination of Consequences of Natural Disasters (OG 16/19) and the Ordinance on the Registrar of Damages of Natural Disasters (OG65/19).

Table 6: State expenditure, 2013–2018 (€, millions)

YEAR	COMPENSATION FROM NATURAL DISASTERS (1) (€, MILLIONS)	DAMAGE ASSESSMENT FROM NATURAL DISASTERS (2) (€, THOUSANDS)	ELIMINATION OF CONSEQUENCES NATURAL DISASTERS (3) = (1) + (2) (€, MILLIONS)	EXPENDITURE FROM THE BUDGETARY STOCK (4) (€, MILLIONS)	TOTAL GOVERNMENT EXPENDITURE (3) + (4) (€, MILLIONS)
2013	2.56	2.52	2.57	—	5.20
2014	5.19	1.99	5.20	—	5.20
2015	2.57	1.99	2.57	1.35	3.92
2016	2.65	0.80	2.66	—	2.66
2017	13.21	3.19	13.21	1.01	14.22
2018	2.65	9.56	2.66	—	2.66

Source: Primorac, 2019 with figures converted from kuna to euro.

The Ministry of Finance also uses budget reallocations to finance unplanned needs. Amendment of the PFM Act, Articles 58 and 59, removes restrictions on the use of budget reallocations after a disaster. The use of budget reallocations—from which budget user to which budget user—is reported twice a year.

At the subnational level, funding for disasters comes from existing budget lines and/or budget reallocations. Local and regional governments can also ask for additional assistance from the state budget if the "value of total direct damage is at least 20 percent of the value of the original income of the local self-government unit for the previous year or if the disaster has reduced the value of property in the area of local self-government units by at least 30 percent."[68]

Data on disaster risks are currently being collected by different entities, but the quality of data differs greatly. For instance, the Ministry of Agriculture is currently collecting data on the potential impact of disasters on agriculture. The city of Zagreb is calculating the risk of earthquakes. The Ministry of Interior carries out risk assessments for different perils on a regular basis as well as in charge of coordinating national risk assessments (2015, 2019, and an update ongoing). The Ministry of Interior's National Assessment identifies 28 risks spread across 11 perils, with scenarios drawn up for each of the risks, and the consequences of the event evaluated by impacts on people's lives and health, the economy, social stability, and politics. The listed 11 selected risks are plant diseases, animal diseases, extreme temperatures, epidemics and pandemics, industrial accidents, floods caused by spills of terrestrial water bodies, earthquake, open-type fires, snow and ice, drought, and water salinization. The Ministry of Finance holds a Damage Register which includes self-reported data from budget users on the type of damage, the time of the disaster, and the area affected by the disaster. Data from the Damage Register are published on the Ministry of Finance's website. There is not, however, at present, a central coordinating body for all data. Moreover, weaknesses in the data that are being collected and analyzed have also been noted. For instance, it was noted by the Ministry of Interior that more data are needed on expected damage and losses, vulnerabilities, and exposure.

Disaster risks are not currently included in the fiscal strategy, medium-term forecasts, or annual budgets. Moreover, line ministries and subnational governments are not currently being asked to provide this information in their plans and budget submissions. They do, however, provide information on damages/

68 Law on Mitigation and Elimination of Consequences of Natural Disasters, OG 16/19.

losses as needed through the registrar of damages held in the Ministry of Finance and are required to conduct a regular risk assessment, which includes the consideration of disaster risks.

The Ministry of Finance is not tracking and reporting on disaster expenditure or the impact of disaster expenditure. The Auditor General has however carried out financial, compliance, and performance audits that relate to disaster risks. For instance, the budget reserve is audited, reports are produced twice a year on the use of in-year budget reallocations, and special reviews have taken place, for example, on the use of EUSF funds and the state inventory. Moreover, the Auditor General has given recommendations on how to improve the performance of certain financing instruments, for example, to improve clarity on the purpose and guidelines in the use of the budget reserve.

Insurance

A new law is being introduced in Croatia which mandates landlords to have property catastrophe insurance for the buildings. This is a good step to ensure protection against disasters, but it is not clear how payouts would be split between landlords and tenants, if at all. Currently for accessing home loans, banks will recommend a purchase of a household insurance policy however the banks do not require catastrophe insurance to be purchased, only fire risks.

State-owned enterprises, especially larger companies that own roads, ports, and airports, will purchase insurance for these assets which will include catastrophe cover. In Croatia, the airports are insured with Croatia Insurance. Buying insurance is up to the commercial entity because of which the level of protection can vary by type of asset and sector. For Croatia the purchase of insurance for public assets will be at the behest of local governments and thus the amount of coverage may differ. However, it was not believed that many local governments would not have insurance for their assets.

Wildfire risk is included in household fire policies, as there is no specific exclusion for wildfires. This has been confirmed by speaking to private insurance companies in Croatia. It is therefore expected that household fire policies would include damage from wildfires in most EU MS. Approximately 25 percent of homeowners have household insurance that includes wildfire with 16 percent of this proportion with cover for earthquakes. The consensus among insurers on the low penetration is that the government will support citizens when there is a large disaster and therefore there is a lack of will to purchase insurance. The ad hoc payouts from the government will also affect take-up in other sectors of insurance such as in agriculture insurance which often provides cover for drought.

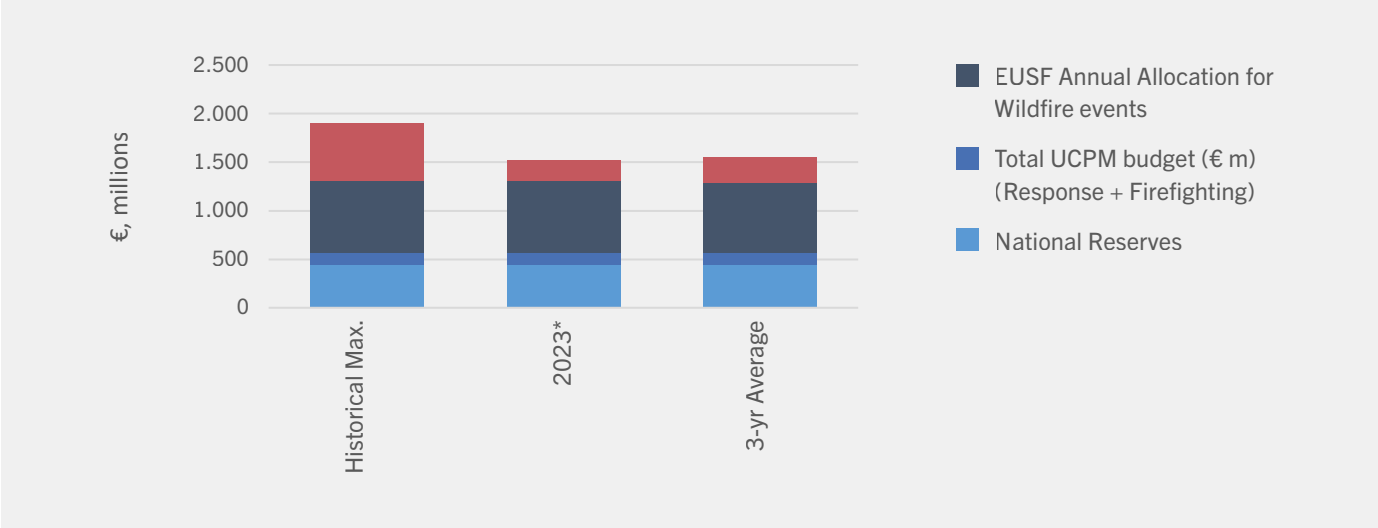
The motor third party liability (MTPL) market in Croatia is the largest non-life insurance class of business. Croatia has compulsory MTPL schemes, and the non-life insurance industry would like to build off this coverage to increase awareness of the value of insurance in the population, especially for catastrophes, particularly earthquakes in Croatia.

Croatia has a government-subsidized agriculture insurance scheme which does not have high levels of penetration. The low levels of penetration could be due to ad hoc payments made to farmers by the local governments, after an event. The publicly available statistics from insurance regulators in Croatia do not provide the breakdown of this information, but it is understood that the business is relatively unprofitable and written only by a handful of insurers.

5.7. Greece

The funding gap analysis conducted for Greece indicates a funding gap based on the midpoint estimate across each of the scenarios. The results of the midpoint estimate analysis are shown in Figure 21. In 2023, the estimated reserves and contingency funds (€447 million) are inadequate to cover the €952 million of estimated costs. When considering the recent three-year average loss (€976 million), the combined financial resources available across reserves, contingency funds, and the UCPM, and EUSF funding would be insufficient to cover the total costs and result in a shortfall of €259 million. According to EFFIS data, the most severe year was 2007, with 225,734 ha burned, equating to a cost estimate of €1.335 billion. If a similar year were to occur, an estimated funding gap of €587 million would emerge despite the availability of additional financing from the UCPM and EUSF. Based on the high-range assumptions, the cost estimates from 2000 equate to €2.148 billion, resulting in an estimated funding gap of €1.4 billion.

Figure 21: Total Cost - Funding Gap Midpoint Estimate

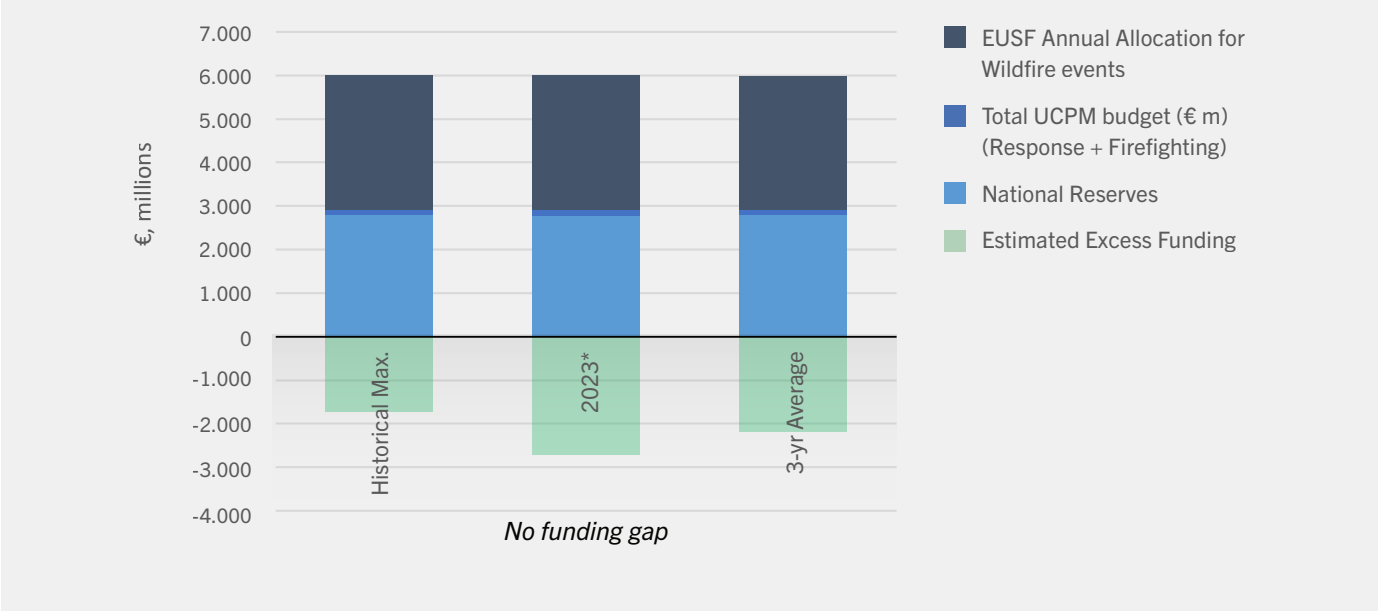


Source: World Bank.

5.8. Italy

The funding gap analysis conducted for Italy indicates no funding gap based any of the scenarios due to the high level of reserves and contingency funds relative to the total estimated costs from wildfires. The results of the midpoint estimate analysis are shown in Figure 22. In 2023, the estimated reserves and contingency funds (€2.791 billion) adequately cover the €391 million estimated costs. These funds would also be sufficient to cover the estimated costs based on the recent three-year average loss (€883 million). According to EFFIS data, the most severe year was 1981, with 229,850 ha burned, equating to a cost estimate of €1.359 billion. If a similar year were to occur, the reserves and contingency funds would suffice to cover these costs based on the midpoint scenario. If the high-range assumptions are applied to the cost estimates from 2000, the estimated cost is €2.187 billion, and the estimated reserves and contingency funds would suffice to cover these costs.

Figure 22: Total Cost - Funding Gap Midpoint Estimate



Source: World Bank.

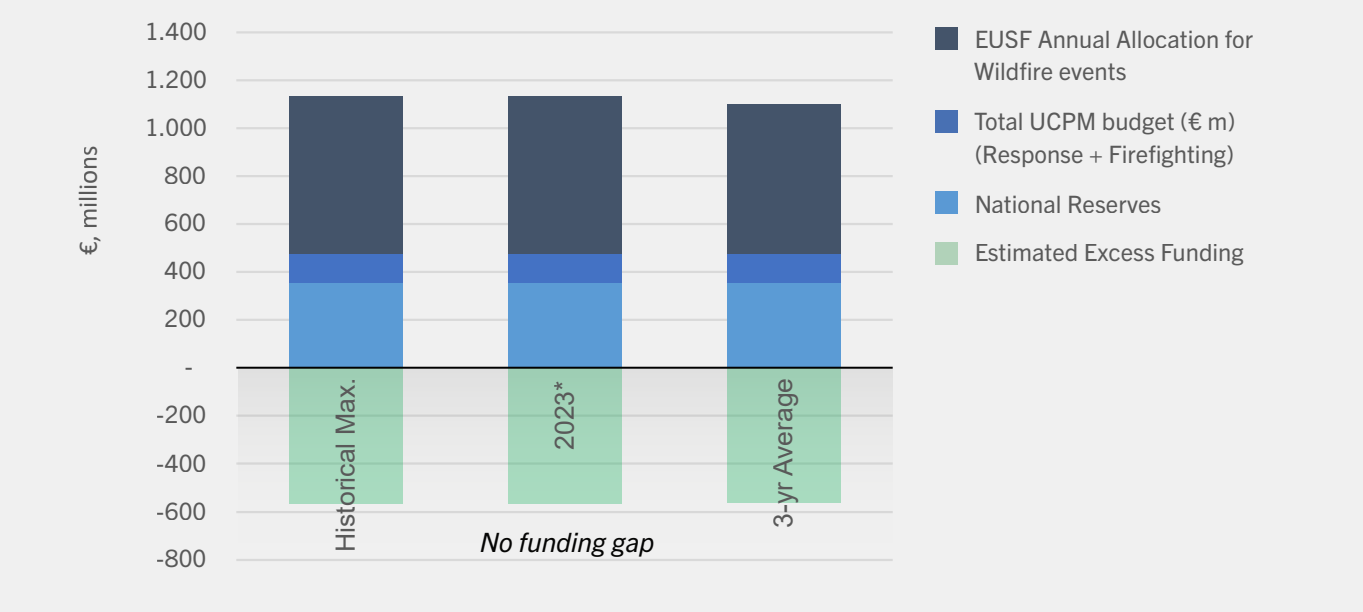
Analysis of expenditure by the National Fire Brigade over 2020–2023 indicates that the government has increased expenditure on forest firefighting. In 2020, it spent an estimated €151 million, which rose to €178 million in 2023.[69] Over this period, the government invested more in its air fleet (€86 million in 2020 to €104 million in 2023), in general budget lines for strengthening forest firefighting (€7 million in 2020 to €19 million in 2023), and in purchasing firefighting vehicles (€2 million in 2020 to €28 million in 2023).[70]

5.9. Romania

The funding gap analysis conducted for Romania indicates no funding gap based on any of the scenarios due to the high level of reserves and contingency funds relative to the total estimated costs from wildfires. The results of the midpoint estimate analysis are shown in Figure 23. In 2023, the estimated reserves and contingency funds (€354 million) adequately cover the €91 million estimated costs. In Romania, 2023 was also the most severe year for wildfires according to EFFIS data, with 15,308 ha burned. These reserves and contingency funds would also be sufficient to cover the estimated costs based on the recent three-year average loss (€64 million). If the high-range assumptions are applied to the cost estimates from 2023, the estimated cost is €146 million, and the estimated reserves and contingency funds would suffice to cover these costs.

69 The figure is an estimate as it does not include related expenditure which may be captured under additional budget lines.
70 Government of Italy. 2024.

Figure 23: Total Cost - Funding Gap Midpoint Estimate



Source: World Bank.

To finance expenditure after a disaster Romania utilizes funds the from the Government Reserve Fund and the Government Intervention Fund. These funds are specified in Article 30 of the 2002 Public Finances Act (500/2002); the size of the Intervention Fund is not set out in legal provisions and has fluctuated over recent years. The Intervention Fund is earmarked for post-disaster expenditure and can be topped up from the Reserve Fund (which is not earmarked). The amount allocated to the Intervention Fund is determined on analysis of historical expenditure.

Table 7: Romania reserve funds

DIMENSION	GOVERNMENT RESERVE FUND	GOVERNMENT INTERVENTION FUND
Scope	Urgent or unexpected spending occurring during the budget cycle	Urgent action to mitigate the effects of natural disasters and supporting affected persons
2019 initial allocation (RON, millions)	99.0	1.0
2021 initial allocation (RON, millions)	597.7	1.0

Source: UNICEF. 2022. Policy Brief on Financing Health Emergencies in Romania: The Response to COVID-19.

Different line ministries are responsible for different disasters and will utilize their own budget lines as needed. For example, the Ministry for Development, Public Works, and Administration is responsible for the aftermath of an earthquake, the Ministry of Agriculture and Rural Development is responsible for droughts, and the Ministry of Environment, Water, and Forests is responsible for floods. Should additional funding be required after a disaster, the Ministry of Finance uses budget reallocations, as needed, to meet unplanned needs. Moreover, legal provisions stipulate that 10 percent of all public institutions' yearly budget is withheld and only released in the second semester, subject to the government's review

of budget execution.[71] This cautious spending enables the government to relocate funds, as needed, and/or withhold funds for unplanned events.

Local governments largely depend on intergovernmental transfers for funding their expenditures.[72] Approximately 70 percent of local government revenue is made up of allocations from the state budget; the rest consists of own revenue.[73] Total revenue is equally divided between non-earmarked revenue, which local governments are free to allocate according to local priorities, and earmarked revenue which must be spent on the services and expenditure items specified in the underlying conditionalities and regulations. In the context of disasters, local governments will use their existing resources and budget lines, make budget reallocations where needed, and request additional funding from the Reserve Fund should the need arise.

In addition to budgetary instruments, the World Bank provided Romania with CAT DDO in 2018 as a contingency credit, which served as an additional funding source alongside the national disaster reserves and EUSF mechanism. However, the COVID-19 pandemic led to the complete exhaustion of the credit line. A new CAT DDO is under development but is not expected to be available until July 2024.

Disaster risks are currently included in Romania's Fiscal and Budgeting Strategy. The strategy estimates the budget impact of four different disaster scenarios. The estimates were calculated through utilization of fiscal risk model, based on disaster scenarios and utilizing data from the RO-RISK platform. Romania's RO-RISK project facilitates the exchange of data and information on risk exposure, vulnerabilities, and existing risks for authorities and the population. The fiscal and budgeting strategy notes that the most important risks Romania may face are earthquakes and floods.

The information on disaster risks, contained in the Fiscal and Budgeting Strategy, is not currently updated to inform annual appropriations of budget users. Moreover, as noted in a recent review,[74] there is a need to strengthen Romania's Medium-Term Expenditure Framework to deliver credible capital expenditure ceilings and incorporate disaster risks. Weaknesses in Romania's public investment management (PIM) system have also been noted, notably in ensuring access to budget funding for new projects and securing adequate funding for existing projects. Line ministries and subnational governments are not requested to consider and incorporate disaster risks into their plans and budget submissions. In making improvements to budgeting practices over the medium term, particularly for annual and capital expenditure, more could be done to explicitly consider disaster related risks.

The Ministry of Finance is implementing performance-based budgeting in select line ministries with the objective of enhancing the efficiency of public spending.[75] Three ministries should execute their budgets based on budget programs in 2024. This process will improve coordination of public policies and spending and lay the ground for a systemic approach to priority setting, planning, and budgeting. This again, as part of reforms to strengthen current planning and budgeting practices could support the greater integration of disasters into the budget cycle—shifting the focus from the management of inputs to a process based on results and achievement of policy objectives.

At present, the Ministry of Finance is not currently tracking disaster-related expenditure or the impact of disasters on government revenue. There is no systematic reporting of disaster risks apart from what it included in the fiscal and budgeting strategy. Moreover, data on disasters and climate change are currently held within different institutions and

71 The Reserve Fund and Intervention Fund are exempt from this rule.
72 The share of local government expenditure in general government expenditure was 22 percent in 2021.
73 World Bank. 2022b. *Technical Support to the Ministry of Romania. Modernizing the Intergovernmental Transfers Systems - Assessment of the Current Situation.*
74 Nadoll, J. 2017. *Unblocking Public Investment Bottlenecks in Romania: A Report on Systemic Causes of Delays and Inefficiencies in the Preparation and Implementation of World Bank Financing Investment Projects.*
75 World Bank. 2022a. *Advisory Services Agreement on Strengthening Planning and Budgeting Capacity II: Output 5. Final Report Presenting the Recommendations of the RAS.*

hampered by not having a standard policy framework on digitalization, data storage and protection.[76]

The Court of Accounts, Romania's Auditor General, is primarily responsible for financial and compliance audits. To strengthen the application of risk-based budgeting, the Court of Account's work focus would need to shift toward performance audits and checking whether internal control frameworks are functioning properly. Twinning arrangements with other Supreme Audit Institutions could be considered to changes current practices.

Insurance

Household property policies in Romania generally cover 'fire' risks which would include cover for wildfire losses. There is no explicit exclusion for wildfires and thus, it is expected that these policies will cover damage from wildfires under the same terms and limits as other fires losses.

In Romania, catastrophe insurance for flood and earthquake for households is mandatory. It is implemented by private insurers who formed an association, the Natural Disaster Insurance Pool (PAID). This is expected to be a first loss catastrophe cover. The insurance is offered with two fixed sets of premium rates/coverage that differ for urban and rural areas. Beyond this policy, households can purchase multi-peril top-up property insurance cover from private insurers with market-based premiums. However, despite the mandatory nature of the policy, penetration is about 20 percent due to lack of perceived insurance value, limited enforcement of the 'mandatory' aspect (which requires municipalities to fine those not in compliance), and lack of public awareness. This insurance is mandatory for accessing home loans, but many people in Romania own their houses and the number of loans to buy houses is limited. PAID is looking to increase penetration using awareness programs with a target of 40 percent penetration over the next five years.

Romania has private insurers who write agriculture insurance schemes. The publicly available statistics from insurance regulators in Romania do not provide the breakdown this information, but it is understood that the business is relatively unprofitable and written only by a handful of insurers.

In Romania, there have been four insurer collapses in eight years, which has decreased public trust in the insurance industry, which presents a case for public intervention. In countries where having insurance is not part of the culture, having instances where there are constant insurer collapses will regress any positive awareness that has been built by other private insurers and the insurance associations. While MTPL schemes account for 73 percent of the non-life insurance market,[77] nonmandatory schemes do not have high levels of penetration. A lack of confidence in the insurance industry due to insurance collapses could be one of the reasons for this.

As a result of the reinsurance market hardening with large rate increases on the same terms, insurers have struggled to maintain the same level of profitability when allowing for this additional cost. PAID in Romania have mentioned that their reinsurance rates have increased dramatically and as they want to maintain their strong level of solvency their combined ratios have deteriorated. This has resulted in them submitting to the regulators an increase in their premium rates. The reinsurance market has had rate hardenings due to large catastrophe losses and utilizing reinsurers in the region such as Europa Re could provide cheaper reinsurance to MS. Seeking alternative ways to reinsure their risk considering the current state of the market could be a good option.

Summary of Case Study Findings

Noting the differences in the quality of inputs and as mentioned earlier in the discussion, combining the analysis to develop a multi-hazard view of the funding gap is not possible. However, to help

76 World Bank. 2023. *Romania Country Climate and Development Report.* Link.
77 AXCO 2022.

understand the differences in the order of magnitude created by the hazards, Table 8 provides a summary which reinforces the key findings of the regional analysis by indicating that if a flood or earthquake occurs at the same time as a wildfire or flood, there are insufficient resources to respond. However, if only a single wildfire or drought occurs, sufficient finance should be available in most years.

Table 8: Range of funding gap from Phase 1 and 2 analysis (€, millions)

	BULGARIA	CROATIA	GREECE	ITALY	ROMANIA	METHOD
Phase 2	0–130	0–220	259–1,400	0	0	10-year historical measures
Phase 1	140–1,478	9–815	42–773	741–3,933	0–4,160	Probabilistic measures

6. Key Findings

This report reinforces the findings from Phase 1 confirming that financial instruments to manage disaster risk are limited to risk retention and more should be done to incentivize risk transfer at both the EU and the EU MS levels. At present there are no risk transfer products at the EU level or in the two case study countries. There is a trade-off with risk transfer products as the initial premium is to be paid upfront regardless of payouts. However, in extreme loss years, the payouts from a risk transfer product can be many times the premium.

Direct damage and loss associated with wildfire and extreme heat are significantly lower than for other hazards, for example, earthquake and flood. This is due in part to the assets exposed to the hazards that consist of natural assets with some limited infrastructure for wildfire and the fact that extreme heat by itself has little physical impact on assets.

Indirect losses from wildfire and drought (including extreme heat as a sub-hazard of these events) are expected to be far higher and pose impacts for the long-term health of society and ultimately businesses as the potential to reduce the number of working days increases. However, the data are not available to substantiate this and there is a need to start collecting data on the number of hospital admissions due to extreme heat and wildfire events.

The EUSF has been triggered eight times since 2002 for wildfires, in response to damages of €6.1 billion for these eight events. Since its establishment, there have been eight successful applications to the EUSF for support costs associated with wildfires, which have received €207.1 million in financing.

Droughts have had large impacts on economies in MS; since the EUSF was created in 2002 there have been four applications submitted and accepted for droughts. Funding was provided to Cyprus in 2008 and 2016 and to Romania in 2012 and 2022. In 2022, Romania which suffered a loss of over €1 billion in the agricultural sector due to droughts and wildfires in the south-eastern region received almost €34 million from the EUSF to cover some of the losses from the drought and associated wildfires. Currently, MS are not easily able to access EUSF funds to support drought losses, due in part to the challenges in defining the exact start of a drought and the fact that droughts are often connected to extreme heat and wildfires, compounding overall impacts. It is the damage from this combined risk that leads to the application to the EUSF.

Wildfire accounts for over one-third of the UCPM response costs, while no expenditures were found for extreme heat. The response budget of the UCPM increased from €13 million in 2014 to €150 million in 2022. Other notable increases over 2014–2022 include a rise in funding for prevention and preparedness activities (from €9million in 2014 to €19 million in 2022) and for firefighting (from €1 million in 2014 to €1.67 million in 2022).

The budgets of the UCPM and the EUSF have both been exhausted in recent years, and there is a need to revisit the budget of the UCPM to strengthen

response capacity and complement preparedness. It is recommended that these are complemented by the introduction of risk transfer instruments as a cost-effective tool that enables prearranged finance to be released when it is needed most. A phased approach to the introduction of risk transfer instruments is recommended, noting that the funding gap from earthquake and flood risk is far higher than that for wildfire and drought. This will also provide time for the wildfire models under development to be released and further analysis to ascertain whether risk transfer for this risk is cost-effective. Such instruments could be linked to the UCPM and/or EUSF.

The analysis in this report was hindered because, at present, no probabilistic models for wildfire in the EU exist. However, models are under development, but for the time being their absence limits our understanding on the future risk that wildfire events may pose. As noted throughout, it was not possible to combine the results with Phase I due to (i) the differences in the number of observed events for wildfire and drought, (ii) the lack of probabilistic models, and (iii) the differences in exposure. However, where possible the team has tried to draw parallels.

The magnitude of losses from wildfire and drought, while marginal in comparison to earthquake and flood, creates additional pressure on already constrained response and recovery budgets. The size of the funding from Phase 1 (earthquake and flood) varies between €13 billion and over €50 billion for the low liability scenario, where the EU assumes a smaller proportion of the cost. In comparison, losses from wildfire range between €16 million and €717 million, depending on the scenario and magnitude of event, while drought saw a consistent funding gap between €29 million and €323 million.

Should a drought or a wildfire happen in a year where a major earthquake and flood has already occurred, there would be no funding available at the EU level to respond to a wildfire or drought event. This reinforces the finding from Phase 1 that there is scope for additional financial instruments at the EU level and/or there is a need to incentivize national governments to invest in DRF.

6.1. Options for Consideration

The above findings suggest that more can be done at the national and EU levels to promote DRF solutions and close funding gaps. Below are some options for consideration; not all need to be pursued or implemented at the same time. Some of these options were presented in Phase 1 but remain relevant today based on the analysis and findings of Phase 2.

1. **Develop an EU level overarching DRF strategy.** This was recommended in Phase 1 and as noted the introduction of a coherent and comprehensive EU-wide policy on DRF would benefit the region by defining common priorities and practices and identifying the level of loss the EU can and is willing to cover via its EU-level instruments. Having simple and clear messaging at the EU level could incentivize investments in DRM, including DRF, at the national level. A DRF strategy can be developed to reinforce the application of the 2021 EU Climate Adaptation Strategy.

2. **Increase the allocation for the UCPM and EUSF.** Both instruments have proven an important source of finance for disaster damages in EU MS and accession countries. Though the funding they provide covers only a small fraction of needs, designed to complement national DRF instruments, the budget allocation to both remains insufficient as shown in the analysis.

3. **Introduce risk transfer instruments.** These would complement the limited funding from the EUSF and the UCPM and could be structured to bring in additional finance when needed most such as cross-border events where multiple countries are affected.

4. **Improve data on DRF.** To inform decision-making on DRF at the EU level, it is important to have reliable data and analytics. As noted in this report, it is suspected that there are significant health costs associated with wildfire, extreme heat, and drought. However, no data are collected on hospital admissions associated with these events which limited the analysis. Systematically collecting data on health impacts could help identify whether additional financial solutions such as health insurance could help cover some of these costs. If found effective, this could be subsidized at the national and/or regional level.

At the national level:

5. **Develop national DRF strategies. To complement the EU-level DRF strategy, consider the introduction of comprehensive national DRF strategies to ensure financial preparedness to disasters.** The first step would include determining national priorities in strengthening DRF (such as focusing on households, the poorest members of society, and government budget). Improving data for DRF, including the collection of heat stress–related hospital admissions should also be considered during development of DRF strategies.

6. **Consider the introduction of sovereign risk transfer instruments.** As mentioned at the EU level, while this is not a new recommendation, this analysis has served to reinforce the need for finance when it is needed most and the introduction of risk transfer instruments at the sovereign level could present a cost-effective way to manage this risk. While this may not be a viable option for wildfire or drought at this time, it is overdue for earthquake and flood risk.

7. **Increase penetration of insurance.** National governments should consider options for increasing catastrophe household insurance and public asset insurance. This could be done through public-private partnerships. However, each country has its unique set of circumstances and will face different complexities when introducing household insurance (that is, making insurance mandatory may not be feasible for all countries). At the same time, in some countries, a political decision may be made on providing different ways of supporting households after disasters, such as through public compensation. Therefore, a decision on how to increase penetration of household insurance will be context specific.

8. **Strengthen risk-based budgeting.** It was also recommended in Phase 1 and is further justified in this report. The implementation of risk-based budgeting can strengthen financial resilience and could be explored more fully across the EU, with guidance and good practice shared across MS. While this report was unable to identify EU contingent liabilities based on an all-hazards approach, a funding gap was still found for wildfire and extreme heat. The identified funding gap for these hazards was significantly lower than for earthquake and flood, but, as mentioned earlier, this was based on a small number of observed events and should be revisited once modelling capacity improves. This would help develop quantified estimates of risk that could be applied to a risk-based budgeting framework; this would in turn create incentives to invest in DRF by supporting MS to know, understand, and plan for the risks they face.

Annex 1. Current wildfire models

COMPANY	MODEL DESCRIPTION	PROBABILISTIC
Munich Re	Higher resolution to better resolve wildland-urban interfaces (WUIs), key zones for high-risk and high-value locations. The WUI is 1.5 miles (2.4 km) wide and divided into 5 detailed zones. Easy-to-visualize maps for risk acceptance rather than complex stochastic models. API available for flexible integration into your existing tools and processes. Underpinned by the claims analysis of one of the world's leading reinsurers. Taking into account the latest knowledge on the impacts of climate change.	No
RMS	No model for Europe	Somewhat
Descartes	Our parametric wildfire product is structured using a combination of satellite imagery, long-term climate, and weather data. We develop an index calibrated to historical wildfire impact and the distribution of value across the property or areas insured.	Somewhat
Verisk (AIR)	No model for Europe	No
Celsius Pro	Probabilistic model under development	
Swiss Re	Apply WUI layer, similar to Munich Re	No
Guy Carpenter/ Marsh	Not available for Europe. The GC Wildfire Risk Score assesses risk on a site-by-site basis, capturing climate, meteorological and landscape data across multiple spatial scales summarized in a simple, single metric. Covering the lower 48 states at a 30-meter resolution.	No
CORELogic	Not available for Europe. They also just made a score. CoreLogic developed highly granular 30 m resolution deterministic and probabilistic models to create a score that differentiates hazard within neighborhoods down to the parcel level. The new model uses artificial intelligence and machine learning to measure risk reduction from a dozen mitigation factors that influence structure vulnerability to wildfire. The advanced model offers more precise risk assessment, differentiation, and reduction to reflect the unique characteristics of every structure.	Somewhat
AON	Only for the United States Considers expected fire propagation, various fire spread azimuths, and a wide range of fuel loads. Loss reporting allows a choice of views of multiple aggregated expected losses. Examines the effects of fuel and slope on fire behavior as well as the possibility of multiple large fires within an extensive fire outbreak during extreme fire weather conditions.	Yes
AXA XL	Appears to be under development. Some probabilistic components. Focus on the United States	Somewhat

COMPANY	MODEL DESCRIPTION	PROBABILISTIC
Mitiga	Mitiga, use a hybrid approach for wildfire forecasting. That includes using physics-based models to determine how real-time factors like wind, topography, or vegetation may affect the behavior of wildfires.	Somewhat
Liberty Mutual	Trained on past burning experience	No

Annex 2. Examples of Disaster Reserve Funds and Contingencies Funds in the EU

NAME	PURPOSE	COUNTRY
Dedicated disaster funds		
National disaster reserve fund (Katastrophenfonds)	Established with the Disaster Fund Act of 1996, the fund can cover both ex ante risk management and post-disaster needs. The fund can be used to finance large-scale protection infrastructure (ex ante risk management) but also serves to compensate the affected population. The fund can cover damages from flood, avalanche, earthquake, landslide, hurricane, and hail.[78] In addition to this fund, ministries and agencies in Austria seem to be able to use their reserves (savings or additional revenues) at their own discretion for different purposes, including post-disaster financing.[79]	Austria
National Recovery Fund	Managed by the Ministry of Finance, the fund can support municipalities if disaster damages to public infrastructure exceed their own budgets. However, the amount of funding available annually is challenging to estimate. [80]	Finland
Fonds de prévention des risques naturels majeurs ('Fonds Barnier')	The fund can cover emergency housing or temporary rehousing and relocation, prevention measures, information measures, and research activities (the local governments are the beneficiaries). [81]	France

78 OECD 2015, 2016, and 2018.
79 Steger, Gerhard. 2010. "Austria's Budget Reform: How to Create Consensus for a Decisive Change of Fiscal Rules." *OECD Journal on Budgeting* 2010/1.
80 DRIVER Finland 2015.
81 French Ministry of Ecology Report 2019. Other special purpose reserve funds covering disaster relief expenditures are available in France but were not considered for the analysis: (i) the *Fonds national de gestion des risques en agriculture* covers agricultural producers for uninsurable crop lost due to natural hazards or disease outbreak and (ii) the *Fonds de secours outre-mer* covers the reconstruction of uninsured private assets, uninsurable subnational assets, and for immediate disaster relief in overseas territories (purchase of basic necessities). OECD. 2019. *Fiscal Resilience to Natural Disasters.*

NAME	PURPOSE	COUNTRY
General contingency funds		
Interagency Commission for Relief and Recovery to the Council of Ministers	The commission is allocated with regular budget that is aimed at covering exceptional and unanticipated costs that may occur from disasters (natural or man-made) or other events such as the mass migration of refugees.[82]	Bulgaria
Budgetary reserve	Article 56 of the Budget Act provides for the establishment of a budgetary reserve covering expenditures which emerged during the alleviation of the consequences of natural disasters, epidemics, environmental mishaps, or extraordinary events and other unforeseen purposes for which no funding has been secured in the budget, or for which it is ascertained during the course of the year that insufficient funds were established for them because they were impossible to foresee during budget planning. Although the government can use the reserve discretionally, it has to report use of the reserve to the Sabor (the Croatian Parliament). Its amount cannot exceed 0.5 percent of budget revenues (including taxes but excluding receipts such as user charges and fees).[83]	Croatia
General contingency funds	Two general contingency funds are available: (i) a budgetary allocation for emergency and immediate measures, based on Regulatory Acts No. 239/2000 Sb and No.240/2000 Sb, that can cover rescue and health protection of affected population and (ii) a budgetary allocation for property reconstruction and revitalization (State Aid for Territorial Restoration), based on Acts No. 12/200 Sb and No.186/2002 Sb, that can cover reconstruction of destroyed property in the form of interest-free loans to municipalities, firms, and households.[84]	Czech Republic
Stabilization Reserve Fund	The fund can be used in case of "resolution or prevention of an emergency situation, a state of emergency, a state of war or other extraordinary situation or a crisis with material effect." Unexpected costs of small-scale emergencies are covered by the government liquidity reserve.[85]	Estonia
Force Majeure Fund	The fund can cover reconstruction of government owned assets destroyed by natural disasters.[86]	Hungary
Rainy Day Fund	The fund set up by National Surplus Bill 2018 and managed by the National Treasury Management Agency (NTMA) on behalf of the Ministry of Finance aims to mitigate severe economic shocks, in excess of the normal fluctuations of the economic cycle.	Ireland
Fondo per le emergenze nazionali	The fund was set up by art. 5.5-quinquies Legge 225/1992 to cover "situations of national emergencies." The fund can, for instance, finance relief and assistance to the population, restoration of public services and network infrastructure, needs and damages assessments, fiscal exonerations for victims and temporary suspensions of repayments of real estate loans on destroyed or damaged buildings, and so on.[87]	Italy

82 Bulgaria Assessment of DRM sector 2018.
83 Budgeting in Croatia 2006.
84 World Bank. 2011. *Financial and Fiscal Instruments for Catastrophe Risk Management Addressing Losses from Flood Hazards in Central Europe (Poland, Czech Republic, Hungary, and Slovakia).*
85 Estonian Ministry of Finance website.
86 World Bank 2011.
87 PROMETEIA 2019.

NAME	PURPOSE	COUNTRY
Fiscal Safety Reserve	The fund was set up by the Civil Protection and Disaster Management Law and can cover fiscal risks with funding of maximum 0.1 percent of GDP.[88]	Latvia
Stabilization Reserve Fund	The fund can cover state budget expenditures in case of "exceptional circumstances."[89]	Lithuania
Annual reserve for prevention and recovery	It can cover disaster risk prevention activities such as flood protection works, as well as liquidation of property damages caused by natural disasters through financial assistance to local governments for housing or infrastructure reconstruction, and post-disaster assistance to individuals.[90]	Poland
Fundo de Apoio Municipal and the Emergency Bank Account	The Fundo de *Apoio Municipal* financial can cover recovery of the municipalities in financial state of imbalance through the implementation of municipal adjustment programs. This includes loans to municipalities to finance reconstruction of infrastructure and equipment damaged as a result of disasters. The Emergency Bank Account can support individual citizens affected by certain disasters.[91]	Portugal
Fondul de rezervă budgetară	The fund was set up by Lege 500/2002 to cover disaster costs as well as other contingencies.[92]	Romania
Special budget reserve	The reserve can cover general contingencies and disaster relief programs.[93]	Slovenia
Ad hoc reserve funds		
Funds established after disasters	Following disasters, several ad hoc reserve funds were established, for instance in Germany, (i) *Sonderfonds Aufbauhilfe*, amount €7.1 billion, was set up to cover damages from the 2002 flood and (ii) *Aufbauhilfegesetz*, amount €8 billion, was set up to cover damages from the June 2013 flood.[94] In France, ad hoc emergency relief funds are usually set up by the Ministry of Interior to provide immediate disaster relief (purchase of basic necessities, for example, food, clothing, accommodation) to the affected individuals with compensations, capped at €300 per affected adults and €100 per affected child. These funds are excluded from the analysis.	For example, in Germany, France
Subnational disaster reserve funds		
Funds to cover disasters costs at the local level	In some countries, like in Belgium, the national disaster reserve fund was abolished and instead replaced with funds at the subnational level. In Germany, disaster risk reduction and DRM are under the responsibility of the *Landers*. In Slovakia, self-governing regions can also establish crisis funds to finance a potential damage, even if the obligation to do so does not exist.[95] These funds are excluded from the analysis.	For example, in Belgium, Germany, Slovakia

88 Civil Protection and Disaster Management Law.
89 OECD. 2012b. *Budgeting in Lithuania.*
90 Act on Crisis Management of April 26, 2007.
91 EC, EUROPA 2019 and Fundo de Apoio Municipal website, Link.
92 România Consiliul Fiscal 2019.
93 Final account of the budget of the Republic of Slovenia for 2019.
94 MERZ, ELMER, KUNZ et al. 2014.
95 DRIVER Slovakia 2015.

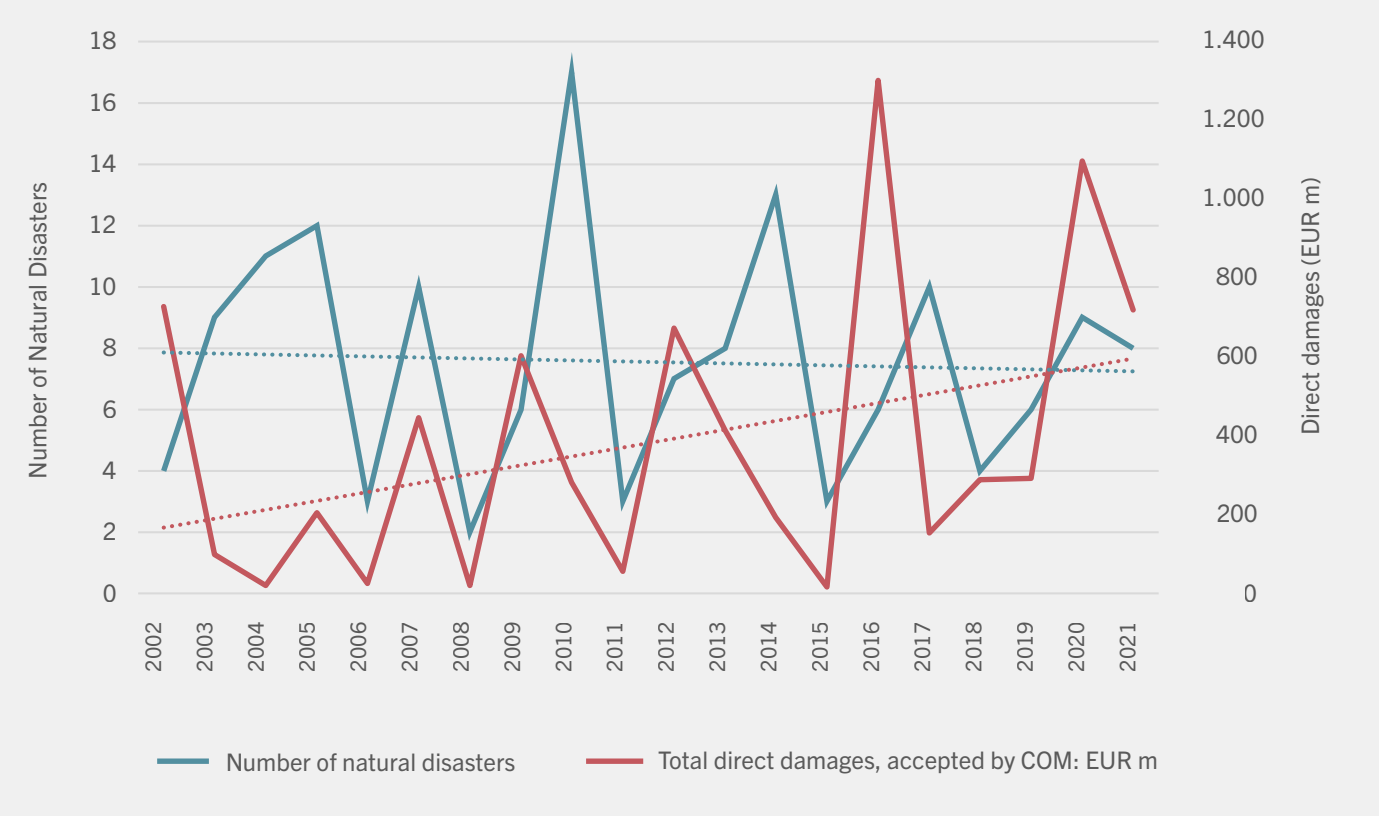
Annex 3. Funding from the EUSF and Disaster Damages over 2002–2022

Table 9: Funding from the EUSF (2002–2022) versus total damages of the disasters accepted by the EU

COUNTRIES	SUM OF EUSF AID PAID (2002–2022) (€, MILLIONS)	TOTAL DIRECT DAMAGE OF DISASTERS WHICH WAS ACCEPTED (2002–2022) (€, MILLIONS)
Albania	1	
Austria	214	4,872
Belgium	125	5,560
Bulgaria	42	1,184
Cyprus	15	515
Czech Republic	178	3,578
Germany	1,645	53,351
Estonia	5	48
Spain	154	7,167
France	403	13,289
Greece	160	5,026
Croatia	1,033	17,882
Hungary	77	1,441
Ireland	57	521
Italy	3,081	69,762
Lithuania	20	423
Luxembourg	5	189
Latvia	28	573
Montenegro	0	
North Macedonia	-	
Malta	1	30
Netherlands	5	500
Poland	125	3,773
Portugal	198	4,277
Romania	141	4,389
Serbia	72	1,106
Sweden	82	2,297

Slovenia	48	1,285
Slovakia	26	785
United Kingdom	223	7,724
Grand Total	8,164	211,547

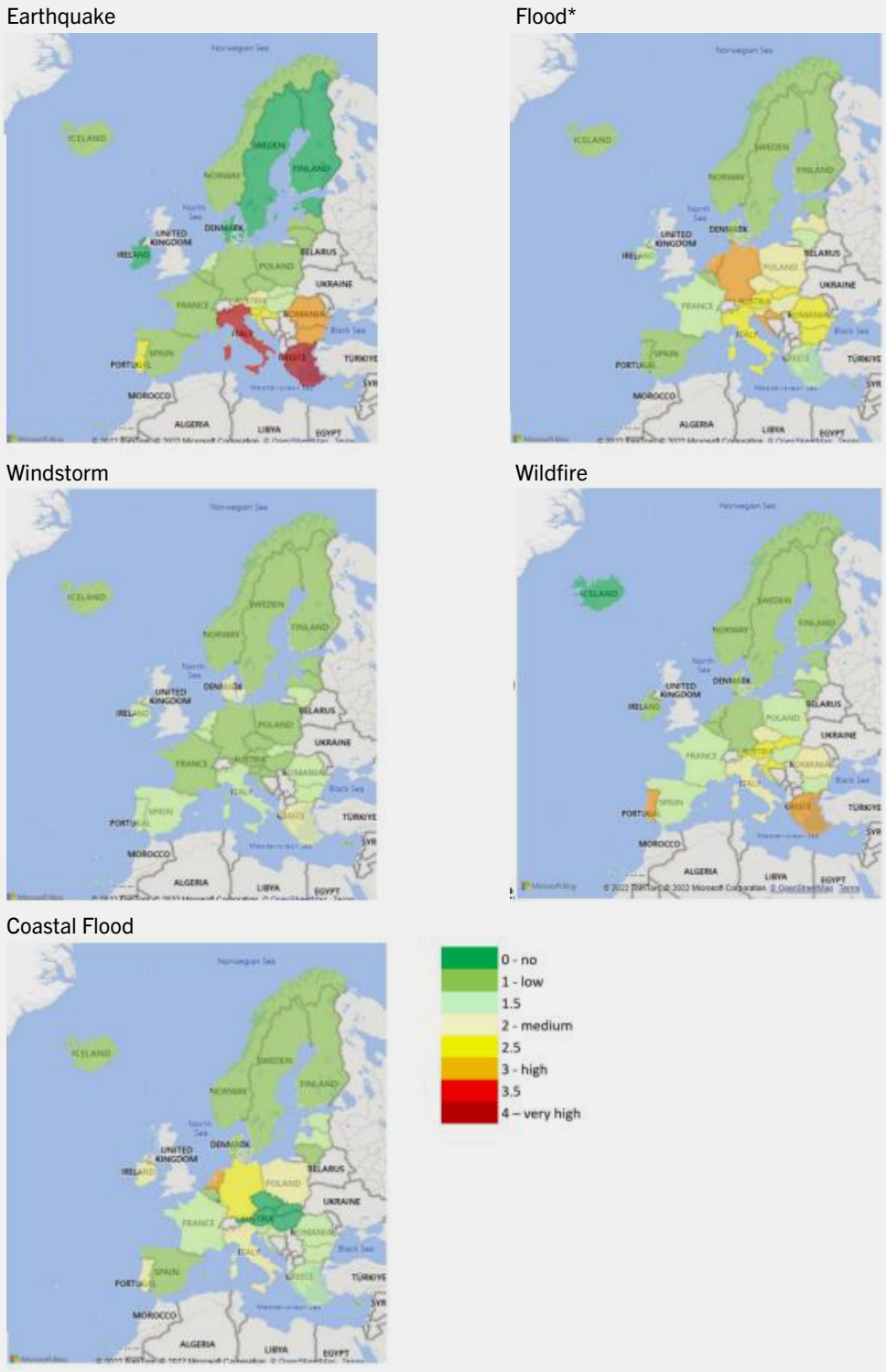
Figure 24: Number and direct damages (€, millions) of natural disasters as reported to the EU for the EUSF



Source: Authors based on EUSF data. Link.
*Note:** This includes applications which have been rejected by the EUSF.

Annex 4. Insurance penetration in the EU MS

Figure 25: Insurance penetration in EU MS by peril



Source: EIOPA dashboard.
*Note:** Flood excluding coastal flood.

Table 10: Proportion of households covered by insurance in the EU MS (%)

	INSURANCE PENETRATION - EIOPA DASHBOARD					INSURANCE PENETRATION - FROM NATIONAL DISCUSSIONS				
	WINDSTORM	FLOOD EX COASTAL	COASTAL FLOOD	EARTHQUAKE	WILDFIRE*	WINDSTORM	FLOOD EX COASTAL	COASTAL FLOOD	EARTHQUAKE	WILDFIRE
Austria	33	15	0	0	0					
Belgium	57	20	0	0	0					
Bulgaria	13	0	0	0	0					
Croatia	2	6	0	0	0	25	25	25	4	25
Cyprus	19	0	0	0	0					
Czech Republic	15	38	0	0	0					
Denmark	62	72	75	0	0					
Estonia	18	0	0	0	0					
Finland	54	5	50	0	0					
France	41	37	86	58	0					
Germany	51	23	0	24	0					
Greece	1	3	0	2	0					
Hungary	34	1	0	0	0					
Iceland	0	98	0	98	0					
Ireland	24	28	0	0	0					
Italy	4	3	0	3	0					
Latvia	12	0	0	0	0					
Liechtenstein	100	0	0	0	0					
Lithuania	15	0	0	0	0					
Luxembourg	64	49	0	0	0					
Malta	13	0	0	0	0					
Netherlands	55	2	0	10	0					
Norway	98	59	100	100	0					

	INSURANCE PENETRATION - EIOPA DASHBOARD					INSURANCE PENETRATION - FROM NATIONAL DISCUSSIONS				
	WINDSTORM	FLOOD EX COASTAL	COASTAL FLOOD	EARTHQUAKE	WILDFIRE*	WINDSTORM	FLOOD EX COASTAL	COASTAL FLOOD	EARTHQUAKE	WILDFIRE
Poland	11	8	0	0	0					
Portugal	35	3	0	0	5					
Romania	0	2	0	40	0	13	20	20	20	13
Slovakia	2	6	0	0	0					
Slovenia	16	55	0	8	0					
Spain	27	33	32	66	2					
Sweden	28	100	0	0	35					
EEA Countries	41	20	52	3	3					

Source: EIOPA dashboard, Croatian and Romania based on discussions with the insurance industry in the country.
*Note:**Generally speaking, wildfires are covered under household fire policies, that is, not explicitly excluded.

Annex 5. Assumptions of the National Funding Gap Analysis

Government Liabilities

The funding gap analysis focuses on the national-level contingent liabilities as follows:

- **Emergency operations.** These include essential infrastructure restoration, temporary accommodation, emergency service costs, prevention infrastructure, measures for protecting cultural heritage, and cleanup operations. While not explicitly stated in EUSF documentation, suppression and prevention activities are assumed to fall within this category given the nature of wildfire events. The government is assumed to be 100 percent liable for all emergency operation costs.

- **Government liability for public sector damage.** It is assumed that the government is 100 percent liable for the costs associated with damage to public assets. Additional costs associated with reconstruction of these assets are not considered but increase the potential costs associated with these liabilities if included.

- **Government liability for non-public sector damage.** Encompassing residential, commercial, and industrial losses. In the absence of data and information on the distribution of these losses among categories, it is assumed that the remaining losses are not contingent liabilities of the government and will either be covered through insurance or absorbed directly by the private sector.

- **Proportion of public sector damage relative to total damage.** The data used to estimate damages resulting from wildfires do not differentiate between losses incurred by the public and private sectors. Consequently, an assumption must be applied to ascertain the government's proportionate share of these losses. An average of 50 percent has been used in the analysis based on historical events where the EUSF has provided support, but the proportion to damages associated with the public sector fluctuates considerably across these events—ranging from the minimum of 0.5 percent of total damage to a maximum of 83.3 percent.[96] Given the observed variability, the overall funding gap assessment incorporates two separate scenarios, each applying alternative values to this assumption. The low scenario assumes that public damages constitute 35 percent of total damages, while the high scenario posits an increased percentage of 80 percent.

Financial Instruments

To understand the funding gap in EU MS, the analysis considers the following financial instruments:

- **National reserve funds.** Information on relevant reserve funds is included in each case study where possible, but these funds are multipurpose in nature, and it would be unrealistic to assume they can be solely used to fund wildfire costs. The national funds are estimated based on 0.075 percent of national revenues based on data between 2019 and 2022. This estimate was calculated by assuming a reserve level of 0.5 percent held in the respective EU MS, which was the basis for the analysis conducted in Phase 1. Subsequently, it was reduced by 85 percent to accommodate the likelihood of the majority of these reserved funds being utilized for other hazard events beyond wildfires. This serves as a

96 EC - cohesion data. Link.

proxy for overall general contingencies funds (including any dedicated national disaster reserves) held in each country.

- EUSF. Given the complexity of the EUSF, the level of loss required to activate the EUSF (0.6 percent of GNI or a max level of disaster loss) is analyzed to understand (i) where the activation point is relative to the national reserves and (ii) if lowering the activation level allows for an improved risk layering of instruments for less severe but frequent events. Second, EUSF financing is capped due to the split between the EUSF aid and the Emergency Aid of the EU. For all scenarios, the analysis assumes a total available balance of €800 million based on the information contained in the special meeting of the European Council (February 1, 2024). Based on historical data, the EUSF has predominantly supported other hazards such as floods and earthquakes, accounting for approximately 85 percent of total assistance. Therefore, an assumption of €123.4 million from the EUSF is made available for wildfire events.

Annex 6. Assumptions of the EU-Level Funding Gap Analysis

Besides the assumptions already presented in Annex 4**, some more simplifying assumptions were needed to be able to run an 'all MS' analysis.**

Government Liabilities

- **Eligible emergency operations costs.** The baseline scenario assumes that such costs represent 16 percent of total economic costs, which is the historical average for the eight wildfire events where the EU has provided support where eligible emergency operations and the costs are estimated. The low scenario and high scenario assume that eligible emergency operation costs are 12 percent (median) and 35 percent (maximum) across the respective scenarios.

- **Proportion of public sector damage relative to total damage.** The same method has been applied as stated in Annex 4.

Financial Instruments

- **National reserves.** Each country is assumed to have a national contingency fund and/or a dedicated disaster reserve to respond to disasters, and for the EU-level analysis it is assumed that the EU will benefit from a country's national DRF instruments. The national funds are estimated based on 0.075 percent of national revenues based on data between 2019 and 2022. This estimate was calculated by assuming a reserve level of 0.5 percent held in the respective EU MS. The allocation for wildfire and drought was subsequently reduced to 15 percent and 8.6 percent, respectively, to account for the likelihood of the majority of these reserved funds would be used for other types of hazards beyond wildfires and drought. This serves as a proxy for overall general contingencies funds (including any dedicated national disaster reserves) held in each country. These amounts are then aggregated up to the EU level.

- **Budget allocations under the MFF.** Within the MFF, the proportion of budget allocated to response, the ECP pool, and the rescEU transition are the main DRF instruments available for eligible emergency operations costs. These budget allocation instruments are first assessed individually to determine their adequacy and then collectively in a separate emergency funding gap analysis which combines the MFF and the EUSF resources.

- **EUSF.** The assumption is that the EUSF serves as the primary DRF instrument to address costs beyond the capacity of national reserves and the

MFF. In recognition that the EU faces multiple hazards in any given year it is unlikely that countries will receive the full amount of €500 million in 2011 prices[97] which has resulted in the need for some plausible assumptions. As a result, the EUSF is capped at an annual limit of €123 million for wildfire, which represents 15 percent of the EUSF annual budget and aligns with the approach used for natural reserves. Similarly, the fund is capped at €69 million for drought, equivalent to 8.6 percent of the EUSF annual budget and consistent with the treatment of the national reserves.

Other Key Assumptions

- **Percent of losses covered by the EUSF.** Historically the EUSF has only paid a fraction of the estimated total costs associated with wildfire events. Six wildfire events were identified between 2002 and 2020 where the EUSF was activated and where public damages were estimated.[98]

  → The total emergency operation cost estimate from these events is €1.3 billion.

  → The total public damage estimate from these events is €2.3 billion.
    - Combining these values and based on the associated assumptions previously stated, the total government contingent liabilities are estimated at €3.6 billion.

  → From these six events, the EUSF support paid was €157.3 million.
    - On average, this equated to 36.4 percent of emergency operation costs per event.
    - On average, this equated to 2.3 percent of the estimated contingent liabilities.

The style of analysis is based on a low number of wildfire events; however, no clear alternative was available for use. To account for this uncertainty, the high scenario assumes that the EUSF will aim to cover 3.2 percent (the maximum proportion observed in the six historical events), while the low scenario assumes that the EUSF will aim to cover 2.2 percent (the second lowest proportion[99] observed in the six historical events) of the estimated contingent liabilities in future.

Annex 7. Deriving public sector costs

The EFFIS data indicate that 394,962 (approximately 400,000) ha of land across the EU was destroyed by fire in the first nine months of 2023. A corresponding cost of €4.1 billion was estimated for a subset of EU countries by Distrelec[100]—giving the ratio of cost per hectare burned of €10,332.50. The ratio estimates for economic impact include costs of firefighting, reforestation, damages, and cleanup. Hence, the portion of private sector losses was calculated and the ratio was adjusted to account for costs associated with emergency costs and public sector damages of €5,914 per ha or 56.7 percent of the total estimated economic cost. Additional spot checks were conducted by examining historical wildfire events both in the region and globally, comparing the area of hectares burned to overall cost estimates. The analysis revealed that, although some 'cost per area burned' ratios were similar, the limited number of data points for this comparison and substantial variations in other instances raised concerns about the validity of the value used in this analysis.

97 Plus any unspent allocation from the proceeding year which is raised over and above the normal EU budget. Link.
98 Link.
99 The lowest proportion recorded was 0.3 percent from the 2012 wildfire in Romania which is considered an outlier.
100 Link.

Annex 8. Reserve Funds of the EU MS (€, millions)

Table 11: Reserve and contingency funds in the EU MS, including the estimated contingency funds

	Existing data (mil EUR)			Estimates (mil EUR)				
country_code	2019 revenues	Contingency funds	Disaster reserve funds	Contingency fund (lower bound)	Contingency fund (upper bound)	Total gov retention mechanism (Lower bound)	Total gov retention mechanism (upper bound)	Amount used (mil EUR)
AT	195,101		438.0	488	976	926	1,413	**925.71**
BE	238,268			596	1,191	596	1,191	**1,191.34**
BG	23,292	35.0		58	116	58	116	**116.46**
CY	9,047			23	45	23	45	**45.24**
CZ	92,763			232	464	232	464	**463.82**
DE	1,608,567			4,021	8,043	4,022	8,044	**4,022.42**
DK	165,616			414	828	414	828	**828.08**
EE	10,849		433.8	27	54	461	488	**460.96**
EL	89,480			224	447	224	447	**447.40**
ES	486,754			1,217	2,434	1,217	2,434	**2,433.77**
FI	125,239			313	626	313	626	**626.20**
FR	1,275,708		131.5	3,189	6,379	3,321	6,510	**3,320.77**
HR	25,626			64	128	64	128	**128.13**
HU	63,288			158	316	158	316	**316.44**
IE	87,453	1,527.0		219	437	219	437	**437.26**
IT	841,441		687.6	2,104	4,207	2,791	4,895	**2,791.21**
LT	17,024			43	85	43	85	**85.12**
LU	28,456			71	142	71	142	**142.28**
LV	11,790		30.5	29	59	60	89	**59.95**
MT	5,045			13	25	13	25	**25.23**
NL	354,279			886	1,771	886	1,771	**1,771.40**
PL	218,417			546	1,092	546	1,092	**1,092.08**
PT	91,008			228	455	228	455	**455.04**
RO	70,836	1,061.8		177	354	177	354	**354.18**
SE	236,269			591	1,181	591	1,181	**1,181.35**
SI	21,228			53	106	53	106	**106.14**
SK	39,085			98	195	98	195	**195.42**

Source: World Bank (2021)

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