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EIOPA Staff Discussion Paper
Protection gap for natural catastrophes

The current EIOPA Staff Discussion Paper addresses the issue of a protection gap for natural catastrophes in Europe in light of available evidence about the impact of climate change on the frequency and severity of extreme weather and climate-related events.

The paper builds on research conducted by various stakeholders so far and sets out elements for discussion.

In particular, we highlight the potential systemic impact of situations across Europe where a lack of coverage is combined with high exposures compared to the size of the economy and public revenues as well as high levels of public debt.

A coherent European approach, involving private and public actors, with a focus on mitigation and adaptation, should address the risks caused by climate change with regard to natural catastrophes in Europe.

Economic losses caused by weather and climate-related extremes in the EEA, in light of climate change

1. Over the period 1980-2016, the total amount of weather and climate-related economic losses in the EEA member countries was EUR 436 billion (at 2016 Euro values), at an average of EUR 12 billion per year, EUR 76 300 per square kilometre or 784 per capita.[1]

2. Climate change affects the frequency and severity of certain extreme weather and climate-related events, such as droughts, heat waves and heavy precipitation events:
   - Among long-term climate extremes, **heat waves** are expected to increase across Europe and **droughts** are expected to increase in most regions in southern Europe. The direction of future changes is uncertain for short-term meteorological extremes, such as wind and hailstorms. Model projections show a likely increase in hydrological extremes (i.e. **floods**). Such an increase is likely to occur across Europe for coastal floods owing to the projected sea level rise; projections for river floods differ for different parts of Europe.[2]
   - **'Natural disaster hotspots**' are likely to develop along the following lines: The greatest accumulation of future risks will occur in coastal regions bordering the North Sea such as the British Isles and the Netherlands, which are densely populated and economically pivotal for Europe. Regions in Southern Europe (including the Iberian Peninsula, southern France, Northern Italy and the Balkan countries along the Danube) will see a progressive and strong increase in overall climate hazards. The frequency of riverine floods will triple (with current 100-year events occurring roughly every 30 years in the 2080s in Southern France and northern Italy, and perhaps sub-annually in the Danube region); and the frequency of heat waves, droughts and wildfires will increase more than 10-fold in the same period (mainly in Southern Europe). The overall exposure to multiple (independent) hazards shows a positive gradient that is 'even more pronounced than in single-hazard scenarios'.[3]

3. Increasing extreme events will presumably lead to greater (economic and insured) losses. According to a study carried out by the European Commission's Joint Research Centre[4], in the absence of measures for adaptation or mitigation, the impact of direct and indirect effects of climate change in Europe over a very long term (2071-2100) could cause annual total damages across EEA of around 190 billion.

4. Exposure (through value accumulation - growing population, economic wealth and urbanisation) is currently the main driver of increase in predicted losses by natural hazards. The extent to which observed climate change has already

[1] Source: European Environment Agency (EEA), Economic losses from climate-related extremes, 2018. Weather and climate-related events include meteorological, hydrological and climatological events (storms, floods, mass movements, heatwaves, cold waves, droughts, forest fires), but exclude geophysical events (earthquakes, tsunamis, volcanic eruptions). Natural disasters comprise the four types of events.

[2] EEA, Climate change, impacts and vulnerability in Europe 2016. An indicator-based report. EEA Report No 1/2017.

[3] EEA, Climate change adaptation and disaster risk reduction in Europe. Enhancing coherence of the knowledge base, policies and practices. EEA Report no. 15/2017.

[4] European Commission, Joint Research Centre, JRC Scientific and Policy Reports, Climate Impacts in Europe, The JRC Peseta II Project, 2014.

contributed to growing disaster losses is still difficult to estimate.[5] The losses may just be at the lower bound: economic losses arising from business interruption in the absence of any structure damage are captured only occasionally and ecosystem impacts are not monitored routinely.[6] Economic losses mainly reflect monetised direct damages to certain assets. The loss of human life, cultural heritage or ecosystem services is not part of the estimation.[7]

5. Climate events in the EU cross national borders, and with it the economic impact, mainly due to high economic integration between EU Member States (e.g. through (contingent) business interruption impact on business value chains), potentially adding around an extra 25-30 % impact at EU level.[8]

6. Europe is also susceptible to spill-over effects from climate change impacts occurring outside European territories through the trade of (non-) agricultural commodities, infrastructure and transport (e.g. disruptions to transportation networks), geopolitics and security risks, human migration and finance (e.g. climate-related price volatilities).[9]

The role of insurance and reinsurance in covering extreme weather and climate-related risks

Role-benefits - The insurance and reinsurance sector plays a key role in absorbing losses arising from natural catastrophe risks through the risk-pooling mechanism and incentivising risk mitigating behaviour. Sound risk pricing requires (re)insurers to have adequate models and sufficient data for their estimations, including risk maps for underwriting natural catastrophe risks. This aspect is key for providing risk management solutions inducing risk-sensitive behaviour and advice on preventive measures.

Challenges – Low insurance penetration, the capacity to factor in climate change in reserving and concentration risk in reinsurance are notable challenges for the insurance sector in covering extreme weather and climate-related risks due to climate change.

Concerns - Affordability and insurability are likely to become an increasing concern in a climate change context.

7. Insurance business allows to pool resources to spread risks over a large number of policyholders, in exchange for a risk-based premium. The transfer of risks from insurers to reinsurers mitigates the risks which insurers are exposed to. Prudential regulation requires (re)insurers to cover expected and unexpected losses arising from various risks, including underwriting risk with regard to natural catastrophes. The valuation of liabilities is based on forward-

[5] EEA, Climate change, impacts and vulnerability in Europe 2016. An indicator-based report. EEA Report No 1/2017.

[6] EEA, Climate change adaptation and disaster risk reduction in Europe. Enhancing coherence of the knowledge base, policies and practices. EEA Report no. 15/2017. Also: European Environment Agency (EEA), Economic losses from climate-related extremes, 2018.

[7] European Environment Agency (EEA), Economic losses from climate-related extremes, 2018.

[8] European Commission, Joint Research Centre, JRC Scientific and Policy Reports, Climate Impacts in Europe, The JRC Peseta II Project, 2014.

[9] EEA, Climate change, impacts and vulnerability in Europe 2016. An indicator-based report.

looking estimates taking into account expected future developments that will have a material impact (such as e.g. climate-related hazards). In their projections, (re)insurers shall take account of all uncertainties in future cash-flows. A risk margin is added on top of the best estimate to ensure transferability of the liabilities, and capital requirements should cover unexpected losses. The (re)insurance industry also plays an important role as a user and/or developer of CAT models, to assess, price and manage risk, for example for managing physical climate risk.[10] Insurance, through risk transfer, helps to mitigate the macroeconomic cost of disasters and the potential systemic risk.[11]

8. Nevertheless, certain factors may influence the (re)insurance industry's capacity to play this role and to deal with the increased frequency and severity of natural catastrophes across the EEA in light of climate change. These are low levels of insurance protection and/or insurance penetration in a particular sector or country, the capacity to factor in climate change in reserving (risk of inadequate reserving potentially due to impact of very far-out tail events) and concentration risk in reinsurance.

    - Overall, only 35 % of the total losses caused by extreme weather and climate-related events across Europe are currently insured. This leaves an insurance protection gap, i.e. the difference between the level of insurance (measured by insured losses) and the amount of economic losses, of 65%.[12] It does not necessarily follow however that it would be optimal for all losses to be insured.

    - Some countries provide a structured public or public-private (re)insurance solution to address protection gaps for catastrophe risks. These include state-sponsored direct insurance programmes, such as for example the Consorcio de Compensacion de Seguros in Spain, the Natural Catastrophe Insurance of Iceland or the Danish Storm Council. Other measures include state-sponsored reinsurance programmes, including the French Caisse Centrale de Réassurance or the UK FloodRe. Regional risk pooling also exists in Europe, for example the regional catastrophe reinsurance company "Europa Re", covering southeast Europe catastrophe and weather risk insurance. However, such solutions do not exist for all countries or regions. At European level, the European Union Solidarity Fund has provided financial relief to regions affected by extraordinary natural disasters amounting to 5 billion euro, since its creation in 2002.

    - Climate variability and uncertainties related to climate change or to the regional impact of extreme weather events due to climate change may impact on the capacity of the (re)insurance industry to capture sufficiently the future developments in their underwriting practices. The extent, to which insurance and reinsurance pricing and reserving practices would effectively integrate an increased frequency or severity of extreme weather-related events, without reducing the insurance

[10] See: The Geneva Association. Managing Physical Climate Risk: Leveraging Innovations in Catastrophe Risk Modelling. November 2018.
[11] See: BIS Working Papers, No 394, Unmitigated disasters? New evidence on the macroeconomic cost of natural catastrophes, Goetz von Peter, Sebastian von Dahlen, Sweta Saxena, December 2012.
[12] European Environment Agency (EEA), Economic losses from climate-related extremes, 2018.

penetration, will determine largely the sustainability of coverage of natural catastrophes in Europe.

- While the 2018 EIOPA insurance stress test confirmed high resilience of the biggest European insurance groups to a series of natural catastrophes[13], it also showed that the current high resilience relies on reinsurance, even to a larger extent than for market risks losses. Participating firms in the stress test were among the 42 biggest European insurance groups who transferred 55% of the losses caused by the so-called Nat Cat scenario to reinsurers through the actual treaties in place. Accordingly, the most affected participants by this scenario were reinsurers and direct insurers largely involved in reinsurance activities. Furthermore, we noted that the losses were ceded to a limited number of counterparties, highlighting a potential concentration of risk. From a geo-political perspective, 45% of the ceded loses went to reinsurance carriers based in non-EU jurisdictions.

9. Affordability and insurability are likely to become an increasing concern. Peaks in losses and necessary risk-based regulatory adjustments are likely to lead to higher premiums or more restrictive terms and conditions in insurance products. Insurers may have to become more selective on the risk quality, and consider not underwriting certain risks. The economic impact of climate change is difficult to quantify in monetary terms (e.g. impact of climate change on ecosystems). Sometimes the risks are technically uninsurable, such as for example the impact of climate change on human migration.

Public finance and other considerations in light of climate change and natural catastrophes

10. Natural catastrophes can affect critical economic resources and infrastructure, including energy production, transport, and agriculture, financial infrastructure, such as banking and payment services, as well as human welfare. In addition to the cost of the direct (physical) losses and supply bottlenecks ("demand surge"), indirect impacts arise from increased uncertainty from investors, loss of market confidence leading to asset fire sales, causing further falls in asset prices. This affects directly the financial (banking) sector, limiting in turn financing available for reconstruction, leading to fall in output in affected areas, further weakening households and corporate balance sheets.

11. Damages caused by natural catastrophes may put additional strain on public finances where, in the absence of sufficient coverage via insurance and reinsurance solutions, the government is called to step in to provide relief and potentially compensation (incl. emergency response and financial aid), but will also need to restore damaged government property and infrastructure.

12. Particular sovereign risk mitigation or transfer mechanisms aim to address (financial) risks arising from climate change, including issuance of CAT bonds,

[13] The stress test showed a limited impact of a set of catastrophic losses over Europe from various perils supposed to materialise over a short period of time, like windstorms, floods and earthquakes. It needs to be pointed out that the events tested were not designed taking into account climate change, yet. In addition, the short time horizon does not take into account longer term developments due to climate change. Nevertheless, the results are useful to illustrate the effect of an increased severity and intensity of natural catastrophes hitting different geographical areas in Europe.

insurance for the management of fiscal risks, the existence of reserve funds, contingent credit arrangements, and the insurance of public assets.[14] These are designed to alleviate the pressure on public finance – in some cases transferring the risk back into the economy. However, without additional government action on climate change adaptation and mitigation, the impact of climate risks on sovereign borrowing costs may become more costly.[15]

13. It is relevant to identify potential issues in terms of the ability of Governments to finance such actions.

14. The charts below allow to identify relative risk exposure and financial strain, which may have systemic relevance. Figure 1 shows historical loss figures (as share of GDP and government revenue) and the debt-to-GDP ratio plotted against historical insurance coverage for those losses. Figure 2 sheds some additional light on public debt sizes and the ability to finance potential additional losses.

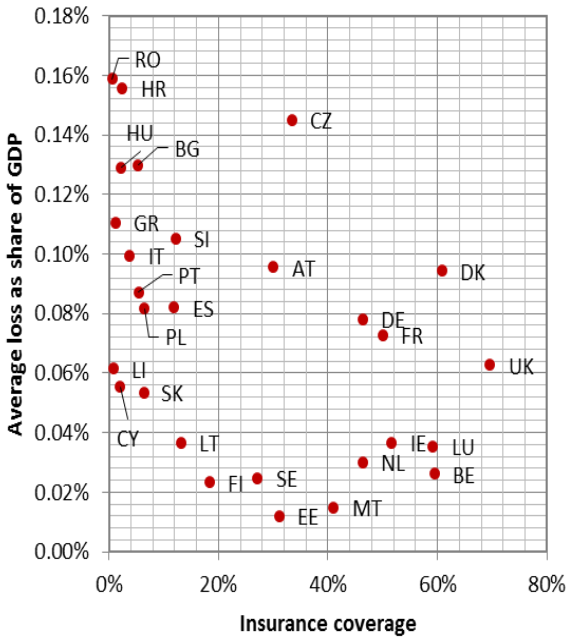
15. Some countries may be particularly prone to suffer from risks related to climate change, for example regions in Europe's South/South-East will see a progressive and strong increase in overall climate and extreme weather-related hazards.

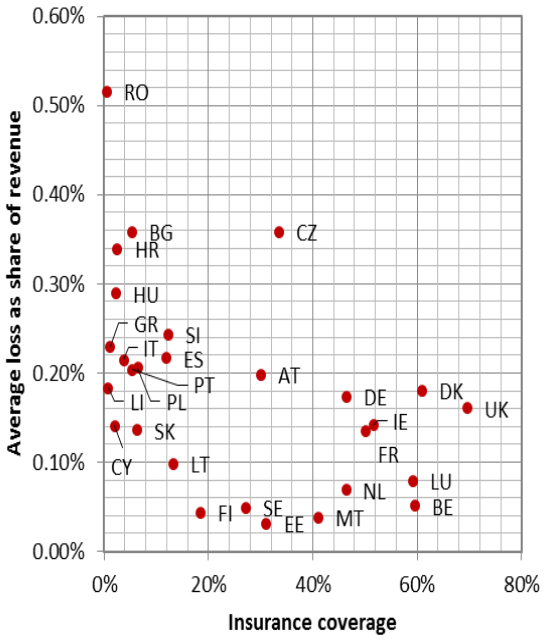
16. Other regions/countries are also at risk of suffering important losses from climate change. The materiality of the impact on public finance will depend also on the type of natural event which will materialise and the concentration of exposures to those perils.

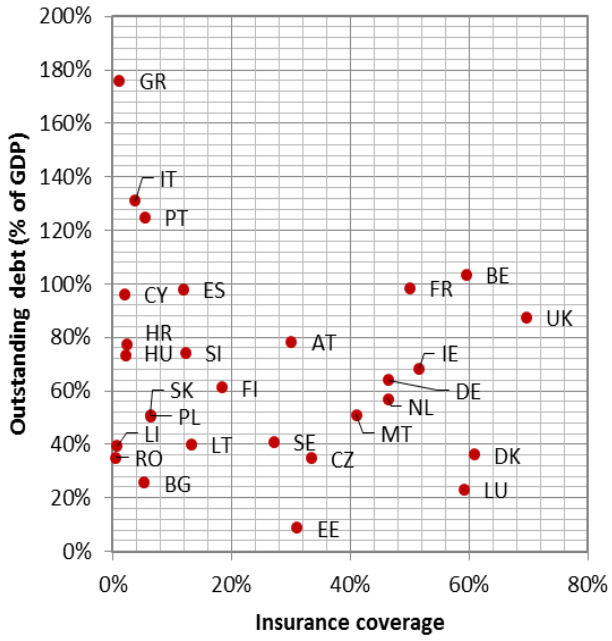
17. The impact of climate change and extreme weather-related events also differs across sectors and regions and the expected impact of adaptation and mitigating action. Figure 4 shows that under a scenario consistent with a 2 degree climate goal, for additional flood-induced damages to road infrastructure, the most relevant part of damages would occur in the Northern European region.[16] Sea flood damage would mainly affect, in both scenarios, the Central Northern European region.[17]

[14] See OECD (2015), Disaster Risk Financing: A global survey of practices and challenges, OECD Publishing, Paris.
[15] See Imperial College Business School, Climate Change and the Cost of Capital in Developing Countries. Assessing the impact of climate risks on sovereign borrowing costs.
[16] JRC Peseta II Project, 2014, table 20 and 22. Climate simulations under the reference scenario are derived from a medium-high emission scenario without mitigation ("business as usual scenario"). Under the assumption that no measures for adaptation or mitigation are taken, projections were made for the period 2070-2100. The 2C simulation is consistent with the EU 2°C climate goal.
[17] Countries with no direct access to the sea coast can be arguably impacted by sea floods damage estimate is 40 to 60 times more material than induced-flood damages, therefore the impact allocated to the area of Central Southern Europe most likely corresponds only to some of the countries involved.

Figure 1: Historic insurance coverage, debt and losses as share of public finance

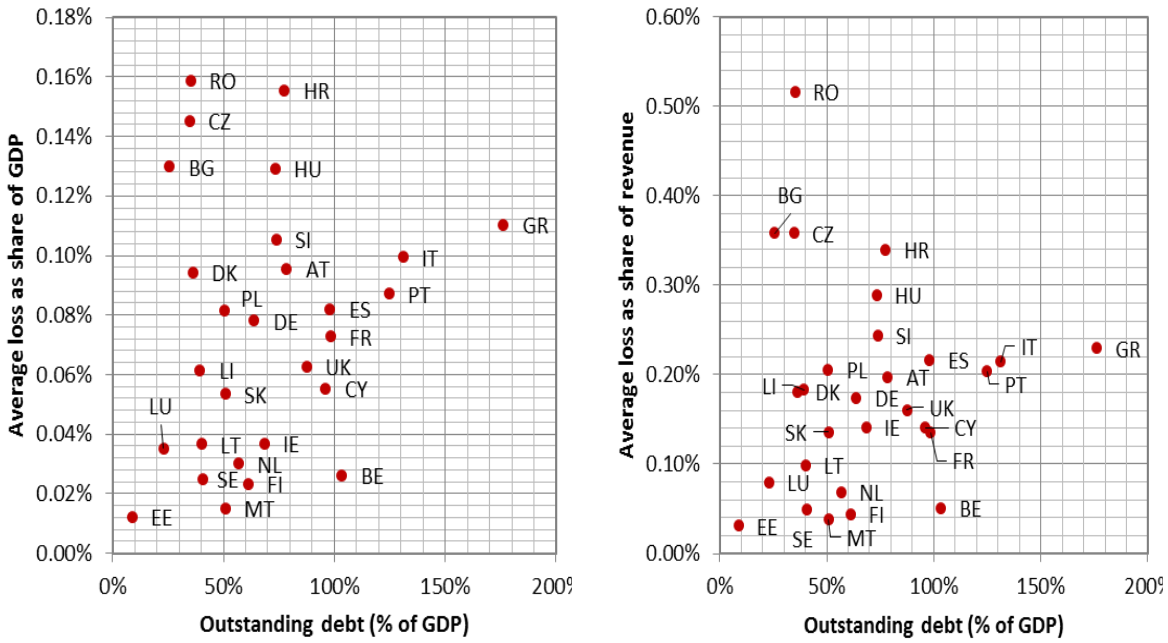






Note: Historic non-life insurance coverage and average annual loss based on data from 1980-2016.
Sources: EEA and Eurostat.

Figure 2: Losses and outstanding public debt



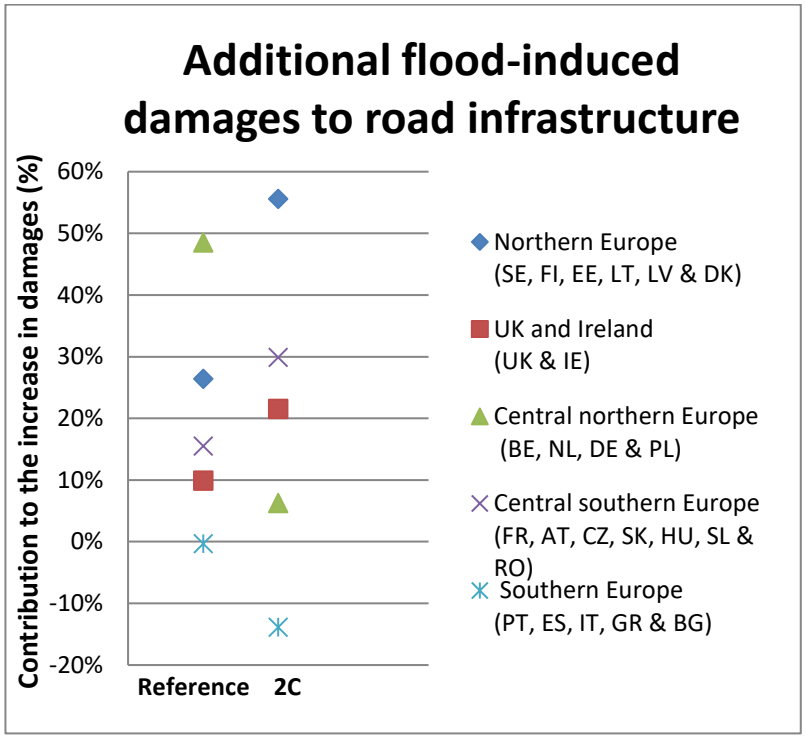
Note: Average loss data based on 1980-2016. Source: EEA. Public finance data from Eurostat.
Sources: EEA and Eurostat.

Figure 3: Additional flood induced damage across Europe

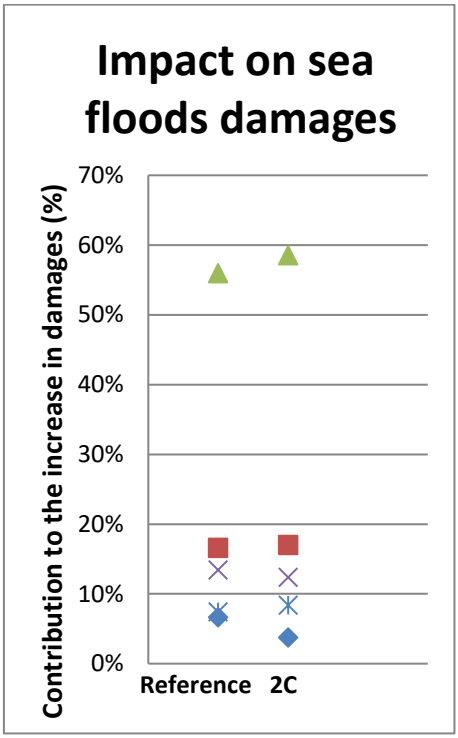
JRC Peseta II Project, 2014, tables 20 & 22	EU	Northern Europe (SE, FI, EE, LT, LV & DK)	UK and Ireland (UK & IE)	Central northern Europe (BE, NL, DE & PL)	Central southern Europe (FR, AT, CZ, SK, HU, SL & RO)	Southern Europe (PT, ES, IT, GR & BG)
Additional flood-induced damages to road infrastructure	**Increase € billion/year**	Contribution to the increase in damages (%)				
Reference Simulation	**303**	**26%**	**10%**	**49%**	**16%**	**0%**
2C Simulation	**144**	**56%**	**22%**	**6%**	**30%**	**-14%**
Impact on sea floods damage	**Increase € billion/year**	Contribution to the increase in damages (%)				
Reference Simulation	**12,196**	**7%**	**17%**	**56%**	**13%**	**7%**
2C Simulation	**8,824**	**4%**	**17%**	**59%**	**12%**	**8%**

Source: JRC Peseta II Project, 2014, table 20 and 22.

Figure 4: Contribution to additional flood damage across regions



Source: JRC PESETA II Project., 2014.
Table 20



Source: JRC PESETA II Project., 2014
Table 22

Elements for discussion

18. One of the most important risks today in relation to climate change is the failure to take measures in respect of climate change mitigation and adaptation.[18] As exposure and vulnerability are key drivers of the expected losses from climate change[19], truly transformative measures geared towards adaptation and mitigation are likely to be most effective.

19. There is an important role for the (re)insurance industry, through their risk-taking activity, to drive adaptation and mitigation measures. Insurers and reinsurers' risk management practices in assessing, modelling, pricing and underwriting natural catastrophe risks are crucial tools in managing risks from climate change. However, considering potential systemic implications on the overall economy, with vulnerabilities that may build up, and the possible impact on public finances, relevant government action should inherently be part of the solution.

20. Sustainable European natural catastrophe management will necessarily be multi-faceted and involve actors at local, national, regional and European level from industry, government, academia and civil society. Three areas are presented for taking the discussion forward.

Adaptation – insurability and affordability

21. Various measures are already available for improving insurance penetration.[20] In particular, higher insurance penetration for "new" catastrophe risks will be needed. Heat waves, drought and forest fires are the least insured today, even if they show sizeable losses, and increasingly due to climate change. The practice of combining multiple risks in a single policy or connecting the purchase of extreme weather insurance to more commonly required and mandatory products (e.g. mortgage contracts, fire insurance), could be part of the solution.

22. Measures to maintain insurability and affordability may in addition require public policy solutions.[21] National, regional or European risk pooling mechanisms should actively be considered, particularly in light of the cross-regional and cross-sectoral relevance of certain climate and weather-related developments.

23. Other measures, aiming at promoting risk-mitigating behaviour by insurance takers, or increasing the transparency on conditions and pricing for insurance coverage, may further support affordability and insurability.

Adaptation - risk management and modelling

24. By coordinating the gathering and exploitation of knowledge on natural disaster risk at a European level between European, national and regional authorities,

[18] World Economic Forum, The Global Risks Report 2019.

[19] European Commission, Insurance of weather and climate-related disaster risk: Inventory and analysis of mechanisms to support damage prevention in the EU, Final Report, August 2017.

[20] See the analysis conducted by the Geneva Association: Understanding and Addressing Global Insurance Protection Gaps, April 2018.

[21] See CRO Forum

scientists and industry, a European hazard map should be developed and made commonly available. Institutional agreements on knowledge and data (PPP) could further centralise and broaden the scope for synergies in collecting and analysing data and improving the responsiveness of adaptive and preventive measures. In this respect, big data analytics could play a part and the collection of sufficiently robust data provide for a more granular risk mapping.

25. As a crucial input, the insight from climate specialists, and analysts and model vendors on the scenario(s) for climate change should help in unhinging the next phase of model development for future natural catastrophe events, enabling the use of common stress scenarios across Europe.[22] This will increase the predictive value of reserving and capital allocation practices of (re)insurers to address risks arising from future extreme weather and climate-related events.

Mitigation – national and European concerted action

26. Private sector initiatives on risk mitigation (or adaptation) will need to be paired with overarching national government or European initiatives to ensure coherency of prevention or adaptation measures. Cross-border effects of natural hazards will also need to be increasingly taken into account in assessing the impact on regions across Europe.

27. At national level, governments should evaluate and disclose the potential (financial) exposures to extreme weather and climate-related risks in order to assess the sustainability of catastrophe risk coverage in their country.[23] Assessing and pursuing public risk financing options should be part of governments' adaptation and mitigating action, as well as pursuing, possibly in close exchange with private sector initiatives, concrete risk prevention measures and regulatory measures supporting sound risk management practices by their industry and citizens.

28. Advanced European solutions for providing financial relief and disaster management to countries who need to make relatively larger efforts compared to their GDP, due to higher exposure or higher financial strain, may be needed. Successful examples of national frameworks for (re)insuring natural catastrophe risks may prove relevant in developing further national, regional or European frameworks. Coordinated disaster recovery may mitigate the impact of extreme weather and climate-related events across Europe. [24]Cross-border (re)insurance and disaster management facilities may be of increasing relevance in certain EU regions and neighbouring countries. Institutional arrangements for sharing experience on national governments' intervention programmes should also increase the efficiency of disaster risk management and prevention.

[22] See: The Geneva Association. Managing Physical Climate Risk: Leveraging Innovations in Catastrophe Risk Modelling, November 2018.

[23] See: OECD Recommendation on Disaster Risk Financing, February 2017.

[24] At European level the European Civil Protection Mechanism provides direct disaster risk management. The European Commission proposes to strengthen the EU civil protection response to disasters (known as 'rescEU') by increasing preparedness and prevention. See: https://ec.europa.eu/commission/news/resceu-2018-dec-12_en.