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Overview of Natural and Man-made Disaster Risks the European Union may face

Commission Staff Working Document

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Executive Summary

Natural and man-made disasters affect the lives of European citizens, the European economy and the environment every year. Whether of natural or man-made origin, disasters are becoming increasingly extreme and complex, exacerbated by the impacts of climate change in our interlinked economies, and are by nature irrespective of national borders. There is a need to support the improvement of European capacities to assess risk, as the first step towards the development of disaster prevention and emergency plans, while allowing European countries to assess their levels of preparedness and capabilities to manage disasters.

In the context of the Union Civil Protection Mechanism (UCPM)[1], the European Commission has established a cross-sectoral overview of natural and man-made disaster risks the Union may face[2]. The Overview is developed using the results of national assessments of the main risks of natural and man-made disasters across the EU 28 Member States and the six non-EU countries participating in the UCPM[3].

As part of the UCPM legislation, Participating States provided the European Commission with summaries of the main elements of their National Risk Assessments (NRAs)[4]. Contributions received were of varying levels of details, and reflected varying levels of progress and completeness in the production of NRAs. Certain summaries demonstrated a high level of advancement in undertaking a national assessment of disaster risks and using this exercise to contribute directly to emergency planning[5]. In a relatively high number of cases, however, information on the range of disaster risks and their assessment at a national level remains limited or is not yet finalised. This exercise also highlighted the diverse landscape across Europe of very different risk management governance structures and risk management methods in place at national or appropriate sub-national levels. Finally, there is scope to strengthen the contribution of science to the knowledge base on disaster risks, by facilitating the use and uptake of science for policy and operational decision-making. The overview was produced taking into consideration these challenges and will be continuously improved through the work carried out by and with competent national authorities, with the support of the European Commission when needed.

NRAs identify and assess the natural and man-made disaster risks which would, if faced, require a response at a national or supra-national level[6]. Disaster risk types range from meteorological (flooding, extreme weather), climatological (forest fire, drought), geo-physical (earthquake, landslide, volcano) and biological (pandemic, epizootic, animal and plant diseases) natural disaster risks, to non-malicious man-made disaster risks of technological origin (industrial accident, radiological accident, critical infrastructure disruption), and

[1] Decision No 1313/2013/EU of the European Parliament and of the Council of 17 December 2013 on a Union Civil Protection Mechanism, OJ L 347, 20.12.2013, p. 924.
[2] Based on the European Commission Guidelines for Risk Assessment and Mapping, the temporal horizon for risk assessment should consider risks that may appear in the immediate future (one to five years ahead): Commission Staff Working Paper, 'Risk Assessment and Mapping Guidelines for Disaster Management', SEC(2010)1626 final, 21.12.2010, p.24
[3] Iceland, Norway, Serbia, Montenegro, former Yugoslav Republic of Macedonia, and Turkey.
[4] Based on Article 6 of the UCPM decision, Participating States submitted summaries of NRAs by 22 December 2015, and will do so every three years thereafter.
[5] A number of countries have published the main observations of their National Risk Assessments: Netherlands; Sweden; Ireland (undergoing review); Poland; United Kingdom; Norway.
[6] Good practice examples of NRAs and an overview of approaches and methodologies can be found in Annex.

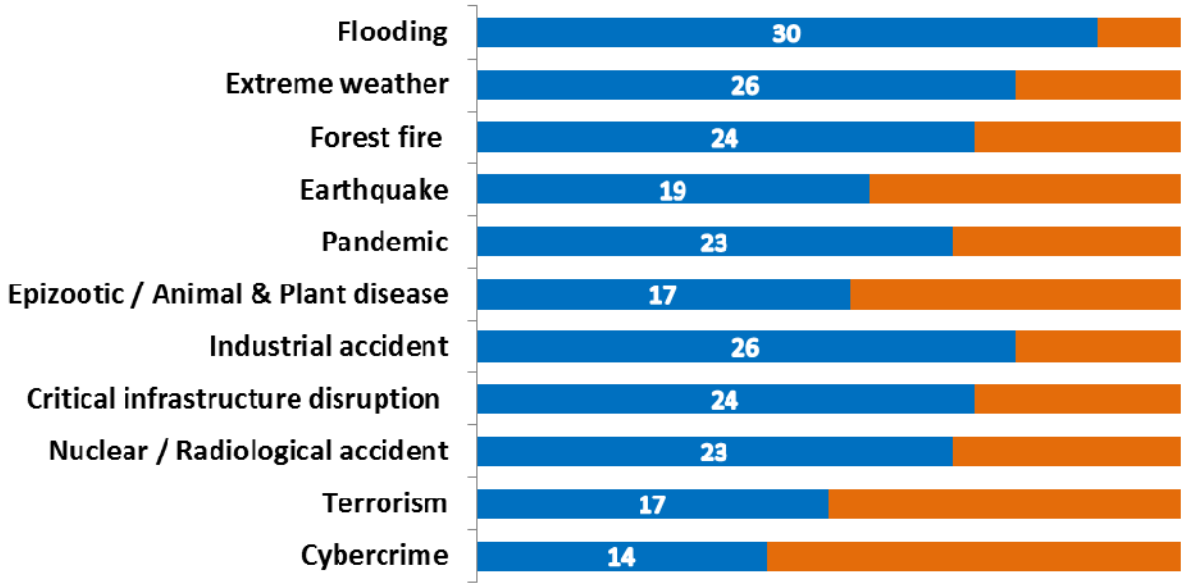
malicious man-made disaster risks and security threats (cybercrime, terrorism) closely associated with the European Agenda on Security[7].

Based on a comprehensive picture of disaster risks in a country, NRAs contribute to the establishing the risk-informed basis on which national disaster management is carried out. They inform capability assessments required for preparedness and response planning, and contribute to an improved recovery and reconstruction. Risk assessments also play an important risk reduction and preventive role by improving understanding of risks and contributing to the planning of preventive measures and the prioritisation of risk-informed investments.

The overview focuses on 11 main disaster risks extracted from National Risk Assessments: flooding; extreme weather; forest fire; earthquake; pandemic; epizootic; industrial accident; critical infrastructure disruption; nuclear and radiological accident; cybercrime and terrorism. An insight into new and emerging risks and a series of annexes presenting some national risk assessment good practices complete the overview.

The overview does not constitute, in itself, a European assessment of disaster risks. It builds on nationally-assessed disaster risks to reflect the complex landscape of disaster risks across Europe, the supra-national dimension of disaster risks and the relevance of their management to many policy areas at national, regional and European levels. The overview informs decision-makers of the main disaster risks to which Participating States in the UCPM are exposed, of the perceptions and assessments of these risks, and on the wealth of relevant processes, instruments and initiatives in place at a European level.

The following graph shows the number of UCPM Participating States, out of a total 34 countries, to have assessed each of the disaster risks covered in this risk overview.



Graph 1: number of UCPM Participating States having assessed each risk covered by the Overview of Risks

This technical exercise provides a basis for observations on how to improve national outputs and European added value for risk assessment and for the full disaster management cycle[8]:

[7] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, 'The European Agenda on Security', COM(2015) 185 final, 28.4.2015.

[8] From prevention to preparedness, response and recovery.

Towards a regional approach to disaster risk management

The need to reinforce the regional dimension of risks and subsequent risk management capabilities is expected to become increasingly relevant within the UCPM framework.

Disasters can happen irrespective of national borders. Natural and man-made events of a regional dimension can take the form of:

> i.) small-scale events may affect border regions – regional entities within and across countries may be vulnerable to certain risks and face a combination of obstacles: vulnerability of natural border environments; legal/administrative obstacles.
> ii.) Large-scale events with impacts across different countries, which may overwhelm capacities on a national scale[9].

Initiatives addressing disaster risk management on a supra-national scale exist, but these remain limited to a number of EU macro-regional strategies (Danube, Baltic Sea, Alpine, Adriatic-Ionian) or hazard-specific cooperative initiatives (e.g. Nordic Forum for Risk Analysis). Moreover, existing regional initiatives on risk management are not reflected in the risk assessment, risk management planning and response planning processes undertaken at national level.

The European Union may see a role to play to meet the existing gaps in the assessment and planning for such risks, complementing and supporting the work of competent authorities at national or appropriate sub-national levels. The UCPM legislation already promotes Member State cooperation to address common risks[10]. In the context of the Sendai framework for Disaster Risk Reduction, regional actions for disaster risk management are also central to its implementation. In this context, the European Commission could work on developing regional risk assessments, methodologies and tools, risk management and response plans, and regional preparedness exercises on which to strengthen the Emergency Response Coordination Centre and contribute to the implementation of the Sendai framework for DRR.

Strengthening methods and approaches to risk assessments

Based on the main outcomes of the overview and the good practice examples identified in national risk assessment approaches (see Annex 1), a number of technical observations also aim to contribute to improving Member State initiatives in undertaking disaster risk assessments:

- Disaster risks are complex and affect a multitude of sectors, levels of governance and connected infrastructures and services. Multiple shocks can happen simultaneously and one shock may lead to other shocks and aggravate the impacts. Interdependencies and cascading effects of disaster risks could therefore result in improving the management of complex disasters by bringing together competent authorities and streamlining approaches at all levels of disaster risk governance (example: links between critical infrastructure disruption, epizootic, extreme weather).

- Current timescales of risk assessments reflect a focus on immediate response needs. The long-term impacts of climate change, increasingly felt in Europe (ex: severe forest

[9] For example: Central European floods, 2010; Balkan floods, 2014; Icelandic volcanic eruption 2010
[10] See Decision 1313/2013/EU, *op.cit*., Art. 12.3 on capacity gaps; Art. 21.1.j on eligible actions.

fire seasons, 100-year floods every decade, etc.), as well as long term pressures on natural resources (e.g. poor management practices and population growth) are often not sufficiently taken into consideration in disaster management. Recognising the impact of climate change could be more substantially reflected in the assessment of disaster risks and in our approach to the collection of disaster loss and damage data. Defining trends and longer-term preventive measures to reduce future burden on response requires the integration of climate change impacts, in particular for natural disasters.

- Increasing evidence of emerging shocks and trends, such as the recent sudden influx of migrants and refugees, climate- and environment-induced migration, anti-microbial resistance, space weather and loss of biodiversity, point to a changing risk landscape in Europe. Addressing these risks in the risk assessment and response planning processes could reinforce national and European capacities for disaster management in the face of increasing future shocks.

1. Assessing disaster risks: a policy priority

Article 5(1).c of the UCPM decision tasks the European Commission to produce an overview of natural and man-made risks the EU may face. Among its main prevention priorities, the Commission shall 'improve the knowledge base on disaster risks and facilitate the sharing of knowledge, best practices and information', 'support and promote Member States' risk assessment and mapping activity' and 'establish and regularly update a cross-sectoral overview and map of natural and man-made disaster risks the Union may face'[11].

From an operational emergency management perspective, knowledge on disaster risks contributes to the work of national and sub-national civil protection authorities and the coordinating and supporting role of the Emergency Response Coordination Centre (ERCC) for response operations in the EU and abroad. In 2016 alone, the ERCC was engaged in 37 operations, including activations of the UCPM for assistance requests in the face of forest fires, flash floods and the European refugee crisis.

Improving a common understanding and mapping of the increasing risks of extreme and complex disasters across the EU is therefore a pre-condition to understanding the required capability to manage disaster risks at an EU level and, *in fine*, to ensure robust preparedness planning and timely and efficient operational response on the ground. Undertaking response planning for disaster risks of a regional scale is a collaborative process relying on the efficient organisation of UCPM support in case of catastrophic events, i.e. by better planning the sequencing of assistance, developing functional "packages" of assistance, identifying logistical and transport requirements upfront, and by making the best possible use of the European Emergency Response Capacity ('voluntary pool'). Knowing the common disaster risks can contribute to the work of the EU voluntary pool of pre-committed response assets, and inform of potential gaps in terms of available resources (e.g. forest fire fighting planes)[12]. Mapping the main disaster risks in the EU may also support the development and better integration of transnational Early Warning Systems (EWS), as well as the running of trainings, exercises and advisory missions. All rely on a strong scientific base of knowledge of disaster risks for information gathering, detection and monitoring.

In addition to the adoption of the UCPM legislation, a number of major policy developments have recently taken place, both at European and global level, which reinforce the policy importance of improving our understanding of disaster risks in Europe. A wide range of other EU policy processes are indeed closely associated to the management of disaster risks, in which the EU and its Member States have developed substantial experience in enhancing and mainstreaming disaster risk management[13]. In the context of the European Agenda on Security[14] and the Security Union communication[15] for example, the European Commission is further developing security risk assessments with Member States, the EU Intelligence and Situation Centre and relevant Agencies. Thorough analysis of security threats and vulnerabilities provide the basis for effective response at EU level.

[11] Art.5.1.c, Decision No 1313/2013/EU, *op.cit*

[12] See the Report from the Commission to the European Parliament and the Council on progress made and gaps remaining in the European Emergency Response Capacity, COM(2017)78 final, 17.2.2017.

[13] See a complete list of relevant EU policies in the Commission Staff Working Document "EU Policies contributing to Disaster Risk Management", SWD(2014)133 final, 8.4.2014.

[14] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, The European Agenda on Security, COM(2015)185 final, 28.4.2015

[15] Communication on delivering the European Agenda on Security to fight against terrorism and pave the way towards an effective and genuine Security Union, COM(2016) 230 final, 20.4.2016

Policy-makers need to ensure coherence and complementarity across the wealth of existing legislative frameworks, policy initiatives and scientific evidence. In this respect, initiatives such as the Community of Users on Secure, Safe and Resilient Societies[16] and the Disaster Risk Management Knowledge Centre[17] provide platforms for information exchange on research supporting inter alia the UCPM. Several actions undertaken by the European Commission in the framework of the Disaster Risk Management Knowledge Centre are meant to provide Participant States in the UCPM with useful and usable tools and guidelines to carry out disaster risk management activities, such as multi-hazard national risk assessment, the collection of disaster loss and damage data and the assessment of disaster risk management capabilities.

At a global level, the EU is contributing to the implementation of the UN Sendai Framework for Disaster Risk Reduction by providing a better understanding of disaster risks in its geographical region and contributing to a disaster risk informed approach to EU emergency management and other relevant policies. The Sendai framework provides a coherent agenda across EU policies to strengthen resilience to risks and shocks and supports the EU priorities of investment, competitiveness, research and innovation, building on existing links and defining potential gaps. It aims to move from disaster management to disaster risk management in order to reduce existing and prevent new disaster risks, through an all-hazards and all-of-society approach. Defined globally, the four key objectives of the Sendai framework set out clear mandates across civil protection and many other policies and actions. Under its first objective "Understanding Disaster Risks", the Sendai framework addresses data, risk and vulnerability assessment, and the sharing of good practices.

As part of its commitment to the implementation of the Sendai framework set out in a 'Sendai Action Plan'[18], the European Commission aims to build disaster risk knowledge across all EU policies. Undertaking of risk assessments, a better collection of loss and damage disaster data, and a strengthened engagement with the scientific community play a key role in defining risk-informed policies. The Sendai framework highlights the importance of collecting data regarding damages and losses occasioned by disasters. The need for damages and loss data collection contributes both to the effectiveness of DRR policies and strategies, as well as to the improvement of risk assessment models, which are used not only in the frame of the NRAs, but also as integrated part of the Early Warning Systems.

By reinforcing a risk-informed approach to policy-making, the European Commission also contributes to the implementation of other global commitments such as the Paris Agreement on climate change, the New Urban Agenda, and the overarching 2030 Agenda for Sustainable Development. Disaster resilience and disaster risk management are both considered critical to poverty reduction and enablers of sustainable development in the EU's strategy for implementing the UN 2030 Agenda for Sustainable Development and meeting the Sustainable Development Goals (SDGs)[19].

[16] A Community of Users on Secure, Safe and Resilient Societies (CoU) – Mapping EU policies and FP7 research for enhancing partnerships in H2020, https://www.securityresearch-cou.eu/
[17] Disaster Risk Management Knowledge Centre platform: http://drmkc.jrc.ec.europa.eu/
[18] See: Action Plan on the Sendai Framework for Disaster Risk Reduction 2015-2030: a disaster risk-informed approach for all EU policies, SWD(2016)205 final/2, 17.6.2016.
[19] Commission Communication, Next steps for a sustainable European future: European action for sustainability, COM(2016)739 final, 22.11.2016; Commission Communication, The Road from Paris: assessing the implications of the Paris Agreement and accompanying the proposal for a Council decision on the signing, on behalf of the European Union, of the Paris Agreement adopted under the United Nations Framework Convention on Climate Change, COM(2016)110 final, 2.3.2016.

2. Key trends

2.1. Interdependencies and cascading effects

Managing disaster risks efficiently requires an all-hazards and multi-risk approach, as is reflected in the European Commission Guidelines for Risk Assessment and Mapping[20] and the objectives of the Sendai framework for Disaster Risk Reduction. A comprehensive approach to disaster risks should address all types of risk – small-scale, large-scale, frequent and infrequent, sudden and slow-onset – across all natural and man-made hazards as well as within and across all sectors.

An all-hazard approach to disaster risk management requires that the assessment of disaster risks takes into account cascading, or domino, effects – i.e. the situation for which an adverse event triggers one or more sequential events – and interdependencies of risks. Risk assessments are essential to identify the interrelations between different types of significant risks, as well as the potential cascading effects requiring cross-sectorial and at times international cooperation. Taking a multi-hazard, systemic approach also implies assessing new risks that could be generated by some of the current social and economic trends and their inter-dependencies.

In the case of national assessments of natural disaster risks carried out by Denmark, Norway, Romania, Hungary and the United Kingdom, links are underlined between severe weather phenomena such as storms, snowfall and heavy precipitation and an increased risk of floods and, in the case of Italy, with landslides. The United Kingdom and Ireland point to the impacts of infrastructure disruption on risks of flood and environmental pollution, as well as further cascading effects on other forms of critical infrastructure across a range of sectors; the loss of critical infrastructure, nuclear and industrial accidents may also be linked to increased risks of terrorist and cyber-attacks.

Certain cascading effects may result in what are known as 'Natech' risks – i.e. technological accidents resulting from natural events. Cyprus, Denmark, Lithuania, Sweden and Norway address Natech risks such as the cascading effects of severe weather phenomena such as storms and heavy precipitation on an increased risk of pollution, loss of critical infrastructure and transport accidents resulting from difficult manoeuvring conditions. Bulgaria points to the indirect damage that could be caused by an earthquake such as chemical and radioactive contamination, and disruption of vital goods, supplies and services.

Links between natural and man-made hazards reinforce the need to focus on the interdependency of hazards, vulnerability and potential impacts on system performance (casualties, service downtime, revenue loss, environmental impact, etc.) associated with the delivery of services by vital infrastructure. Indeed, in addition to having a significant social and economic value, vital infrastructure is an essential vehicle to provide lifeline services to the population affected by a disaster and to restart its social and economic recovery. A performance-based approach to risk assessment goes beyond the focus on reducing physical damage to infrastructure, to help draw a more dynamic picture of risks and enhance contingency planning and response operations by emergency authorities. Developing resilience indicators for recovering services disrupted by an event can also help better inform disaster response plans and accelerate recovery.

[20] SEC(2010)1626 final, 21.12.2010, *op.cit.*

2.2. Cross-border and regional risks

Understanding the cross-border dimension of disaster risks is central to developing a comprehensive picture of risks at a European scale, identifying interdependencies and enhancing preparedness and response through the coordination of the ERCC. Cross-border dimensions of risks are addressed ad-hoc at national level, and could benefit from a more systematic focus in future risk assessments.

Most natural and man-made disasters present cross-border risks due to their geographical nature (earthquakes, fires, severe weather, floods and space weather), as well as the volatility and scale of their impacts (pandemics, livestock epidemics, nuclear/industrial accidents). The human, economic or environmental impacts of these hazards, as well as their likelihood of occurrence exist irrespective of national borders. In fact, cross-border risks may extend beyond the borders of the EU[21], particularly for countries in the Southern and Eastern Neighbourhoods, and globally (e.g. cyber-attacks; terrorist attacks; geopolitical threats; pandemics; risks from Neighbourhood countries from possible contamination of groundwater deriving from waste dumps, poorly safeguarded old mines, as well as risks from accidents on the sea, in particular of vessels carrying oil or chemicals; etc.).

A number of national assessments highlight the cross-border or global nature of certain risks, which may require cross-sectoral and even international cooperation. While assessing risks of a national and sub-national character is common practice for national authorities, risk assessments of cross-border or global hazards can present certain challenges (e.g. defining accurately probability of occurrence). As Austria's risk assessment highlights, this can be the case for certain hazards such as communicable diseases, nuclear accidents and, in certain contexts, malicious events and electricity outages. The risk assessment undertaken by Bulgaria distinguishes the risk of accident with subsequent radioactive contamination both within and outside the country's territory.

A number of initiatives are under way to address the regional dimension of disaster risks, defined predominantly by geographical groupings of countries exposed to similar hazard types:

- The Benelux Region has undertaken an identification and assessment of cross-border risks across the 3 Benelux countries and the German region of North-Rhine-Westphalia; while this exercise does not influence the outcomes of risk assessments at national level, it offers a reflection on the regional dimension of key disaster risks[22].
- Cross-border cooperation programmes ('Interreg') under the European Territorial Cooperation goal of Cohesion Policy[23] incentivise cross-border risk assessments in EU border regions as well as investment in risk prevention; preparedness and response (e.g. border crossing of emergency vehicles, downstream flood or pollution alerts, etc.). The European Commission is currently assessing ways to alleviate legal and administrative border obstacles, which currently hinder joint mechanisms in border regions.
- In the context of the macro-regional EU Strategy for the Baltic Sea Region, work focuses on the development of scenarios and the identification of gaps for the main hazards in the region[24]. Questions related to climate change mitigation, adaptation and emergency management at sea are also addressed in the Strategy.

[21] The impact of the 2010 volcanic eruption in Iceland on European airspace offers a telling example.
[22] http://www.benelux.int/fr/publications/publications/inventaire-benelux-des-risques-transfrontaliers
[23] http://ec.europa.eu/regional_policy/fr/policy/cooperation/european-territorial/
[24] See activities of Project 'From GAPS to CAPS – Risk Management Capability on GAPS Identification in the Baltic Sea Region': http://www.balticsea-region.eu/ ; the project focus areas are: storms/extreme weather, flooding, pandemic flu, accidents at sea, nuclear accidents, and forest fires.

- One of the priority areas of the macro-regional EU Strategy for the Danube Region focuses on environmental risks, their assessments and management[25].
- Other macro-regional initiatives under which environmental risks may be looked at in a coordinated manner include the EU Strategy for the Adriatic and Ionian Region (2014) and the EU Strategy for the Alpine Region (2015).
- Nordic collaboration through the Nordic Forum for Risk Analysis and Strategic Foresight brings together Emergency Management authorities of Norway, Denmark, Sweden, Iceland and Finland to improve collective understanding and learning on common disaster risks[26].
- Regional initiatives are also run through EU-financed projects, such as the BE-AWARE (I & II) projects under the scope of the Bonn Agreement addressing marine pollution in the North Sea area[27]; and the SEERISK project on the development and testing of a common risk assessment methodology in the Danube macro-region[28].
- In the field of pandemic risk management, the Global Research Collaboration for Infectious Disease Preparedness (GloPID-R[29]) is a network of 26 research funding organisations and the World Health Organisation in the area of infectious disease preparedness research. It was established in 2013 with the aim to facilitate an effective research response within 48 hours of a significant outbreak of a new or re-emerging infectious disease with pandemic potential.

The Copernicus programme[30] of the European Commission establishes a European capacity for Earth Observation. Copernicus has specifically designed services to meet user requirements. In the context of risks addressed in the NRA three of the six Copernicus Services are of utmost relevance: Emergency Management, and, to some extent, the Security and Climate Change Services. The Emergency Management Service (EMS) operates as a tool for emergency response to natural and man-made disasters as well as facilitating the other parts of the disaster management cycle (preparedness, prevention, and recovery) with risk assessment, vulnerability assessment and recovery plans. Hazards mapped by the EMS include: earthquake, volcano, flood, tsunami, landslide, storm, hurricane, cyclone, technological accident, border control and maritime surveillance.

The importance of these initiatives is paramount to better define a picture of disaster risks at a European level, and in turn support the work of the European Commission in reducing the risk of disasters and planning response actions in a coordinated and solidary way across the EU.

2.3. Climate change impacts

Adaptation to climate change is an important component of Member States' climate policies, which shares many linkages with disaster risk reduction and prevention. Improving knowledge of the main natural disaster risks across the EU through the undertaking of vulnerability assessments at national level feeds into addressing the exposure and vulnerability to climate-

[25] http://www.danube-region.eu/
[26] Work has been carried out on a regional risk assessment of a volcanic eruption originating in Iceland
[27] http://www.bonnagreement.org/be-aware; project funded by the European Commission Civil Protection financial instrument
[28] http://www.seeriskproject.eu/seerisk/#main ; project funded by the European Regional Development Fund (South East Europe Transnational Cooperation Programme)
[29] https://www.glopid-r.org/
[30] www.copernicus.eu

related risks and contributes to promoting resilience in the EU and to the implementation of the EU Adaptation Strategy[31].

The 2013 Commission Communication on an EU Strategy on adaptation to climate change points to the increase of extreme events resulting from climate change and to the need for adequate adaptation actions; it states that "the consequences of climate change are increasingly being felt in Europe and worldwide. The average global temperature, currently around 0.8°C above pre-industrial levels, continues to rise. Some natural processes are being altered, precipitation patterns are changing, glaciers are melting, and sea levels are rising".[32]

Extreme events have increased in Europe, with more heat waves, droughts and forest fires in southern and central Europe, while the number of floods and instances of heavy precipitation has increased in Northern and North-eastern Europe. Slow-onset events and longer-term changes in temperature and precipitation may also contribute to increasing disaster risks in Europe (e.g. climatic changes impacting exposure to disease outbreaks). Even in the case of modest scenarios of climate change, economic costs can potentially be high,; in the case of more severe scenarios of global warming, costs rise significantly. The projected damage costs from climate change are highest in southern Europe. Estimates of the projected economic impacts of climate change in Europe, however, only consider certain sectors and uncertainty remains high.[33]

Based on the European Commission Guidelines for Risk Assessment and Mapping[34], the overview supports a forward-looking approach to the assessment and understanding of disaster risks. Most of the scenarios used in NRAs are characterised by a short time window, looking at potential events occurring in the next five years. By considering longer-term periods (e.g.: 25-35 years), in particular for natural events, disaster risk assessments could enlarge their potential benefits by defining longer term purposes and widening the range of end-users. Longer-term periods could allow capturing of broad trends, emerging risks and the potential impacts of climate change on certain types of natural disasters, and therefore allow developing better risk-informed policies and programmes in support of more resilient development. In line with this, it is necessary to better integrate and account for climate change effects over the likelihood of some phenomena and their related impacts.

In line with the Sendai framework to better tackle underlying risk drivers to reduce exposure and vulnerability to disaster risks, NRAs should reinforce their attention to the impacts of climate change on disaster risks. Stressing the climate angle of disaster risk assessments may strengthen the important contribution of climate change adaptation to disaster risk reduction and resilience building. Stronger links with climate vulnerability assessments would contribute to more robust risk assessments of all types of disasters.

3. Disaster Risks in the EU: Overview

NRAs produced by EU Member States and Participating States in the UCPM are the main source of disaster risk evidence for this overview. Numerous policy and technical initiatives

[31] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, An EU Strategy on adaptation to climate change, COM(2013) 216 final, 16.4.2013, p.2.
[32] Ibid, p.2; See also the European Environment Agency report 'Climate Change, impacts and vulnerability in Europe 2016', EEA Report No 1/2017.
[33] EEA Report No 1/2017, *op.cit,* p.283.
[34] SEC(2010)1626, *op.cit.*

undertaken by the European Commission and relevant external stakeholders have been taken into account in this exercise.

NRAs identify major disaster risks which would, if faced, require a response on a national or supra-national level – see Annexes 1 and 2. They tend to be used to provide the evidence base to inform prioritisation of disaster prevention measures, preparedness and response planning, and related investments. The existence of risk assessments for disaster management was introduced as a precondition for funding from the European Structural and Investment Funds in the 2014-2020 period, which contributed positively to the implementation of prevention measures under the UCPM.

NRAs are reviewed regularly, following nationally-defined cycles and methodologies – see Annex 1. Participating States in the Mechanism were provided with risk assessment and mapping guidelines produced by the European Commission to support the technical development of comprehensive NRAs[35]. This voluntary tool was used in varying degrees of detail, and is regarded by the European Commission to be an important supporting contribution to the risk assessment exercise.

As terminology and definitions differ from one country to another, a baseline set of definitions is used: a *disaster* is understood to describe any situation which has or may have a severe impact on people, the environment or property, including cultural heritage. By *disaster risk*, is understood as the potential loss of life, injury, destroyed or damaged assets which could occur to a system, society or community in a specific period of time, determined by taking into account hazard (both natural and man-made), exposure, vulnerability and capacity[36] – the *assessment of risks* of disasters refers to the overall cross-sectorial process of risk identification, risk analysis, and risk evaluation[37]. Further terms are defined in the European Commission guidelines for risk assessment and mapping, which regroups definitions agreed at UN level or defined under ISO 31010[38].

This document builds on Staff Working Document (2014)134[39], as well as new developments across relevant policy areas at national, EU and global levels. It is a living document to be updated regularly in order to reflect the dynamic nature of disaster risks and risk drivers, evolving trends in vulnerability and coping capacity across the EU, and the cyclical reviews of NRAs undertaken at national level.

The following table provides an exhaustive list of the main disaster risks assessed per UCPM participating country:

	Geological	Hydro-logical	Meteorological	Climatological	Extra-terrestrial	Biological / Environ-mental	Industrial / Infrastructural	Socio-economic	Security
AT	Earthquake Avalanche	Flood	Extreme weather (heavy rain, snowfall, heat, cold, hail, storms)	Forest fire	-	Pandemic; Communicable diseases; Pollution	Industrial accident; Nuclear accident; Transport accident; Breakdown of critical infrastructure	Disruption of supplies	Terrorism

[35] SEC(2010) 1626 final, *op.cit*
[36] UN Terminology related to Disaster Risk Reduction, produced by the Open-Ended Expert Inter-Governmental Working Group on Sendai Indicators OEIGW, 2016.
[37] Article 4, Decision No.1313/2013/EU, *op.cit*
[38] SEC(2010)1626, *op.cit*
[39] Commission Staff Working Document, Overview of natural and man-made disaster risks in the EU, SWD(2014)134 final, 8.4.2014

BE (top 10 risks)	-	Basin flood	Extreme temperatures (heat-wave)	-	-	Influenza pandemic; Large-scale environmental pollution	-	-	Terrorism; Cyber terrorism / intrusion into critical infrastructure; Mass migration flow; terrorism infiltration of migration flow; Industrial espionage
BG	Earthquake	Flood; Landside	Extreme weather and climatic conditions (heavy rain, heavy snow, freezing conditions, storms, strong winds, drought, heat-waves)	Drought; Forest fire	-	Epidemic; Epizootic; Environmental pollution	Industrial accident; Radioactive release; Transport accident (road)	-	Terrorism
CY	Earthquake; Tsunami	Flood; Wave action	Strong wind; Thunderstorm; Extreme temperatures; Asian dust cloud	Drought; Forest/Wildfire; Sea level rise	-	-	-	-	Cyber incident
CZ	-	Flood (flash and special flood); Landslide	Extreme wind; Heavy rainfall; Extreme temperatures	Drought	-	Epidemic; Epizootic; Epiphytic	Power outage; Chemical release; Radioactive release; Information infrastructure disturbance; Gas/petroleum supply disturbance	Financial and exchange market disturbance; Food/water supply disturbance	Terrorism; Mass migration flow; information security disturbance
DE	Earthquake	Flood (storm surge)	Extreme temperatures (cold wave and heat-wave); Heavy precipitation	Forest/Wildfire, Drought	Solar storm, meteorite impact, space debris	Animal disease / zoonosis; Pest (crop pathogens);	Power outage; Release of chemical substance; release of radioactive material	-	-
DK	-	Flood (storm surge)	Strong storm / hurricane; Heavy rainfall / cloudburst	-	-	Pandemic influenza; Animal disease / zoonosis; Marine pollution; Land pollution (dangerous substances)	Radioactive release; Transport accident (air, land, sea); Industrial accidents	-	Terrorism; Cyber-attack
EE	-	Flood; ice breakup;	Storm; Accident during Extreme temperatures	Forest/Wildfire	-	Epidemic; Mass intoxication; Foreign health incident; Epizootic; Marine, coastal, inland pollution	Industrial accident; Structural explosion / collapse; Fire; Chemical release; Radioactive release; Transport accident (air, land, sea)	-	Sudden armed attack; Refugees; Large-scale prison riot; Mass riot; Cyber-attack
ES	Earthquake; Volcano	Flood	-	Forest/Wildfire	-	-	Industrial accident involving dangerous substances	-	-
FI	-	Watercourse overflow/ Storm water/ storm surge	Thunderstorm; Large-scale winter storm + extreme cold temperatures	Forest/Wildfire	Solar storm (100-year)	Pandemic	Power outage; Fire at critical infrastructure; Chemical release; Radioactive release; Transport accident (air, land, sea)	Extensive / extended water supply disturbance	Terrorism; Cyber-attack; Serious act of targeted violence; Violent, large-scale civil disturbance; Mass influx migration; Foreign security / political crisis
FR	Earthquake; Volcano	Flood; Tsunami; Avalanche	Cyclone; Heavy rainfall; Heavy snowfall; Extreme temperatures	Forest/Wildfire	-	-	Industrial accident; Mining accident; Radioactive release; Dam failure	-	-
GR	Earthquake	Flood; Landslide; Wave action	-	Forest/Wildfire	-	-	Industrial accident	-	-
HR	Earthquake	Flood (result of spills of inland water bodies)	Snow & ice; Extreme temperature	Drought; Forest fire		Epizootic; Pandemic; Animal disease; Salinisation	Industrial accident	-	-

HU	Surface mass movement, Earthquake	Flood (incl. flash flood and inland inundation)	Storm; Extreme temperatures	Forest/Wildfire; Drought	Geomagnetic storm	Pandemic; Animal and plant health; Invasive allergenic toxic plants	Radioactive release; Industrial accident	-	Terrorism; Migration; Cyber-attack
IE[40]	Volcano	Flood	Storm; Snowfall; Extreme temperatures	Drought	-	Pandemic; Animal incident; Waterborne / foodborne outbreak	Industrial accident; power outage; Fire; Radioactive release; Transport accident (air, land, sea; road); Loss of critical infrastructure	Crowd safety incident	Terrorism; Cyber-attack; Public disorder
IT	Earthquake; Volcano	Flood; Landslide	Storm with strong wind	Forest/Wildfire	-	-	-	-	-
LV	-	Flood	Storm	Forest/Wildfire	-	Pandemic; River water pollution; Marine pollution	Industrial accident; Critical information infrastructure disturbance; Transport accident (air, land, sea)	-	-
LT	-	Flood; Ice drift; Ice field	Storm; Extreme temperatures; Tropical cyclone	Drought	-	Epidemic; Pandemic; Epizootic; Pest; Insect infestation; Animal incident (suffocation of fish; animal famine); Pollution	Industrial accident; Power outage; Fire; Chemical release; Radioactive release; Transport accident (air, land, sea); Communication infrastructure disturbance	Disruption to governing bodies; Destruction of cultural heritage	Terrorism; Cyber-attack; Civil unrest / riots; Hostage-taking
LU	-	-	Storms; heavy rainfall; and extreme (high) temperatures	-	-	Pandemic	Loss of critical infrastructures or services; Power outage; Chemical release; Radioactive release; CBRN accident; Hydraulic infrastructure accident	-	Terrorism; Cyber-attack; Maritime piracy
MT	Earthquake	Flood	Extreme temperatures	Drought	-	Pandemic; Maritime oil spill	Loss / disruption of critical infrastructure; Aviation accident; Navigation accident; 'Natech' accident	Major social event	Terrorism; Cyber-attack; Migration
NL	-	Flood (river, coastal)	Severe storm; Severe snowstorm; Black ice; Extreme temperatures	Drought	Solar storm + satellite disruption	Pandemic	National power failure (accident + malicious); IP network failure (ICT); Prolonged electricity failure; Cyber incident (espionage; conflict); Radioactive release; Transport accident (rail)	Food supply shortage; Market manipulation; Disruption to governing bodies	Terrorism; Political / religious extremism; Foreign crisis
PL	-	Flood; Landslide	Rainfall; Snowfall; Storm; Extreme temperatures	Forest/Wildfire	-	Epidemic; Epizootic	Electricity, fuel and gas supply disruptions; Chemical release; Radioactive release; Telecommunication infrastructure disruption; Construction disasters	Disruption of public bodies / buildings	Social protest
PT	Earthquake	Flood; Landslide; Wave action	Extreme temperatures	Forest/Wildfire; Drought	-	-	Industrial accident; Structural collapse; Fire; Radioactive release; Transport accident (air, land, sea)	-	-
RO	Earthquake	Flood; Landslide	-	Forest/Wildfire; Drought	-	Pandemic; Animal disease	Radioactive release; Industrial accident	-	-
SE	Earthquake, volcanic eruption	Flood; Landslide	Storm; Extreme Temperature (Heat-wave)	Forest and vegetation fire	Solar storm;	Pandemic; Epidemic; Pest;	Disruption to the energy supply; Fire; Emission of hazardous substances (CBRNE); Transport accident; Dam failure; Disruption to electronic communications	Transport disruption; Drinking water supply disruption; Disruption to the payment system; Disruption in food supply; Disruption to the supply of drugs	Terrorism; Cyber-attacks; School shooting; Violent disturbances
SK	Earthquake; Volcano; Mass	Flood; Landside	Thunderstorm; Heavy rainfall; Extreme	Forest/Wildfire; Drought	-	Pandemic; Pest; Insect infestation;	Industrial accident; Power outage; Fire; Explosion;	Financial crisis; Disruption of	Disruption of public order; CBRN attack;

[40] Currently under review.

	movement (avalanche)		temperatures			Animal disease; Pollution	Chemical release; Radioactive release; GMO release; Mining accident; Transport accident (air, land sea); ICT accident; Water infrastructure accident; Oil and gas supply disruption	schools; Healthcare disruption; Food supply disruption; Waste management disruption	Migration; National / ethnic / religious conflict; Disruption of armed forces
SI	Earthquake	Flood	Sleet	Forest/Wildfire; Drought	-	Pandemic; Animal disease	Release of dangerous substances; Radioactive release; Transport accident (aircraft; railway)	-	Terrorism
UK	Volcano	Flood	Storm; Extreme temperatures	Forest/Wildfire; Drought	Space weather	Pandemic; Animal disease; Poor air quality	Industrial accident; Power outage; Dangerous substance release; Transport accident (air, land, sea)	-	Terrorism; Cyber-attack; Widespread public disorder; Disruptive industrial action
FYROM	-	-	-	-	-	-	-	-	-
IS	Earthquake; Volcano; Mass movement (avalanche)	Flood; Wave action (storm surge); Tsunami; Landslide; Drift ice	-	Climate change; Geo-thermal events; Forest/Wildfire	-	Pandemic; Animal disease; Pollution	Mass casualty accident (land, sea, air); traffic disruption; CBRN accident; Utility and infrastructure breakdown; Dam or structure failure	Food security, supply; Tourism safety	Terrorism; Civil and political disruption and unrest; Sabotage
MNE	-	-	-	-	-	-	-	-	-
NO	Earthquake; Volcano	Flood; Landslide	Storm/hurricane/ice storm/heavy precipitation/ extreme temperature	Forest/Wildfire	Space weather	Pandemic	Industrial accident; Fire; Chemical release; Radioactive release; Transport accident (land, sea); Disruption to the energy supply	-	Terrorism; Strategic attack; Cyber-attack (financial and communication infra.)
SB	Earthquake	Flood; Landslide + erosion	Storm wind; Hail; Snow blizzard, snow drift and glaze ice	Drought	-	Epidemic; Epizootic	Fire and explosion; Technological accident; Radioactive release	-	Terrorism
TR	-	-	-	-	-	-	-	-	-

Table 1: List of disaster risks assessed in NRAs, as identified in summaries of NRAs submitted to the European Commission,

Various 'similar' hazards were grouped together under common terminology to facilitate the overview process. This includes: flooding understood in broad terms to include floods from rivers, mountain torrents, Mediterranean ephemeral water courses, and floods from the sea in coastal areas, and may exclude floods from sewage systems, as defined under the European Floods Directive[41]; severe weather includes storms, heat waves, snow/ice, and rain; pandemics and epidemics are addressed together and refer to the main current pandemic risk in Europe, influenza; chemical accidents and the release of chemical substances are grouped together, as are nuclear and radiological accidents and the release of radioactive substances; transport accidents include air, land, maritime and hazardous material transport accidents; the variants of cyber security risks, both malicious and non-malicious are regrouped under cyber threats, as is also the case for terrorist threats.

Drawing on the wealth of information in NRAs, the following risk fiches inform on the essential elements for each of the most frequently assessed disaster risks. The risk fiches provide a concise source of knowledge to inform decision-making in both operational and policy areas. The overview of risks, and the content of the risk fiches, will be updated as revisions of NRAs are provided to the European Commission[42], as well as to incorporate new evidence stemming from science and operations.

[41] Article 2, Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks, OJ L 288, 6.11.2007, pp. 27-34.
[42] Next deadline for submission by Participating States of summaries of their NRAs is set at 22 December 2018, as per Article 6 of the UCPM decision, *op.cit.*

Flooding

Flooding affects more people worldwide than any other hazard. It is the main risk faced by European emergency management authorities.

Flood events occur frequently across the EU in the form of river, flash and water surface floods, and coastal flooding. While flood risks in some areas of Europe can be considered of limited significance – in areas of low population density, low economic or ecological value – many areas are prone to one or more flood type. The most common source of reported historical flood events is by far fluvial (66% of events) followed by pluvial (20%) and sea water (16%)[43].

The vulnerability of the population to flood risk varies greatly according to risk drivers such as geographical exposure (floodplains), quality of urban planning and housing conditions. Land use and management practices can influence the intensity of fluvial and pluvial floods, based on the different capacity of retention of water in soil and vegetation. Industrial, commercial and residential developments in floodplains, combined with climate change, make flooding a very dynamic risk.

Recent activations of the UCPM for European emergency assistance to respond to major flood events in Europe were carried out by the Former Yugoslav Republic of Macedonia and Albania (2015, 2016), Bosnia and Herzegovina, Serbia and Croatia (2014). Monitoring by the ERCC also addressed events in the United Kingdom and Slovenia (2014); the Italian island of Sardinia, France and Slovakia (2013); and in Austria, Germany and the Czech Republic (2013).

In terms of economic impact, a number of recent major flood events resulted in important estimated economic losses across Europe, for which the Solidarity Fund was activated; examples include: EUR 400 million in Greece (Central and Evros regions) in 2015; over EUR 1.5 billion in Croatia, Serbia and Romania in 2014; EUR 2.2 billion in Italy, and EUR 311 million in Bulgaria in the same year; EUR 9.5 billion in Germany, Austria, Hungary and the Czech Republic in 2013; over EUR 380 million in Slovenia, Croatia and Austria in 2012; EUR 2.9 billion in Poland, EUR 875 million in Romania, EUR 719 million in Hungary, EUR 561 million in Slovakia, and over EUR 300 million in Slovenia and Croatia in 2010 alone; EUR 4.6 billion in the United Kingdom in 2007; EUR 14.3 billion in Germany, Austria and the Czech Republic in 2002. Overall, the EU Solidarity Fund has mobilised over EUR 1.9 billion in financial assistance in response to flood events since 2002[44].

Impacts & cascading effects

Flooding is a complex process involving socio-economic and physical factors, with potential significant impacts on people, businesses, infrastructure and services, but also to the environment and cultural heritage.

Potential cascading effects of a flood event may include the loss of vital infrastructure, the outbreak of epidemic or epizootic events, damage to industrial facilities causing the release of chemical or radioactive substances.

Cross-border dimension

While many flood events present an extensive risk – high frequency but the localised impacts, limited in time and severity – major floods can affect vast areas, have very dramatic impacts,

[43] European Overview Assessment of Member States' reports on Preliminary Flood Risk Assessment and Identification of Areas of Potentially Significant Flood Risk, Final Report, European Union, 2016, p.36

[44] EU Solidarity Fund, Overview 2002-2016, http://ec.europa.eu/regional_policy/sources/thefunds/doc/applications_overview_en.pdf

including across borders (e.g. flood event in the Balkans, 2014).

Most waterways in Europe are characterised by river basins located in more than one country (e.g. Danube river basin). Countries located along the same river basin region will be exposed to similar flood risks (e.g. flood risks assessed in Bulgaria, Croatia, Hungary and Romania – see table below).

Climate change

The increased frequency and severity of flood events in Europe may be associated with climate change. Countries assessing flood risks recognise the growing role of climate change (see table below).

Policy context

The Foods Directive on the assessment and management of flood risks was adopted in 2007[45]. Its main provisions include the requirement to assess if all river basin districts (or other unit of management including coastal areas) are at risk from flooding, to map the flood extent and assets and humans at risk in these areas and to take adequate and coordinated measures (flood management plans) to reduce this flood risk. Article 4 of the Directive requires Member States to undertake a Preliminary Flood Risk Assessment (PFRA) for each River Basin District, Unit of Management, or the portion of an international River Basin District or Unit of Management lying within their territory (a revision of the PFRA reports are to be submitted to the Commission by the end of 2018).

Member States and regions have allocated EUR 8 billion for climate change adaptation and risk prevention and management for the 2014-2020 period from the European Regional Development Fund (ERDF) and Cohesion Fund, including for cross-border and transnational cooperation. These investments address various types of risks, although the predominant focus is on flood prevention.

As regards the Common Agricultural Policy (CAP) at least 30% of the European Agricultural Fund for Rural Development (EAFRD) had to be programmed in support of actions linked to climate change adaptation and mitigation and environmental care. Eventually, this resulted into an amount around 50 billion euro, corresponding to some 50% of the EAFRD envelope. Moreover, Member States can provide support for investments in preventive actions against natural disasters and climatic events. Furthermore, territorial ecosystems and the impacts of extreme events and climate change represent explicit objectives of the support under the rural development pillar of the Common Agricultural Policy.[46]

The European Flood Awareness System (EFAS)[47], started in 2002, is the first operational system that monitors and forecasts flood events across Europe. This Early Warning component of the Copernicus Emergency Management Service provides its partners (national/regional authorities, as well as the ERCC) with a wide range of complementary, added value flood early warning information including related risk assessments up to 10 days in advance.

[45] Directive 2007/60/EC; *op.cit.*

[46] See Regulation (EU) No 1305/2013 of the European Parliament and of the Council of 17 December 2013 on support for rural development by the European Agricultural Fund for Rural Development and repealing Council Regulation (EC) No 1698/2005, 20.12.2013, OJ L 347, pp.487-548

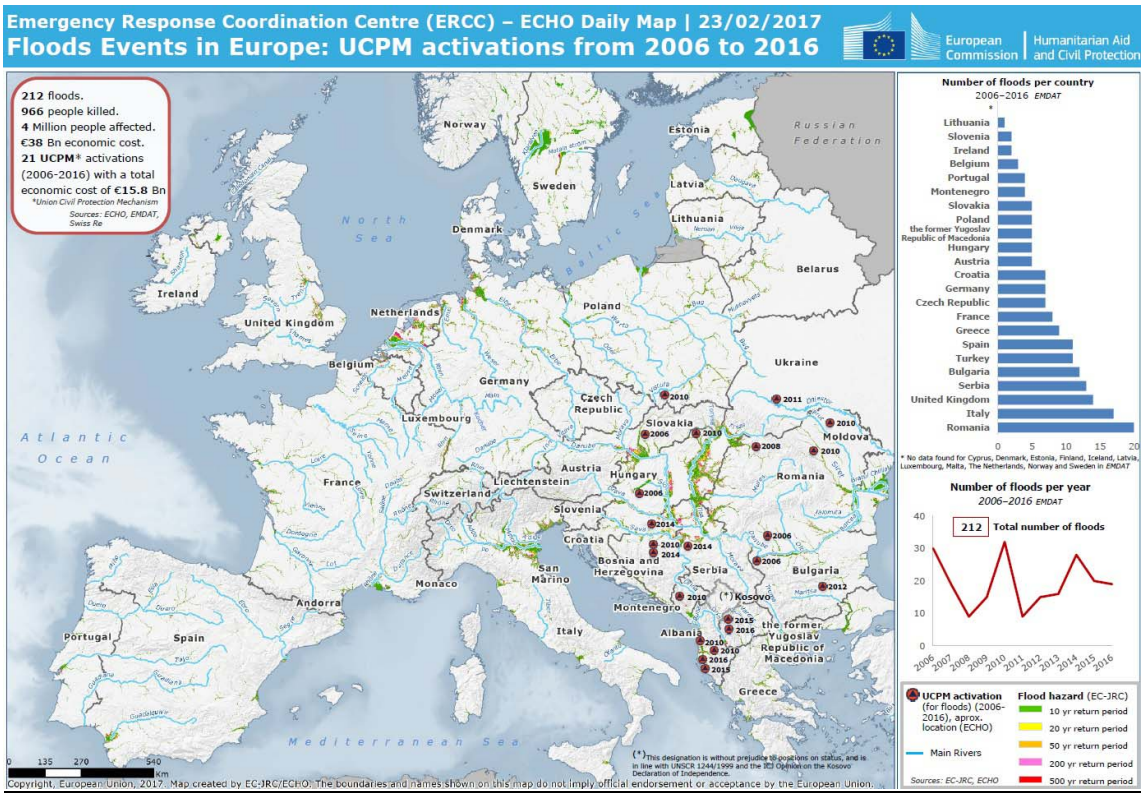
[47] https://www.efas.eu/

Table 2: Flooding risk in National Risk Assessments (DG ECHO)

National assessment	Risk type / Scenario	Relative risk (likelihood/impact) [48]	Climate change	Cross-border risk	Cascading effects
Austria	National scale flood	Medium Likelihood/ High Impact			
Belgium	River basin flood	Top 10 risks	X		
Bulgaria	River basin flood			Danube river basin	
Croatia	Spill of inland water bodies – Danube basin	Very high / High risk	X	Danube river basin	Critical Infrastructure
Cyprus	Short-term flash flood		X		Transport/ Communication/ energy/ health
Czech Republic	Flood / Flash flood				
Denmark	Storm surge	Critical risk	X		Result of severe weather
Estonia	Flood in populated area	High risk			
Finland	Rapid urban flooding	3/5 L. / 2.5/5 I.			X
France	All slow & sudden onset events				
Germany	Winter / summer flood			River basin authorities / bilateral cooperation	
Greece	Fluvial/flash flood				Hazardous material release
Hungary	Fluvial flood	Highest priority risks	X	Danube river basin	Critical Infrastructure
Iceland	Glacial outburst / River flood	High risk	X		Infrastructure
Ireland	Fluvial flood	Likely / High I.			Result of severe weather
Italy	Fluvial flood				Infrastructure
Latvia	Fluvial/coastal flood	Significant risk			Hydro-technical infrastructure
Lithuania	Fluvial/coastal flood	Acceptable to High risk		Neighbouring countries	Power supply / transport
Malta	Storm water / coastal flood / tsunami	Highly likely / Minor I.	X		Fishing / tourism
Netherlands[49]	River overflow + dike breach	Somewhat likely / Serious I.		Neighbouring countries	Dike failure
Norway	Major flood (1/500 years) in populated area	Moderate risk	X		Landslide / flood defence breach
Poland	Pluvial/ snowmelt/ storm surge/ hydro-technical failure	Moderate risk			
Portugal	Fluvial/coastal flood	High risk	X		Transport
Romania	Fluvial/coastal flood	High risk	X	Danube river basin / Black sea	

[48] L: Likelihood; I: Impact
[49] Version 6 of the National Risk Assessment.

Serbia	X				
Slovakia	Pluvial/Flash				
Slovenia	Pluvial/Flash	Very high risk			
Spain	Fluvial/coastal				Infrastructure
Sweden	Fluvial/pluvial				Infrastructure
United Kingdom	Coastal/inland	1/200–1/20 L. 4/5 (coastal) 3/5 (inland) I.		X	Infrastructure



Map 1: Mapping of flood events in Europe: UCPM activations from 2006 to 2016, DG ECHO/JRC

For more information:

- European Commission Directorate-General for Environment: http://ec.europa.eu/environment/water/index_en.htm
- European Solidarity Fund: http://ec.europa.eu/regional_policy/FR/funding/solidarity-fund/#4

- European research and capacity-building projects: FLOODsite (Integrated Flood Risk Analysis and Management Methodologies), http://www.floodsite.net/; CORFU (Collaborative research on flood resilience in urban areas), http://www.corfu-fp7.eu/; IMPRINTS (Improving preparedness and risk management for flash floods and debris flow events), http://www.imprints-fp7.eu/en/projectes; STARFLOOD (Strengthening and redesigning European flood risk practices towards appropriate and resilient flood risk governance arrangements), http://www.starflood.eu/; HAREN (Hazard Assessment based on Rainfall European Nowcasts); FLOOD CBA (Knowledge Platform for Assessing the Costs and Benefits of Flood Prevention Measures); ACHELOUS (Action of Contrast to Hydraulic Emergency in Local Urban Site); ENHANCE (Partnership for Risk Reduction), http://enhanceproject.eu/.
  A full list of relevant Horizon2020 research projects can be found here: https://ec.europa.eu/research/environment/pdf/research_and_innovation_sc5_projects_2014-2016.pdf

Extreme weather

Meteorological phenomena or severe weather events that are disruptive and necessitate the intervention of emergency services and civil protection and/or lead to other natural disasters (such as flooding or drought) are considered a major risk by large number of national authorities in charge of emergency management.

Storms in Europe generally originate from extra-tropical cyclones resulting from warm subtropical air coming into contact with polar air over the Atlantic Ocean. Large differences in these pressure systems result in the formation of storms over western and central Europe; less frequently, these storms may progress southward and affect southern and south-eastern Europe.

In the case of drought and heatwave, regions of Europe typically most exposed to a moderate or high drought hazard are located in the Mediterranean, especially the Iberian Peninsula, Southern France, parts of Italy, Greece and Cyprus. Nevertheless, national assessments of drought risk underline a much broader scope of the existence of drought risk across the EU.

The UCPM was activated for emergency assistance to address severe weather conditions in Slovenia (2014). Monitoring by the ERCC of other important extreme weather events include heavy snowfall and tropical cyclone (La Réunion) events in France (2013); severe weather events in the UK (2014) and over Northern Europe (2013).

Impacts & cascading effects

Extreme weather events are estimated to have caused the death of over 700 people and be the most costly of all natural hazards in Europe in terms of economic losses, between 1998 and 2009. Extreme weather is also an important cause of disruptions of critical infrastructure and can cause accidents at hazardous installations. The environmental impacts of storms are also relevant: over 130 storm events have been identified as causing "noticeable damage" to forests in Europe in the past 60 years and storms are responsible for over 50% of all primary abiotic and biotic damage by volume from catastrophic events to forests in Europe.[50] France's risk assessment underlines that, between 2001 and 2015, storms represented the most costly natural disasters on its territory (39% of all incurred costs).

The heat wave and drought event of 2003 in Europe affected over 100 million people across a third of the European territory – its cost was estimated to at least EUR 8.7 billion.

In terms of economic impact, a number of recent major extreme weather events resulted in important estimated economic losses across Europe, for which the Solidarity Fund was activated; examples include: over EUR 240 million in Bulgaria due to severe winter conditions in 2015; EUR 428 million resulting from an ice storm episode in Slovenia in 2014; storm Xynthia in 2010 caused over EUR 1.4 billion in damages in France; in France again, Storm Klaus in 2009 resulted in over EUR 3.8 billion in damages; Storm Kyrill in 2007 in Germany led to EUR 4.75 billion in damages. In 2005, Storm Gudrun in Sweden caused EUR 2.3 billion of damages, while Storm Tatras led to EUR 203 million of economic damages in Slovakia that same year. Overall, the EU Solidarity Fund mobilised over EUR 460 million since 2002 to address the impacts of extreme weather events in the EU[51].

[50] Gardiner B., et al., "Destructive Storms in European Forests: Past and Forthcoming Impacts", Commission Report, *European Forest Institute*, 2010, 4, available at: http://ec.europa.eu/environment/forests/pdf/STORMS%20Final_Report.pdf.

[51] EU Solidarity Fund, *op.cit.*

Heavy rainfall and snowfall also have both an economic and social impact on a country and/or region. In the case of severe snow event affecting large areas, i.e. a number of counties or regions or an entire part of the country, transport services are usually severely affected (restrictions/disruptions of train operations; road traffic safety issues such as increased risk of collision; risk of weather-related delays in all modes of services) and healthcare services are disrupted (increased demand and reduced ability to provide services), in addition to other economic and social impacts (access to work, schools, damage to physical assets, etc.).

Risks associated with extreme weather may increase exposure to other forms of natural hazards, such as landslides. Reducing the risks of landslides by improving land management practices is therefore important to reduce the vulnerability of exposed areas to other forms of cascading risks.

Cross-border dimension

The impacts of extreme weather events are not defined by national borders. The impacts of a severe storm will be felt on a regional scale; similarly, a severe drought or period of extreme temperatures will affect communities, the environment and economies across regions. Examples in the table below show how extreme weather affecting Denmark may also impact other parts of the North Sea Region; extreme events in Hungary are relevant to other countries in the Carpathian region.

Climate change

While no clear trend of meteorological events has been identified, related losses have increased in recent years due to increased exposure. Current projections of increased extreme events resulting from climate change indicate that the risk of meteorological hazards in Europe will increase in the future.

As a result, ecosystems and communities may be more exposed to increased intensity and frequency of severe weather events, particularly in the coastal zones: sea level rise (in combination with storm surges) could increase the risk of flooding, coastal erosion and salt water intrusion into groundwater resources and rivers, deltas and estuaries in these areas.

Policy context

The heat wave of 2003 triggered an initiative at European level to address the challenges of drought and water scarcity, which resulted in a Commission Communication on the matter[52].

[52] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, Report on the Review of the European Water Scarcity and Droughts Policy, COM(2012) 672 final, 14.11.2012

Table 3: Extreme weather risk in National Risk Assessments (DG ECHO)

National assessment	Risk type / Scenario	Relative risk (likelihood/impact) [53]	Climate change	Cross-border risk	Cascading effects
Austria	Winter storm/ heat-wave/Mesoscale convective system	High-very high / Low & high (heat-wave)			
Belgium	Extreme temperature	Top 10 priority risks			
Bulgaria	Extreme temperature/drought/storm/heavy snow/wind		X		Transport/ energy infrastructure
Croatia	Extreme temperature – City of Zagreb / Snow & ice – Croatian mountainous area / Drought – Osijek-Baranja County	Extreme temp: Moderate risk Snow & ice: Low / High Drought: Low / Moderate	X	X	Infrastructure
Czech Republic	Drought/extreme temperature/heavy rain/extreme wind				
Denmark	Storm/hurricane/heavy rain/cloudburst	Storm/hurricane: critical risk Rain/cloudburst: very serious risk	X	North sea region	Energy infrastructure
Estonia	Severe storm/extreme temperature	Storm: High Extreme T°: Low			
Finland	Winter-/ Thunder-storm	W: 4/5 / 3.5/5 T: 2/5 / 4/5	X		Infrastructure + health
France	Storm/cyclone/ snow/heavy rain/extreme temperature				Flood/ landslide/ infrastructure
Germany	Storm/extreme temperature				
Hungary	Storm/extreme temperature/ drought	Highest priority risks	X	Carpathian region	Infrastructure
Iceland	Extreme events		X		Infrastructure
Ireland	Storm/extreme temperature/heavy snow/drought				Agriculture/ energy/ transport
Latvia	Storm	High risk			
Lithuania	Storm/hurricane/snowfall/drought	Drought: very high risk Other: high risk	X	Drought: regional	Electricity infrastructure
Luxemburg	Storm/heavy rainfall/extreme (high) temperature	Medium L. / Serious I.			
Malta	Hurricane/extreme temperature/drought	Drought: Likely/ Moderate Weather: Highly likely/ Minor	X		Infrastructure / tourism
Netherlands [54]	Very severe storm / Severe snow	Likely/ substantial-serious			
Norway	Inland storm/ Long-term power rationing	Storm: High / Medium Rationing: Moderate / large	X		Energy infrastructure / Storm surge

[53] L: Likelihood; I: Impact
[54] Undertaken in previous versions of the National Risk Assessment

Poland	Heavy rain/extreme temperature/wind		X	Natural hazards
Portugal	Snow/extreme temperature	High risk	X	
Serbia	Storm/hail/snow & ice/drought			
Slovakia	Storm/extreme temperature/heavy rain/drought			Infrastructure
Slovenia	Drought/sleet	Drought: Medium risk / Sleet: High risk		
Sweden	Storm/heat-wave	Heat-wave: serious human/economic/ envi. impact		
United Kingdom	Storm/gale/ extreme temperature/heavy snow/drought	1/200-1/20 (drought) & 1/20-1/2 3/5 (T°) & 4/5	X	Infrastructure

For more information:

- European Commission Directorate-General for Environment: http://ec.europa.eu/environment/water/
- European Commission Directorate-General for Climate Action: https://ec.europa.eu/clima/
- European Solidarity Fund: http://ec.europa.eu/regional_policy/FR/funding/solidarity-fund/#4

- European research and capacity-building projects: MOTIVE (Models for Adaptive Forest Management), http://www.motive-project.net/; MICORE (morphological impacts and coastal risks induced by extreme storm events), http://www.micore.eu/; PEARL (Preparing for Extreme and Rare events in coastal regions), http://www.pearl-fp7.eu; RISC-KIT (Resilience-Increasing Strategies for Coasts – toolKIT), http://www.risckit.eu; RISES-AM (Responses to coastal climate change: Innovative strategies for high end scenarios Adaptation and Mitigation), http://risesam.eu/; ANYWHERE (Enhancing Emergency Management and Response to Extreme Weather and Climate Events), http://anywhere-h2020.eu/; I-REACT (Improving Resilience to Emergencies through Advanced Cyber Technologies), http://www.i-react.eu/; BeAWARE.
  A full list of relevant Horizon2020 research projects can be found here: https://ec.europa.eu/research/environment/pdf/research_and_innovation_sc5_projects_2014-2016.pdf
  European Commission, Technical Report, 'Resilience of large investments and critical infrastructures in Europe to climate change', 2015, EUR 27598; ISBN 978-92-79-54003-5.

Forest Fire

Climatological hazards such as forest fires are considered by national emergency authorities across the EU to represent a substantial disaster risk. Forest fires are indeed a high probability risk and a recurrent phenomenon in the EU.

Every year, forest fires in the EU burn on average half a million hectares of forest and natural lands. While this amount varies considerably from one year to another 85% of the total annual burnt area in Europe is located in five EU Mediterranean countries (Portugal, Spain, France, Italy and Greece). Forest fires can also affect other regions of Europe (e.g. Union Civil Protection Mechanism activated for forest fires in Sweden, 2014; early warning alerts provided for bush fires in Norway, 2014).

Seasonal meteorological conditions and the dead biomass burning/accumulation cycle determine to a large extent the length of the forest fire season, the spatial patterns and return time period of forest fires. As such, forest fires can be very localised and present varying levels of risk within a given territory – e.g. France, Italy, Spain. The likelihood and impact of major forest fires vary depending on the types of forest, topography, climatic conditions and preparedness to contain localised sources of fire. In fact, a large majority of forest fires are the consequence of malicious or unintended human action.

The EU is regularly called upon to support responses to major forest fire events. Recent activations of the UCPM include: France (2016) Sweden (2014), Bulgaria (2012), Portugal (2012, 2013, 2016), Greece (2012, 2014, 2015), Montenegro (2012, 2016), and Cyprus (2016). Monitoring by the ERCC was provided for a series of forest fires in Norway (2014), Slovenia (2016), and Spain (2012).

Impacts & cascading effects

Forest fires can have major disruptive impacts on the environment, human health and the economy, considering the particularly significant environmental, financial and well-being value of forests in Europe.

Under extreme climatic conditions, forest fires impact ecosystems health and functions, and can cause extensive damages to life and property through the disruption, of transport systems and critical infrastructure (airports, power lines, etc.), businesses and private assets. While casualties can usually be avoided, fires originate significant distress and fumes that can severely affect human health and contribute to global warming.

In terms of economic impact, a number of recent major flood events resulted in important estimated economic losses across Europe, for which the Solidarity Fund was activated; examples include: a severe drought and forest fires in Romania in 2012 causing EUR 806 million in economic damages; a number of forest fires affected Spain that same year (EUR 155 million in damages in Valencia; EUR 72 million in damages in Canary islands; EUR 22 million in Malaga) but did not lead to financial assistance through the Solidarity Fund; recurrent forest fires in Greece resulted in losses of EUR 152 million in 2009, and EUR 2.1 billion in 2007 for which Solidarity Fund assistance was provided. In 2003, major forest fires affected Portugal causing EUR 1.2 billion in economic losses. Overall, the EU Solidarity Fund mobilised over EUR 142 million in financial assistance to respond to the forest fire disasters in the EU since 2002[55].

Large areas of wildland–urban interface (when urban settlements are interspersed with wildland habitats) further contribute to variability in burned area as a consequence

[55] EU Solidarity Fund, *op.cit.*

of ignition probability, landscape fragmentation, and access points for suppression. With the expansion of wildland-urban interfaces, in particular in southern Europe, economic and human impacts due to forest fires are likely to increase.

Cross-border dimension

Wildfires can present a cross-border risk. Indeed, fires are hazards which progress and affect areas irrespective of national boundaries – during the summer period, all Southern European countries are particularly vulnerable to forest fires (in 2007, wildfires claimed 80 lives in Greece alone).

Climate change

Climate projections suggest substantial changes in precipitation and temperature patterns. As a result, the length and severity of the fire season, the area at risk and the probability of large fires and greenhouse gas emissions are projected to grow with respect to the actual conditions.

According to the European Commission PESETA II study, total burned area in southern Europe could more than double during the 21st century. Temperature increases in central and northern latitudes, would also favour the conditions for fire occurrence and spread, thus expanding northward the areas prone to forest fires.

Policy context

The EU Forest Strategy[56] provides a new framework in response to the increasing demands put on forests and to significant societal and political changes that have affected forests over the last 15 years. Protection of forests from different threats, including fire is one of the priorities of this strategy, which also identifies prevention of fires as a key area for Member States to advance[57].

For the period 2014-2020, the European Agricultural Fund for Rural Development (EAFRD), which is active since 2007, has provided support for forest fire prevention and restoration actions. It provides support for the period 2014-2020 for activities preventing and restoring damage to forests from fires and other natural disasters and catastrophic events including pests, diseases as well as climate change-related events. The enhancement of territorial ecosystems and limiting the impacts of extreme events and climate change also represent explicit objectives of the support under the rural development pillar of the Common Agricultural Policy[58]. During the programming period 2007-2013 the five Mediterranean countries allocated more than EUR 1.2 billion for measures targeting prevention and restoration of natural disasters and fires.

Member States and regions have allocated EUR 8 billion for climate change adaptation and risk prevention and management for 2014-2020 from the European Regional Development Fund (ERDF) and Cohesion Fund, including for cross-border and transnational cooperation. These investments address various types of risks, including forest fire prevention.

The European Forest Fire Information System (EFFIS)[59], created in 1998, is a comprehensive information source for fires across the EU. Its role is to support the services in charge of the protection of forests against fires in the EU and neighbouring countries, while also providing the European Commission and Parliament with information on forest and wildfires in Europe. EFFIS is part of the Emergency Management services of the Copernicus Programme.

[56] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, A new EU Forest Strategy: for forests and the forest-based sector, COM(2013) 659 final, 20.9.2013

[57] See Council Conclusions on the New EU Forest strategy, 19.5.2014, 9944/14

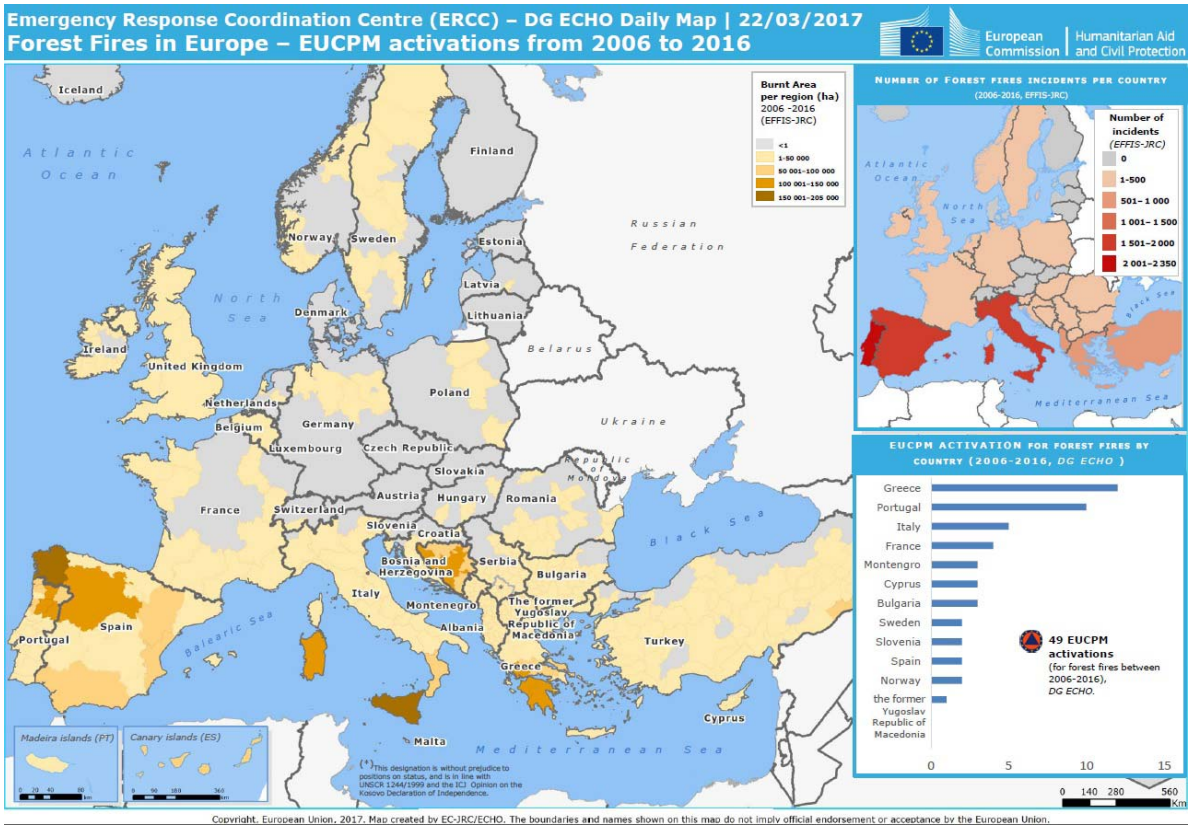
[58] Regulation (EU) No 1305/2013, *op.cit.*

[59] http://forest.jrc.ec.europa.eu/effis/

Table 4: Forest fire risk in National Risk Assessments (DG ECHO)

National assessment	Risk type / Scenario	Relative risk (likelihood/impact) [60]	Climate change	Cross-border risk	Cascading effects
Austria	X				
Belgium	X	2/5 Likelihood 2.5/5 Impact			
Bulgaria	X				
Croatia	Forest (vegetation) fires on the Croatian coastline	Extreme high L. Moderate Impact	X		
Cyprus	X		X		
Estonia	Extensive forest/bush fire	High risk			
Finland	Simultaneous major forest fires	Average L. 2/5 Impact		X (along Russian border)	
France	X				Can result from drought
Germany	X		X		
Greece	X				
Hungary	X	Very Likely Very serious I.			
Iceland	X	Localised medium risk			
Italy	X	Localised	X		
Latvia	X	Significant risk			
Netherlands[61]	X	Likely Substantial I.			
Norway	Three simultaneous forest fires	High Likelihood Small Impact			Loss of biodiversity
Poland	X	Moderate			
Portugal	X	High risk	X		Possible risk for critical infrastructure
Romania	X	Conditionally L. Very low Impact	X		
Slovakia	X				
Slovenia	X			X	
Spain	X	Localised			
Sweden	X	Localised			
United Kingdom	X	1/2000-1/200 L. 2/5 Impact			Transport/energy infrastructure

[60] L: Likelihood; I: Impact
[61] Undertaken in previous versions of the National Risk Assessment



Map 2: Mapping of forest fires in Europe: UCPM activations from 2006 to 2016, DG ECHO/JRC

For more information:

- European Commission, Directorate-General for Agriculture and Rural Development: https://ec.europa.eu/agriculture/forest_en
- European Solidarity Fund: http://ec.europa.eu/regional_policy/FR/funding/solidarity-fund/#4

- European research and capacity-building projects:
  PESETA II focuses on the economic impacts of climate change, http://peseta.jrc.ec.europa.eu/; FUME on forest fires under climate and land-use change, has shown that, with continued global warming, fire danger conditions will increase in average and extremes and that the fire season will be longer throughout Europe, http://www.meteo.unican.es/en/projects/fume; FIRESMART identified obstacles to the effectiveness of forest fire preventive measures and successfully derived recommendations to integrate prevention practices in sustainable forest management (SFM) plans, http://cordis.europa.eu/project/rcn/93946_en.html.
  A full list of relevant Horizon2020 research projects can be found here: https://ec.europa.eu/research/environment/pdf/research_and_innovation_sc5_projects_2014-2016.pdf

Earthquake

Many countries in the South-Eastern part of Europe are particularly exposed to earthquake hazards, which is consistent with the main fault lines in Europe located where the Eurasian plate meets the African plate and runs through the Mediterranean Sea (more than 90% of earthquakes are caused at plate boundaries).

While the frequency and magnitude of earthquakes at a specific location cannot be predicted with accuracy, risk management in earthquake-prone areas across Europe can be informed using scientific modelling (e.g. fault rupture models, vulnerability and loss models for buildings, lifelines and critical infrastructure, the Global Earthquake Model), early warning and impact assessment tools. Effective preparedness, appropriate response capacities and adequate resilience-building measures reducing the risk of these disasters are essential.

Preventive measures such as seismic-proofing of infrastructure through the application of building codes (EN Eurocodes), and zonation for land use planning can considerably reduce the severity of human, structural and economic impacts of earthquakes.

The European Commission provided monitoring support through the ERCC following a series of earthquakes in Italy (2012, 2013) and Iceland (2014); an observation mission was sent in response to the Abruzzo earthquake (IT) in 2016.

Impacts & cascading effects

The impacts of earthquakes can vary from highly localised events to having dramatic impacts on communities, infrastructure, the economy and the environment, across large regions. Occurrence of a major seismic event in a built-up urban area can have a particularly severe impact, resulting in the complete disruption of economic and social functions in the community.

In terms of economic impact, a number of recent major earthquake events resulted in important estimated economic losses across Europe, for which the Solidarity Fund was activated; examples include: in Italy[62], a series of earthquakes in 2012 resulted in EUR 13.2 billion in damages, the Abruzzo earthquake of 2009 resulted in EUR 10.2 billion in damages, and the impacts of the Molise/Apulia region earthquake in 2003 is estimated at EUR 1.5 billion; in the Lorca region of Spain in 2011, costs amounted to EUR 842 million in damages; and in Greece, the earthquake of Kefalonia in 2014 resulted in EUR 147 million in damages, and most recently in Lefkada in 2016 resulting in EUR 66 million in damages. The EU Solidarity Fund mobilised over EUR 1.2 billion in financial assistance to respond to earthquakes that have affected EU countries since 2002[63].

Earthquakes can trigger secondary effects (landslides, damage to vital infrastructure, liquefaction, tsunamis, debris avalanche) and affect severely people, the economy and the built environment. For instance, potential disastrous secondary damage caused by earthquakes, which can also result in Natech events such as the release of hazardous materials and the destruction of vital transport and technical infrastructure, residential buildings, industrial buildings and facilities.

Cross-border dimensions

The location of various European countries along main fault lines, and active zones of seismicity in border regions may result in cross-border impacts of earthquake events – earthquake risk assessments by Bulgaria and Romania highlight this possibility.

[62] No official figures are available to quantify the impacts of the 2016 earthquakes in Central Italy; Munich Re estimates physical damage around €10 billion; see: https://www.munichre.com/topics-online/en/2017/topics-geo/earthquake-italy

[63] EU Solidarity Fund, *op.cit.*

Policy context

Provisions of the Eurocode 8[64] contribute to reducing the vulnerability of buildings by ensuring that, in the event of earthquakes, lives are protected, damage is limited and civil protection structures remain operational. Exposure of built infrastructure and the potential impacts on the levels of performance of vital services requires particular attention to the location and structural characteristics of buildings, the applicable zonation and building codes, and the level of compliance with the codes.

The RAPID-N tool has been developed by the European Commission for the assessment of Natech risks at local and regional levels, and has currently been implemented for earthquakes[65].

[64] http://eurocodes.jrc.ec.europa.eu/home.php
[65] http://rapidn.jrc.ec.europa.eu/

Table 5: Earthquake risk in National Risk Assessments (DG ECHO)

National assessment	Risk type / Scenario	Relative risk (likelihood/impact) [66]	Climate change	Cross-border risk	Cascading effects
Austria	Earthquake Western Austria	Low Likelihood High Impact			
Bulgaria	High degree earthquake	Important infrastructure / building damage		Seismic sources may originate in neighbouring countries (Danube region)	Infrastructure/ flooding/ landslide/ epidemic/ chemical& radioactive release
Croatia	Earthquake city of Zagreb	Small L. Catastrophic I.			Composite risk scenario: flooding
Cyprus	1. Localised event 2. Worst case scenario	Likelihood: 1. 10% in 50years; 2. 2% in 50years Severe structural / human impact			
France	X	Low to medium seismicity level. High exposure of Caribbean territories			Infrastructure disruption/ Industrial accident
Germany	X				
Greece	X				
Hungary	1. Magnitude above 6 2. Magnitude 5-6[67]	1. Possible L. / Very serious I. 2. Possible L. / Substantial I.			
Iceland	X				Volcanic event
Italy	X				
Malta	X	Unlikely / Significant I.			Tsunami/ Landslide/ Hazardous material release
Norway	Earthquake in a city (6.5 magnitude[68])	Low L. Very large I.			Landslide/Infrastructure damage
Portugal	Event in Algarve region (1755 event)	High risk: Low L. / Critical I.			
Romania	Worst case scenario event	Very high risk: Conditionally L. / Very high I.		Impacts abroad	
Serbia	X				
Slovakia	X	Average level of seismicity			
Slovenia	Intensity of VII-VIII on EMS[69] scale	High risk: Low L./ Very high I.			
Spain	X	Low L./ Potentially catastrophic I.			

[66] L: Likelihood; I: Impact
[67] Richter magnitude scale
[68] Idem
[69] European Macroseismic Scale

Sweden	X		Landslide/ Mine collapse

For more information:

- European Commission, Joint Research Centre, EU Science Hub
  https://ec.europa.eu/jrc/en/research-topic/earthquakes-and-tsunamis
- Global Earthquake Model
  http://www.globalquakemodel.org/
- European Macroseismic Scale
  http://media.gfz-potsdam.de/gfz/sec26/resources/documents/PDF/EMS-98_Original_englisch.pdf

- Relevant research and capacity-building projects: Syner-G (Systemic Seismic Vulnerability and Risk Analysis for buildings, lifeline networks and infrastructure's Safety Gain), http://www.vce.at/SYNER-G/; REAKT (Strategies and tools for Real Time Earthquake Risk Reduction), http://www.reaktproject.eu/; NERA (Network of European Research Infrastructures for Earthquake Risk Assessment and Mitigation), http://www.nera-eu.org/; SHARE (Seismic Hazard Assessment in Europe), http://www.share-eu.org/; STREST (Harmonised approach to stress tests for critical infrastructures against natural hazards), http://www.strest-eu.org

Pandemic

Pandemic risk is a major disaster risk of concern to most national authorities across the EU. Influenza is the most commonly assessed form of pandemic risk.

Large outbreaks of an infectious disease are known as epidemics. These become pandemics when they occur on a large geographical area and affect a large portion of population.[70]

The recurrence of past pandemics suggests that this hazard may occur a few times a century, while more localised epidemics may occur more frequently. While predictions of the timing and nature of future pandemic outbreaks are difficult, it is agreed that the most likely future pandemic will be due to a novel influenza-A virus, to which the immunity of the human population is limited or absent. Pandemics may reoccur on average every 30-40 years, following a variation in the virus' antigenetic structure leading to the emergence of new Type-A flu virus subtypes. The level of uncertainty on the likelihood of this hazard makes it a high-ranking disaster risk requiring close attention.

Impacts & cascading effects

Pandemic risk can be characterised by catastrophic human, economic and environmental impacts. In many cases, pandemics will primarily impact human health, as well as incurring both direct and indirect economic costs.[71] The immunity of the human population to new influenza viruses with pandemic potential is limited or absent. Indirect socio-economic impacts may be a consequence of the human impacts, as the scale of impacted individuals may affect the running of vital social and economic services – addressing the performance of vital services may help decrease the extent of the impact on societal functions.

Cross-border dimension

Infectious diseases do not respect any national borders, and in today's globalised world, it has become very clear that Europe is equally vulnerable for emerging and re-emerging disease threats; the significant socio-economic impact of epidemics on societies has been demonstrated.

Global mobility of persons and goods enhances the very fast propagation of a viral outbreak, with very severe impacts on societal functions – such volatility requires addressing the potential pandemic outbreak risk at the appropriate national or supra-national level. Propagation of a viral outbreak on a regional scale will require appropriate planning of emergency capability on a supranational level.

The type A (H1N1) pandemic of 2009 resulted in casualties in several countries and required responses at global, EU and national levels.

Climate change

An assessment of pandemic risk can consider the links between a changing climatic landscape and the spread of infectious diseases, as is currently the case in NRAs undertaken by Croatia and Malta.

Policy context

The Decision 1082/2013/EU on serious cross-border threats to health provides the framework to improve preparedness and strengthen capacity to coordinate response to health emergencies across the EU,

[70] The World Health Organization defines an outbreak, or epidemic, as "*the occurrence of cases of disease in excess of what would normally be expected in a defined community, geographical area or season. An outbreak may occur in a restricted geographical area, or may extend over several countries. It may last for a few days or weeks, or for several years.*"
http://www.who.int/topics/disease_outbreaks/en/

[71] While understood as a natural disaster in the context of this Overview and the Sendai framework for DRR, pandemics are not eligible for support from the EU Solidarity Fund.

caused by biological, chemical and environmental agents, and threats of unknown origin[72]. Under this framework, the Commission closely cooperates with EU Member States within the Health Security Committee, with relevant EU Agencies, in particular the European Centre for Disease Prevention and Control (ECDC)[73], and with international organizations, such as the World Health Organization, to coordinate preparedness planning, notify on threats, ensure appropriate assessment of the risks for the EU, and coordinate response. The EU Early Warning and Response system is instrumental in sharing alerts as well as measures undertaken by the Member States.

Preparedness and response planning to mitigate or prevent the impacts of pandemics is carried out by EU Member States through pandemic preparedness plans, a number of which have been updated since the influenza pandemic of 2009.

The outbreak of the Ebola epidemic in West Africa in March 2014 saw rapid mobilisation of EU and Member States' political, financial and scientific resources to help contain, treat and ultimately defeat the Ebola virus. Activation of the UCPM enabled the swift coordinated deployment of emergency supplies and experts offered by Member States (more than 100 flights and 2 cargo ships). A medical evacuation system was established to support the mobilisation and ensure the safety of international aid workers. The deployment of mobile labs by the European Commission played a pivotal role in diagnosing Ebola within the population of West Africa. As a key lesson from the Ebola crisis, the European Commission has set up a European Medical Corps to improve capacities to deliver rapid medical response.

The European Commission has funded many research and innovation projects for better preparedness and response to (re)-emerging infectious diseases. A fast research and innovation response was mobilised as a response to the Ebola outbreak in West Africa where the European Commission became the second biggest funder of Ebola research (contribution of €139 million Horizon 2020 funding for urgent Ebola research).

To counter the threat of a pandemic, the EU cannot stand alone; in 2013 therefore the European Commission, together with funding organisations from other countries, established the Global Research Collaboration for Infectious Disease Preparedness (GloPID-R), a network of 26 research funding organisations and the World Health Organisation in the area of infectious disease preparedness research; its aim is to facilitate an effective research response within 48 hours of a significant outbreak of a new or re-emerging infectious disease with pandemic potential.

[72] Decision No 1082/2013/EU of the European Parliament and of the Council of 22 October 2013 on serious cross-border threats to health and repealing Decision 2119/98/EC, 5.11.2013, OJ L 293, pp.1-16

[73] http://ecdc.europa.eu/

Table 6: Pandemic risk in National Risk Assessments (DG ECHO)

National assessment	Risk type / Scenario	Relative risk (likelihood/impact) [74]	Climate change	Cross-border risk	Cascading effects
Austria	X	High L/ Very high I			
Belgium	X	Top 10 priority risks			
Bulgaria	X				
Croatia	Pandemic influenza throughout Croatia	High L / Moderate I	X		Health infra.
Czech Republic	X				
Denmark	X	Critical risk		Can be of international scale	Key societal functions
Estonia	X	Very high risk			
Finland	Nationwide pandemic flu	High L/ unpredictable I			
Hungary	Pandemic flu (Re)emerging infectious disease	Likely-very likely / catastrophic I			
Iceland	X				
Ireland	X	Unlikely / Very high		Can be of international scale	Key societal functions
Latvia	X	Medium L/ Catastrophic I			
Lithuania	X	Very high risk		Neighbours	
Luxemburg	Major sanitary risk	Low L. / Severe I.		Possible regional / international scale	Can affect critical infrastructure
Malta	X	Unlikely / Catastrophic I	X	Can be of international scale	Key societal functions
Netherlands[75]	X	Likely / Very serious I			
Norway	National scale pandemic	High L / Large I		May originate abroad	Key societal functions
Poland	X	Moderate risk		May originate abroad	
Serbia	X				
Slovakia	X				
Slovenia	X	Very high			
Sweden	X	Catastrophic impacts			
United Kingdom	X	Top risk: 1/20-1/2 Like. / 5/5 Impact			

[74] L: Likelihood; I: Impact
[75] Undertaken in previous versions of the National Risk Assessment

For more information:

- European Commission Directorate General for Health and Food Security
  http://ec.europa.eu/dgs/health_food-safety/
- European Centre for Disease Prevention and Control
  http://www.ecdc.europa.eu/
- European Medical Corps
  http://ec.europa.eu/echo/files/aid/countries/factsheets/thematic/European_Medical_Corps_en.pdf

- European research and capacity-building projects:
  PREPARE (Platform for European Preparedness Against (Re-)emerging Epidemics); EMPERIE (European Management Platform for Emerging and Re-emerging Infectious Disease Entities), www.emperie.eu; PREDEMICS (Preparedness, Prediction and Prevention of Emerging Zoonotic Viruses with Pandemic Potential using Multidisciplinary Approaches), http://predemics.biomedtrain.eu; ANTIGONE (ANTIcipating the Global Onset of Novel Epidemics), www.antigonefp7.eu; PANDEM (Pandemic Risk and Emergency Management), http://www.pandem.eu.com/; PANDHUB;
  Global Research Collaboration for Infectious Disease Preparedness, https://www.glopid-r.org/

Epizootic / Animal & plant disease

Animals and the foodstuffs production process can be exposed to a variety of serious infectious diseases. Some animal diseases are confined to a single species, while others can spread from one species to another. Climate change and globalisation of trade are considered important drivers of this risk.

In the context of animal diseases, a distinction is made between epizootic – not transmittable to humans (e.g. foot-and-mouth disease) – and zoonotic – diseases naturally transmittable from vertebrate animals to humans (e.g. avian influenza).

Some of the most severe livestock epidemics include classic swine fever, avian influenza, foot-and-mouth disease, bluetongue, African Horse Sickness, Newcastle disease, West Nile virus and rabies.

Epizootic diseases include foot-and-mouth (a highly-contagious viral infection affecting all ruminants and pigs), classical swine fever (a viral infection affecting swine), bluetongue (a viral infection affecting ruminants sheep) and African Horse Sickness (a disease affecting horses transmitted by insects).

Zoonotic diseases include: the highly pathogenic avian influenza HPAI (a viral infection of the influenza-A virus affecting birds), rabies (a fatal viral infection affecting the nervous system of mammals – the most recent form is present in bat populations), and the West Nile virus (a viral infection of birds, horses and humans spread by mosquitos). Other serious forms of epidemics include those affecting farmed fish and shellfish in aquaculture, as well as outbreaks of organisms affecting the wider natural ecosystem, with harmful effects on the economy and possibly human life (toxic algae, jellyfish).

All of these diseases are classified by the World Organisation for Animal Health (OIE) as 'list A' diseases, meaning that they are fast spreading diseases of major economic importance. Indeed, such epidemics can result in substantial losses for governments, farmers and all other stakeholders involved in the livestock production chain. In countries with a highly industrialised agricultural sector, vulnerability to the spread of such diseases is particularly high.

Monitoring and preventive measures as well as eradication programmes in place across the EU contribute to reducing risk of outbreak and infection. Close cross-sector and public-private cooperation likewise contribute effectively to reducing risks.

Impacts & cascading effects

Epizootic risk may result in severe socio-economic and human impacts. Most severe impacts could potentially hit the production and trade of food products (poultry, meat) as well as human health through intoxication and epizootic spread – e.g. when a livestock epidemic spreads from animals to humans.[76]

Based on current levels of veterinary preparedness, classic swine fever, African swine fever, foot-and-mouth disease and avian influenza are the diseases presenting the greatest risks for the EU.

In the case of plant disease risks, numerous diseases and pests could potentially eradicate crops and result in food crises. Moroccan and Italian locusts, the Grapevine Flavescence Dorée (affecting vine plants), the Xylella fastidiosa (affecting olive trees), the pinewood nemathode (Portugal), and the bark beetle (Germany, Czech Republic and Slovakia)

[76] While understood as a natural disaster in the context of this Overview and the Sendai framework for DRR, pandemics are not eligible for support from the EU Solidarity Fund.

are prime examples, capable of extreme levels of breeding on a regional scale.

Cross-border dimension

The cross-border dimension of this risk is particularly relevant due to the high volatility of epidemic outbreaks, as is the potential that climate change and globalisation (including international trade of animals and animal products, and increased human mobility) may contribute to increased probability of diseases affecting local livestock in coming years.

The spread of a virus to neighbouring countries is possible due to the fast spread of viruses and global wild fauna migration irrespective of national borders.

Climate change

Changing climate conditions may cause an increase in the spread of serious infectious vector-borne transmissible diseases affecting humans and/or animals and plants.

The rise in temperatures and changing climate conditions may indeed lead to the development of new fertile environments for certain forms of virus. Rising temperatures may lead to the appearance of new fertile environments for diseases so far considered exotic in Europe.

Climate change will have a major influence on spatial and temporal distribution of pests, weeds, parasites and diseases, which can impact crop, livestock production and forests. As for the livestock systems, changes in the distribution of pathogens and pathogen vectors present challenges across Europe.

Long term adaptation measures are necessary to contain future outbreaks.

Policy context

EU legislation to control avian influenza is laid out in Regulation (EU) 2016/429[77] on transmissible animal diseases and Directive 2005/94/EC[78], which requires the investigation of suspected cases of avian flu, as well as the humane killing of infected poultry and disposal of feeding stuffs/equipment/manure as a means of limiting the spread of the disease.

Directive 2000/75/EC lays out the control rules and measures to fight bluetongue, establishing surveillance zones and possible bans on susceptible animals' movements[79].

Swine fever control measures are laid out in Directive 2001/89/EC: in the case of an outbreak, all pigs of infected farms must be put down and cadavers destroyed; protection and surveillance zones must be put in place[80].

Measures to be taken to combat African Horse Sickness are laid out in Directive 92/35/EEC[81].

EU control measures for foot-and-mouth disease are laid out in Directive 2003/85/EC aiming at regaining the disease infection-free status of the territory in question[82]. For foot-and-mouth disease provisions are also made for the use of emergency vaccinations. As a result, the EU has the biggest antigen bank worldwide for express vaccine formulations.

[77] Regulation (EU) 2016/429 of 9 March 2016 on transmissible animal diseases and amending and repealing certain acts in the area of animal health ('Animal Health Law'), 31.3.2016, OJ L 84, pp.1-208

[78] Directive 2005/94/EC of 20 December 2005 on Community measures for the control of avian influenza and repealing Directive 92/40/EEC, 14.1.2006, OJ L 10, pp. 16-65

[79] Directive 2000/75/EC of 20 November 2000 laying down specific provisions for the control and eradication of bluetongue, 22.12.2000, OJ L 327, pp.74-83

[80] Directive 2001/89/EC of 23 October 2001 on Community measures for the control of classical swine fever, 1.12.2001, OJ L 316, pp.5-35

[81] Directive 92/35/EEC of 29 April 1992 laying down control rules and measures to combat African horse sickness, 10.6.1992, OJ L 157, pp. 19-27

[82] Directive 2003/85/EC of 29 September 2003 on Community measures for the control of foot-and-mouth disease repealing Directive 85/511/EEC and Decisions 89/531/EEC and 91/665/EEC and amending Directive 92/46/EEC, 22.11.2003, OJ L 306, pp.1-87

Table 7: Epizootic risk in National Risk Assessments (DG ECHO)

National assessment	Risk type / Scenario	Relative risk (likelihood/impact)[83]	Climate change	Cross-border risk	Cascading effects
Bulgaria	Biological contamination				Hazard amplified in disaster zones
Croatia	Plant disease - Grapevine Flavescence -dorée phytoplasma in the Vukovar-Srijem County	Low risk: Very high L./ Insignificant I.	X	X	
	Animal disease - Entry and spreading of pathogens of foot-and-mouth disease in the Vukovar-Srijem County	Low risk: Moderate L./ Insignificant I.	X	X	
Cyprus	Pest disease / invasive non-native species		X		
Czech Republic	Mass epidemic of field plantation / of animal disease				
Denmark	Animal disease and zoonosis	Serious risk	X	X	Disruption of agriculture
Estonia	Epizootic	High risk: Medium L. / Serious I.			
Finland	Zoonosis			Affect Finland and vicinity	Pandemic outbreak
Germany	Zoonosis				
Iceland	Animal disease	High risk			
Ireland	Animal disease	Unlikely / High Impact		X	Disruption of agriculture, trade & tourism
Lithuania	Epizootic – Avian flu	High risk		Cross-border avian migratory flows	
	Epizootic – African swine fever (ASF)	Very high risk		High volatility of ASF	
Luxembourg	Major sanitary risk (epizootic/zoonosis)	Low L. / Severe I.			Pandemic outbreak
Poland	Epizootic	Moderate risk			
Serbia	Epizootic				
Slovakia	Pest infestation			X	
	Avian flu / Foot-and-Mouth disease			X	
Slovenia	Particularly dangerous animal diseases			X	
Sweden	Epizootic / Zoonosis			X	Pandemic

[83] L: Likelihood; I: Impact

				outbreak
	Plant pests - Pine Wood Nematode (PWN)			Disruption forestry industry
United Kingdom	Animal diseases - Epizootic / Zoonosis	1/200-1/20 L. 2/5 Impact	Potential global trends	Disruption of agriculture

For more information:

- European Commission Directorate General for Health and Food Security
  http://ec.europa.eu/dgs/health_food-safety/
- European Centre for Disease Prevention and Control
  http://www.ecdc.europa.eu/
- World Organisation for Animal Health, List 'A' diseases
  http://www.oie.int/en/animal-health-in-the-world/the-world-animal-health-information-system/old-classification-of-diseases-notifiable-to-the-oie-list-a/

- European research and capacity-building projects:
  Climate Change, impacts and vulnerability in Europe 2016, EEA Report No 1/2017,
  http://www.eea.europa.eu/publications/climate-change-impacts-and-vulnerability-2016

Industrial accident

The risk of industrial accidents is one of the major risks considered by most emergency management authorities across the EU.

Industrial accidents involving the release of dangerous substances, explosions or fire occur frequently in Europe. They can take a wide variety of forms and their impacts can vary in nature and scale. In the majority of cases, impacts will be localised. While major events are much less likely than minor ones, their impacts can be very severe – the 2016 accident on the BASF plant in Germany resulted in four casualties, 30 injured and significant economic losses due to the shutdown of large parts of the largest integrated chemical plant in the world. Other examples include: the devastating explosion at the Gorni Lom explosives manufacturing site (Bulgaria, 2014), the catastrophic rupture of a liquefied petroleum gas tank car in Viareggio (Italy, 2009), the fire at the petroleum storage depot at Buncefield (United Kingdom, 2005), purported to be the largest fire in the country since the Second World War, or the ammonium nitrate explosion in Toulouse (France, 2001) that resulted in thousands of casualties and property damage within the surrounding community.

Hazardous types of industries include petroleum oil refineries, chemicals manufacturing / storage (including Liquefied Natural Gas), fireworks and explosive manufacturing / storage, fuel storage and distribution, processing of metals, production of pharmaceuticals, waste treatment, small and medium enterprises and non-chemical-based businesses that use dangerous substances.

The UCPM was recently activated by Cyprus to address the consequences of a major oil spill (2014). An important chemical accident in France (2014) was also monitored by the European Commission's Emergency Response Coordination Centre.

Impacts & cascading effects

The main impacts of industrial accidents are as follows:

- fatalities and injuries of workers on site and among the surrounding population
- damage to property and infrastructure on site and in the surrounding area,
- disruption of essential services and transport networks with sometimes far-reaching impacts,
- environmental contamination, and potential cross-border pollution.
- substantial economic losses that may lead to bankruptcy / job losses.

Transportation of dangerous goods through a country's territory may increase the risk of an accident The expansion of urban areas may also increase exposure to the risk of industrial accidents, as the proximity of urban communities to high-risk industrial establishments increases the potential for human and economic consequences in case of an accident.

The release of certain substances may be considered dangerous because of health hazards (e.g. acute toxic substances), physical hazards (e.g. explosives, highly flammable substances) or environmental hazards. Hazardous industries may be vulnerable to the impacts of natural hazards. 'Natech' accidents are a frequent occurrence in the wake of natural disasters.

While small scale industrial accidents are not uncommon, major industrial events (on Seveso sites for example) are a high impact / low likelihood risk. The low likelihood of major events may be to a large extent due to the effectiveness of preventive government and industry interventions, or in some countries, a relatively low presence of hazardous activities.

Cross-border dimension

Industrial accidents can cause impacts in more than one country. The spread of chemicals through water channels, as well as widespread environmental pollution may affect neighbouring countries. The risk of a cross-border impact is important in cases of close proximity of at-risk facilities to border regions or those located alongside transboundary water courses, as recognised by the United Nations Economic Commission for Europe (UNECE) Convention on the Transboundary Effects of Industrial Accidents[84].

Climate change

The impact of climate change increases the risk of industrial accidents. Climatological events such as extreme weather and flooding may result in damaged or weakened infrastructure, in turn causing the release of dangerous substances, explosions or industrial fires or aggravating the effects of such accidents and the risks of multiple hazardous substance releases.

Natech risk is expected to increase in the future due to more natural hazards associated with climate change and a higher vulnerability of society (urbanisation, and interconnectedness).

Policy context

The 'Seveso III' Directive on the control of major accident hazards involving dangerous substances[85] sets a European framework for the prevention of, preparedness for and response to industrial accidents involving dangerous substances. The Seveso III Directive obliges Member States to ensure that operators have a policy in place to prevent major accidents. Operators handling dangerous substances above certain thresholds must notify the relevant national competent authorities of their activities, submit safety reports, establish a safety management system and set up an internal emergency plan. Member States shall ensure that the public that is likely to be affected by an industrial accident is regularly informed and that relevant information is kept permanently available to the public, also electronically. National competent authorities must ensure that external emergency plans are in place for the surrounding areas and that mitigation actions are planned. Regular inspections must take place. Account must also be taken of the objectives of prevention and control of major-accident hazards in land-use planning. There is a tiered approach to the level of controls: the larger the quantities of dangerous substances present within an establishment, the stricter the rules ('upper-tier' establishments have bigger quantities than 'lower-tier' establishments and are therefore subject to tighter control).

In 2016, there were 11,777 Seveso establishments in Europe. Of the total EU/EEA establishments, approximately 42% had upper tier status and 58% lower tier status in 2012. Together, Germany, France, Italy and the United Kingdom account for more than half (56%) of total Seveso establishments in Europe.

In areas which are excluded from its scope, the Seveso-III-Directive is complemented by other legislation such as the Mining Waste Directive[86], or legislation on the transport of dangerous substances[87].

Member States and regions have allocated EUR 8 billion for climate change adaptation and risk prevention and management for the 2014-2020 period from the European Regional Development Fund

[84] UNECE, Convention on the Transboundary Effects of Industrial Accidents, 16.03.1992, UN Treaty Series, Volume 2105, I-36605

[85] Directive 2012/18/EU of the European Parliament and of the Council of 4 July 2012 on the control of major-accident hazards involving dangerous substances, amending and subsequently repealing Council Directive 96/82/EC, 24.7.2012, OJ L 197, pp. 1–37

[86] Directive 2006/21/EC of the European Parliament and of the Council of 15 March 2006 on the management of waste from extractive industries and amending Directive 2004/35/EC, 11.4.2006, OJ L 102, pp.15-34

[87] Directive 2008/68/EC of the European Parliament and of the Council of 24 September 2008 on the inland transport of dangerous goods, 30.9.2008, OJ L 260, pp. 13-59

and Cohesion Fund, including for cross-border and transnational cooperation. These investments address various types of risks, including industrial or technological risks.

Table 8: Industrial accident risk in NRAs, DG ECHO

National assessment	Risk type / Scenario	Relative risk (likelihood/impact) [88]	Climate change	Cross-border risk	Cascading effects
Austria	X	Medium L/ Low I			
Belgium	Incident in a Seveso plant	2.5/5 Likely/ 3.5/5 Impact			
Bulgaria	X			Danube River / Black sea pollution	Water supply contamination
Croatia	Accidents in the area of the Oil Fractionation plant Ivanić-Grad	Low L / Significant I			Infrastructure
Czech Republic	X				
Denmark	Accidents with dangerous substances on land and at sea	Serious to very serious risk	X	Result of contaminatio n spread	
Estonia	X	High risk			
Finland	Serious chemical accident at a plant handling dangerous substances	2/5 / 2/5			Spread to adjacent facilities
France	X				Spread to adjacent facilities
Germany	X				
Greece	X				
Hungary	Escape of large amounts of flammable/ explosive/ toxic substances	Flam./explos.: Possible L/ Substantial I Toxic: Very unlikely/Very serious I			
Ireland	X	Unlikely/ High I			
Latvia	Industrial accident in Seveso site	Insignificant risk		Industrial events abroad	Water/environment pollution
Lithuania	X	Very high risk		Significant impacts abroad	
Malta	Major hazardous material release	Extremely unlikely/ Significant I			Na-tech event + health sector
Netherlands[89]	X	Highly unlikely/ Substantial I			
Norway	Industrial gas emission/ Fire in in-city oil terminal	Gas emission: Very low L/ Moderate I Fire: Moderate L/ Small I			Result of malicious act/ Na-tech event
Poland	X	Moderate risk			Infrastructure

[88] L: Likelihood; I: Impact
[89] Undertaken in previous versions of the National Risk Assessment

Portugal	X	High risk		
Serbia	X			
Slovakia	X			
Slovenia	Accident: liquefied petroleum gas	Medium risk		
Spain	Accident involving dangerous substances	Medium-high risk		
Sweden	Emission of hazardous substances		Incidents in North & Baltic sea areas	
United Kingdom	X	1/2000-1/200 L./ 3/5 Impact		Infrastructure

For more information:

- European Commission Directorate-General for Environment
  http://ec.europa.eu/environment/water/

- European research and capacity-building projects:
  MINERVA (A Collection of Technical Information and Tools Supporting EU Policy on Control of Major Chemical Hazards), https://minerva.jrc.ec.europa.eu/en/minerva;
  IRIS project on industrial risk assessment and technologies for a safer European Industry, http://www.vce.at/iris/index.html

Critical infrastructure disruption

Critical infrastructures include, inter alia, energy, nuclear, ICT, transport, water, finance, food, health, space, research and emergency and security services. Inter-connected critical infrastructure networks, such as transport (road, rail, fluvial, maritime and air transport); energy (electricity, gas, oil, etc.); digital communications (fixed, mobile); water (supply, waste water treatment, flood protection) and to some extent finance, bring huge opportunities for society and the economy but also increased risks.

European Critical Infrastructure (ECI)[90] is an asset or system which is essential for the maintenance of vital societal functions, health, safety and security, economic and social well-being of people.

The resilience of critical infrastructures – i.e. their ability to bounce back from shocks – is essential for the provision of many societal functions post-disaster and the efficient response during emergencies.

In the case of recent events involving the disruption to critical infrastructures, the European Commission has provided monitoring support to EU Member States emergency services through the Emergency Response Coordination Centre. This was the case of a major train accident in France (2013); a major ship accident off the coast of France (2014); and a major train accident in Italy (2016).

Impacts & cascading effects

Critical infrastructures are complex interconnected systems that are subject to a wide range of hazards and threats, such as terrorist and other criminal acts, and natural events. Risks of disruption/failure of vital infrastructure are interdependent and can extend well beyond the geographical boundaries and scope of jurisdiction of one Member State. As interdependencies increase, there is growing potential for systemic failures to cascading across networks and affect society at multiple levels.

The impacts arising from the disruption to, or complete cessation of, critical infrastructures affect the delivery of essential services, including the provision of energy, water, food, communications, health and emergency response services, and transport. The impacts will depend on the duration of the disruption, the time of year, the resilience of the service, and the response by the authorities, but may involve severe societal effects, economic consequences, and in extreme cases casualties.

Due to increased inter-dependence of essential services, the disruption of one piece of critical infrastructure (e.g. power outtakes) may trigger a domino effect causing disruption in the functioning of other key services. While technological developments have improved the quality and resilience of essential services, increased reliance on and use of services (transport, communication, energy) increase the impact and potential likelihood of loss of critical infrastructure. The interdependency between power and communications is well documented, as is the dependency of transport on power and other systems. Dependencies and interdependencies can certainly increase the impact of loss of critical infrastructure, but the link to the likelihood of such a loss is unclear. In effect, the Commission is encouraging a systems approach of risk assessment methodologies in which critical infrastructures are treated as an interconnected network.

Cross-border dimension

[90] Council Directive 2008/114/EC on the identification and designation of European Critical Infrastructure, 23.12.2008, OJ L 345/75

By definition[91], the disruption or destruction of European Critical Infrastructures may have significant impacts on at least two Member States.

The risk of a cross-border impact is relevant in the case of disruption of other forms of vital infrastructure (health, education, transport, etc.) in the event of close proximity of at-risk facilities to border regions.

Climate change

The role played by climate change as a risk driver on extreme natural events may in turn lead to an increased risk of disruption of critical infrastructures. For instance, Malta highlights the potential impacts of climate change on the probability of transport network disruptions. To date, the rise in temperatures and sea levels as well as the increased frequency and intensity of extreme weather events, such as storms, heat waves and flooding, is already having a significant impact on the functioning of transport and energy infrastructure.

Policy context

Based on Directive 2008/114/EC setting out to create a procedure for the identification and designation of critical infrastructures, the European Programme for Critical Infrastructure Protection (EPCIP) contributes extensively to improving the collaboration of Member States on ensuring the resilience of critical infrastructures. EPCIP offers a common approach to the assessment of the need for improvements in the protection of such critical infrastructures. The 2013 revision of EPCIP[92] has taken a much more pragmatic spin fostering the implementation of elements of risk assessment and risk management focusing on real case studies of infrastructures of European dimension. While the 2008 Directive focuses on European Critical Infrastructures in the fields of energy and transport, the revised approach to EPCIP broadens the scope of critical infrastructures to include assets and systems essential for the maintenance of vital societal functions, health, safety, security, economic or social well-being of people.

The new Regulation on Security of Gas Supply (which was politically agreed between the Council and the European Parliament on 26 April 2017 and will soon be adopted to replace the Regulation 994/2010) provides for a comprehensive risk assessment at regional and Member States' level. The competent authorities have to identify risks, among others related to infrastructure relevant for security of gas supply, and address the identified risks with appropriate preventive and emergency measures to be included in Emergency and Preventive Action Plans. A similar approach has been proposed for the electricity sector. The proposal for a Regulation on Risk Preparedness is being discussed with the Council and the European Parliament.

[91] Article 2b, Directive 2008/114/EC, *op.cit.*

[92] Commission Staff Working Document on a new approach to the European Programme for Critical Infrastructure Protection Making European Critical Infrastructure more secure, SWD(2013) 318 final, 28.8.2013

Table 9: Critical infrastructure disruption risk in National Risk Assessments (DG ECHO)

National assessment	Risk type / Scenario	Relative risk (likelihood/impact) [93]	Climate change	Cross-border risk	Cascading effects
Austria	Traffic accident	Medium L./ Medium I.			
Belgium	Transport accident with harmful substances / casualties	Medium-low L./ Medium I.			Chemical / radioactive release
Bulgaria	Transport accident				
Cyprus	Energy supply				
Czech Republic	Food & energy supply/ Information infrastructure disruption				
Denmark	Transport accident	Serious-very serious I.	X		Other transport networks
Estonia	Severe maritime accident	Very high risk: High L./ Very serious I.			Widespread environment contamination
	Aircraft accident	Medium risk: Very low L./ Catastrophic I.			
	. Rail accident	Medium risk: Very low L./ Serious I.			
	Road accident	High risk: Medium L./ Serious I.			
Finland	Fire in a critical infrastructure	Average L./ 2.5/5 Impact			Strain vital societal service
	Major road traffic accident	High L./ 1/5 Impact			
	Major rail transport accident	Average L./ 2/5 Impact			Chemical release
	Major aviation accident: runway collision	Low L./ 2/5 Impact		Many foreign passengers / foreign airline	Disruption of international airways
	Major maritime accident: collision	High L./ 3/5 Impact		Baltic sea region	Possible water contamination
Germany	Power outage				
Hungary	Waterway accident	Likely/Serious			
	Airway accident	Possible/Serious			
	Railway accident	1.Likely/Substantial 2.Very unlikely/ Catastrophic			
	Road accident	Possible/v. serious			
Iceland	Critical infrastructure				Tourism
Ireland	Rail/road accident	Unlikely/moderate			
	Air/maritime accident	Unlikely/high		International dimension	Impact on the environment
Latvia	Significant transport accident (rail, maritime)	Significant risk: Very high L./ Significant I.			
	Significant transport	Significant risk: High			

[93] L: Likelihood; I: Impact

	accident (road)	L./ Significant I.			
	Significant transport accident (aviation)	Significant risk: Very low L./ Medium I.			
	Electricity grid damage	Medium risk: Medium L/Severe I.			
	Damage to gas transport pipeline	Significant risk: Medium L./ Significant I.			
Luxembourg	Energy supply disruption	Low L./ Severe I.			National impact
Malta	Major mass-casualty incident		X (on transport)		
Netherlands[94]	Flooding and dike breach	Somewhat likely/ Serious I.		Cross-border flooding	
Norway	Oil and gas blowout on a drilling rig	Low L./ Medium I.			Marine pollution
	Collision at sea	Moderate L./ High I.			Result of extreme weather/ flooding
	Tunnel fire	Moderate L./ Low I.			
Poland	Electricity / fuel / gas supply disruption	Moderate risk			
Portugal	Transport accident	Moderate-high risk			
	Collapse of tunnels/bridges/ infrastructure	Moderate risk			
	Dam failure	High risk			
Serbia	Transport accident				
Slovakia	Traffic accident / Fire in mine / Energy supply disruption / Vital societal infrastructure disruption				
Slovenia	Plane crash in populated area	High risk		X	
	Train collision	Low risk			
Sweden	Transport accident				
	Dam failure	Serious human I./ Catastrophic eco &envi I.			
	Disruption to technical infrastructure and supply systems	Limited human I./ Limited-very serious eco&envi I.			
United Kingdom	Major transport accidents	1/2000-1/200 L. 3/5 I.			
	Widespread electricity failure	1/200-1/20 L. 4/5 I.			

[94] Version 6 of the National Risk Assessment

For more information:

- European Commission Directorate-General for Home Affairs
  https://ec.europa.eu/home-affairs/
- Critical Infrastructure Warning Information Network (CIWIN)
  https://ec.europa.eu/home-affairs/what-we-do/networks/critical_infrastructure_warning_information_network_en

- European research and capacity-building projects
  STREST (Harmonised approach to stress tests for critical infrastructures against natural hazards), http://www.strest-eu.org; INFRARISK (Novel Indicators for identifying critical infrastructure at risk from natural hazards); WEATHER, assessing the impacts of weather extremes on transport systems and hazards for European regions, www.weather-project.eu; EWENT, assessing the impacts and consequences of extreme weather events on EU transport systems, http://ewent.vtt.fi/; MOWE – IT, corroborating existing information from previous projects and providing short and long - term policy recommendations on mitigation, http://www.mowe-it.eu; CASCEFF (Modelling of dependencies and cascading effects for emergency management in crisis situations); DORATHE, development of a methodology for risk assessment for enhancing security awareness in air traffic management; ASTROM, assessment of resilience to threats to systems of data and control management of electrical transmission networks; RAIN (Risk Analysis of Infrastructure Networks in Response to Extreme Weather), http://rain-project.eu/; European Commission Geospatial Risk and Resilience Assessment Platform (GRRASP), developed to assess interdependencies among infrastructures, https://ec.europa.eu/jrc/en/grrasp
  European Commission Technical Report, 'Resilience of large investments and critical infrastructures in Europe to climate change', 2015, EUR 27598; ISBN 978-92-79-54003-5.
  European Commission Technical Report, 'Risk Assessment Methodologies for Critical Infrastructure Protection: Part II. A New Approach, 2015, EUR 27332, ISBN 978-92-79-49246-4.

Nuclear / Radiological accident

Nuclear accidents – events involving facilities or activities from which there is a likely release of radiological material and with trans-boundary implications[95] – and incidents involving radioactive release are considered risks of low likelihood but with potentially high levels of impact.

There are currently 128 nuclear reactors in operation in the EU, grouped on 55 sites in 14 Member States. Their safety record is such that although "incidents" have occurred and continue to occur, no "major accidents" have ever taken place[96]. In general nuclear accidents correspond to a low probability/high impact type of events, with potentially high human, economic and environmental (marine and inland) impacts. Due to the high potential impact of any nuclear accident, nuclear power plants are subject to strict safety and security controls and strict prevention and mitigation measures are in place.

Other forms of nuclear or radiological accidents can originate outside of nuclear power plants, such as transport of radiological material, installations handling reactor fuel; nuclear-powered engines; storage facilities for used fuel; as well as other powerful industrial sources involving radioactive material.

Impacts & cascading effects

Risk assessments of major radiological release at national level tend to underline the very low likelihood but the potential catastrophic impacts of an occurrence. The likelihood of nuclear accidents is considered theoretically very low, due to a large extent to the level of technical standards, organisation, authority control and safety culture in place.

However, in the event of a severe nuclear accident, the human, environmental and economic impacts would be very severe, involving land/water contamination, longer-term health complications due to exposure to radiation (cancers) or psychological stress and important economic costs due to losses in the agricultural sector, reduced tourism and affected industrial production. Depending on the level of impact, a massive response from the whole society might be needed in order to recover from the damage.

Cross-border dimension

Countries with no nuclear facilities still assess highly the risk of a nuclear accident on their territory –the risk of nuclear accidents will depend on the number and relative proximity to nuclear power plants on a regional scale, as well as the safety and security levels of each individual plant. Addressing the immediate psychological distress caused by the short and long-term health risks is paramount. Preventive measures to contain risk perceptions are particularly relevant in the case of nuclear accident risks.

The cross-border risk of severe nuclear accidents requires strong cooperation between the EU Member States as well as between EU and non-EU countries on the assessment of nuclear power plants, on early warning, and on training and exercises.

Through the European Community Urgent Radiological Information Exchange system (ECURIE)[97], each country can immediately inform all EU Member States in the event of an accident in one of its nuclear facilities.

[95] International Atomic Energy Agency (IAEA), *IAEA Safety Glossary*, 2007, 12, available at: http://www-pub.iaea.org/MTCD/publications/PDF/Pub1290_web.pdf.

[96] Terminology on incidents and accidents according to the categorisations of the International Nuclear Event Scale of the IAEA, available at: http://www.iaea.org/Publications/Factsheets/English/ines.pdf.

[97] https://rem.jrc.ec.europa.eu/RemWeb/activities/Ecurie.aspx

Climate change

The role played by climate change as a risk driver on extreme natural events may in turn lead to an increased risk of accidents in nuclear power plants or facilities containing radioactive substances.

Policy context

Following the accident at the Fukushima reactors (Japan) in March 2011, the European Council agreed that all nuclear power plants in the EU should be reviewed by independent parties by undergoing a comprehensive and transparent risk and safety assessment, also known as a 'stress test'. These 2011-12 stress tests re-assessed the safety margins of the EU power plants against the impacts from extreme external events, such as earthquakes and flooding. The first findings of the stress tests were published in a Commission Communication[98] and were followed on a technical level by the adoption of the European Nuclear Safety Regulators Group (ENSREG) stress test report together with a large number of recommendations for technical improvements at all nuclear power plants in the participating countries, including Switzerland and Ukraine.

In response to the European Council's mandate, the European Commission issued a Communication[99], which identifies its conclusions and recommendations on the stress tests and related activities, as well as a technical summary of the main findings[100]. Implementation of the stress tests recommendations is being undertaken by plant operators under the supervision of national authorities. The national action plans developed have been reviewed by ENSREG (in 2013 and 2015).

Taking account of some of the lessons of the Fukushima accident and the stress tests exercise, the Council Directive establishing a community framework for the nuclear safety of nuclear installations was amended in 2014[101] to include a new safety objective targeting accident prevention and mitigation, and new provisions on topical peer reviews, and on-site emergency preparedness and response. It is due to be transposed into national legislation by 15 August 2017.

Due to the age profile of the European nuclear reactor fleet and considering potential long term operation of European nuclear power plants, ENSREG identified "ageing management" of nuclear power plants as the topic for the first topical peer review to take place in 2017-2018.

A number of emergency arrangements at EU level exist, providing networks that integrate national monitoring and forecasting systems and allow rapid, coordinated responses to radiological emergencies by sharing real-time data (e.g. ECURIE; EURDEP; ENSEMBLE)[102].

Furthermore, through the Communication on a new EU approach to the detection and mitigation of CBRN-E risks[103], the European Commission proposed further measures for enhancing EU's efforts in detecting dangerous material, stepping up research and improving risk awareness in Europe.

[98] Communication on the interim report on the comprehensive risk and safety assessments ("stress tests") of nuclear power plants in the EU, COM(2011) 784 final, 24.11.2011

[99] Communication on the comprehensive risk and safety assessments ("stress tests") of nuclear power plants in the EU, COM(2012) 571 final, 4.10.2012

[100] Commission Staff Working Document, Technical Summary on the implementation of comprehensive risk and safety assessments of nuclear power plants in the European Union, SWD(2012) 287, 4.10.2012

[101] Directive 2014/87/Euratom of 8 July 2014 amending Directive 2009/71/Euratom establishing a Community framework for the nuclear safety of nuclear installations, 25.7.2014, OJ L 219, pp. 42-52

[102] http://www.ensreg.eu/nuclear-safety/prevention-accidents/Emergency-arrangements-at-EU-level

[103] Communication on a new EU approach to the detection and mitigation of CBRN-E risks, COM(2014) 247, 5.5.2014

Table 10: Nuclear / radiological accident risk in National Risk Assessments (DG ECHO)

National assessment	Risk type / Scenario	Relative risk (likelihood/impact) [104]	Climate change	Cross-border risk	Cascading effects
Austria	Accident in power plant close to border			X	
Belgium	Road accident with radioactive release				
Bulgaria	Accident with radioactive contamination	No past event / Catastrophic impact		scenario of foreign source of outbreak	
Czech Republic	Radiation accident				
Denmark	Nuclear accident abroad	Critical risk		Pan-European risk	
Estonia	Nuclear accident with cross-border impact	Medium risk: Very low L./ Very serious I.		X	
	Radiological accident of domestic origin	Medium risk: Low L./ Serious I.			
Finland	Severe nuclear accident in Finland or its vicinity			X (focus on Eastern border)	Severe societal disruptions
France	Major nuclear or radiological accident			X	
Germany	Release of radioactive material				
Hungary	Nuclear accident	Very unlikely / Catastrophic			
Ireland	Nuclear incident abroad	Unlikely / High Impact		X	Long-term health threat
	Domestic radiation incident	Very unlikely / Low Impact			
Lithuania	Nuclear accident	Medium risk (very low L.)			Long-term health threat
Luxembourg	Nuclear emergency	Low L. / Very serious I.		Foreign source of outbreak	National impact
Netherlands[105]	Nuclear incident	Highly unlikely Very serious I.			
Norway	Nuclear accident at a reprocessing plant	Low L. / High to very high I.		X	
Poland	Radioactive contamination	Small risk level		Foreign source of outbreak	
Portugal	Nuclear power plant accident	Moderate risk			
	Accident in a nuclear submarine at quay	High risk			
Romania	Nuclear accident / radiological emergency	Low risk: Very unlikely Very low impact			
Serbia	Nuclear and radiation accident				

[104] L: Likelihood; I: Impact
[105] Undertaken in previous versions of the National Risk Assessment

Slovakia	Release of radioactive substances		
Slovenia	Nuclear power plant accident	Medium risk: Very low L./ Highest level I.	
	Accident involving radioactive sources	Low risk: Medium L./ Lowest level I.	
Sweden	Nuclear accident	Impact: Serious (human); Catastrophic (eco/envi); Very serious (social)	X
United Kingdom	Industrial accident	1/2000-1/200 L. 3/5 I.	

For more information:

- European Commission Directorate General for Energy
  http://ec.europa.eu/energy/en
- European Nuclear Safety Regulators Group (ENSREG)
  http://www.ensreg.eu/

- European research and capacity-building projects
  After the Fukushima accidents, the nuclear fission energy area of the Framework Programme of the European Atomic Energy Community (Euratom) for nuclear research and training activities re-oriented towards safety research of existing reactors (accident prevention, probability risk assessment, severe accident management, plant life management).
  In radiation protection, research focused on better understanding risks arising from low dose of radiation and long term exposures. EDEN Demonstration Project (End-user driven Demo for CBRN-E), https://www.eden-security-fp7.eu/

Terrorism

The security environment in Europe is changing dramatically. European citizens are exposed to an increasing threat of terrorist attacks. Recent terrorist attacks illustrate that the risk landscape in Europe has dramatically changed over the past years and highlight the need for further cooperation across countries and sectors in the EU.

Current security concerns are directly tied to instability in the EU's neighbourhood, combined with evolving forms of radicalisation and terrorism, irrespective of borders and international by nature. Due attention should also be paid to political and religious extremism, which may be perpetrated through Foreign Terrorist Fighters or 'lone wolves'.

The threat of terrorism is highly uncertain and unpredictable due to the complex and fragmented nature of the global terror threat, which emanates not only from structured groups and networks, but also from smaller EU-based groups and individual-perpetrated terrorist actions. Technological developments and globalisation have added to the complexity of the terrorist threat.

Counterterrorism policies contribute to the reduction of the threat through the identification, arrest and conviction of terrorist. Yet there can be no "zero risk" and preparedness measures are essential to mitigate the impact and respond to important terrorist attacks. In the case of biological and radiological contamination for example, ensuring stocks of medical supplies, ensuring health services are able to cope with a sudden need for medical support, improving detection and monitoring of hazards, ensuring adequate evacuation plans and improving communication to inform how citizens can reduce the risks they face.

Impacts & cascading effects

A serious terrorist attack has the potential to have severe impacts resulting in mortality, injury and psychological distress, economic losses and main vital societal infrastructure disruptions. The level of distress and insecurity caused by terrorist attacks is an important human impact.

From the perspective of medical emergency services, there can be a high number of casualties – i.e. cutting wounds, lacerations and gunshot wounds and burns. These situations are considered mass causalities incidents and it might happen that an affected country cannot cope with it all alone. In such cases, a country is eligible to activate the UCPM.

Terrorist attacks can be associated with other types risks (epidemics, pandemics, Chemical/Biological/Radiological/Nuclear threats, industrial accidents, technical failures, severe weather and cyber-attacks) through a series of cascading effects. For example, bioterrorism or attacks against hazardous goods or stationary facilities with hazardous substances could cause large scale epidemics or pandemics. Attacks may also present threats to the environment (substance release, infrastructure collapse).

Cross-border dimension

While the immediate impacts of terrorist attacks are localised (e.g. Paris 2015; London 2007), these tend to reflect a shared terrorist threat across different European countries.

There is also a cross-border dimension in the planning and conduct of terrorist attacks, as illustrated by recent events.

Policy context

The European Agenda on Security[106] defines how the EU can provide added

[106] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee

value to its Member States in ensuring their security. The Agenda gives priority to threats of terrorism, organised crime and cybercrime, while also recognising the existence of emerging threats to European security.

The European Agenda on Security builds on the strategic objectives of the Internal Security Strategy 2010-2014[107]. In fact, the Treaty of Lisbon provides a strong legal base for pooled efforts towards security, internal free moment and European response to cross-border security risks.

In its Communication on the delivery of the Agenda on Security to fight against terrorism and pave the way towards an effective and genuine Security Union[108], the European Commission identified implementation gaps and additional actions needed to address all dimensions of terrorist threats.

The European Commission is presenting monthly 'Progress reports towards an effective and genuine Security Union' covering developments on the two pillars of tackling terrorism and the means that support it, as well as strengthening our defences and building resilience.

A Communication by the European Commission on supporting the prevention of radicalisation leading to violent extremism[109] was adopted June 2016, stressing the need of preventing radicalisation as a key part of the fight against terrorism.

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of the regions, The European Agenda on Security, COM(2015) 185 final, 28.4.2015

[107] European Union, Internal Security Strategy for the European Union: Towards a European Security Model, March 2010

[108] Communication from the Commission to the European Parliament, the European Council and the Council delivering on the European Agenda on Security to fight against terrorism and pave the way towards an effective and genuine Security Union, COM(2016) 230 final, 20.4.2016

[109] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions supporting the prevention of radicalisation leading to violent extremism, COM(2016) 379 final, 14.6.2016

Table 11: Terrorism risk in National Risk Assessments (DG ECHO)

National assessment	Risk type / Scenario	Relative risk (likelihood/impact) [110]	Climate change	Cross-border risk	Cascading effects
Austria	X				
Belgium	Individual terrorist actions & influence of international terrorist organisations	Top 10 risks: 4.5/5 Likelihood 3.5/5 Impact		X	
	Terrorist infiltration of migration flow (asylum)	Top 10 risks: 4.5/5 Likelihood 2.5/5 Impact		X	
Bulgaria	X				
Czech Republic	Huge legitimacy disturbance				
Denmark	X	Critical risk			
Finland	Dirty bomb in Finland	Low L./ Serious to very serious I.		X	
Hungary	X	Possible L./ Serious I.			
Ireland	X	Unlikely / High Impact			
Luxembourg	X	Medium L./ Severe I.			
Malta	Domestic terrorist attack	Highly unlikely / Significant I.			
Netherlands	Political and religious extremism				
Norway	Terrorist attack in city	Low I./ High I.			
Serbia	X				
Slovakia	X				
Slovenia	X	High risk			
Sweden	Bomb attack in city	Very serious I.			
United Kingdom	Priority: Catastrophic attack	Medium low L. 5/5 Impact			
	Attack on infrastructure	Medium L. 3/5 Impact			
	Attack on crowded places	Medium high L. 3/5 Impact			
	Attack on transport systems	High L. 3/5 Impact			

[110] L: Likelihood; I: Impact

For more information:

- European Commission Directorate-General for Home Affairs
  https://ec.europa.eu/home-affairs/

- European research and capacity-building projects
  SAFIRE (Scientific Approach to Finding Indicators & Responses to Radicalisation), http://www.safire-project.eu/; VOX-Pol (Virtual Centre of Excellence for Research in Violent Online Political Extremism), http://www.voxpol.eu/; IMPACT Europe (Innovative Method and Procedure to Assess Counter-violent-radicalisation Techniques in Europe), http://impacteurope.eu/; HOMER (Homemade explosives (HMEs) and recipes characterisation), http://www.homer-project.eu/; DANTE (Detecting and analysing terrorist-related online contents and financing activities), http://www.h2020-dante.eu/; TENSOR (Retrieval and Analysis of Heterogeneous Online Content for Terrorist Activity Recognition), http://tensor-project.eu/, DARE (Dialogue About Radicalisation and Equality), http://cordis.europa.eu/project/rcn/208416_en.html

Cybercrime

The protection of cyber space has become a primary issue for European countries, as societies are increasingly dependent on electronic networks and information systems. Information and Communication Technology (ICT) is central to our economic growth and is critical to the functioning of our European economic sectors. ICT underpins the systems on which vital sectors rely. The uninterrupted availability of the internet and smooth information systems are central to many business models.

Cyber-attacks to which individuals, organisations and networks are most commonly exposed are: syntactic attacks, using malicious software (e.g. viruses, worms and Trojan horses) relevant to cyber espionage and sabotage; and semantic attacks, through the dissemination of incorrect information to affect credibility of the target resources, relevant in the case of cyber subversion. Other forms of cyber threats have become increasingly relevant, such as the risk of 'social engineering' involving insider manipulation of individual data and installation of malware.

Hybrid threats covers the mixture of military and non-military actions that can be used in a coordinated manner by a state or non-state actors, often in a disguised and deniable form, to undermine public trust in government institutions or exploiting social vulnerabilities while remaining below the threshold of formally declared warfare. Hybrid threats can take a wide range of forms such as; cyberattacks on critical information systems and the disruption of critical services, such as energy supplies or financial services. The co-ordinated cyber-attacks, in 2007, on Estonian banks, Parliament, media and other institutions are a good example of a hybrid attack.

Impacts & cascading effects

Alongside the energy, transport, banking and health sectors, other areas of society exposed to such threats include government services, emergency services, food and agriculture, water supply, transport, financial services and distribution. The rapidly changing nature of such attacks as a result of developments in ICT renders the quantification of and response to this threat difficult. Historical events show that the level of attention given to this risk is not sufficient for proper prevention, preparedness, response, and recovery with respect to cyber-attacks.

Cross-border dimension

Cyber-attacks are not limited to the local or national level insofar that the target data of such attacks is not necessarily associated with a given geographical area – ex: Lithuania underlines that a cyber-attack may not limit itself to a national scale and may also target data relevant to the EU and NATO. A cross-border dimension to this threat also lies in the source of the aggression: both Denmark and the United Kingdom define 'foreign powers' as major threats to their cyber-security. The global dimension of this threat is clear, as sources of aggression can be located anywhere around the globe and can, in cases, be directly linked to the threat of terrorism.

Policy context

A Commission Communication on the Cyber security Strategy of the European Union confirms that cyber-attacks "are increasing at an alarming pace and could disrupt the supply of essential services we can take for granted such as water, healthcare, electricity or mobile services"[111]. Currently, the Commission and the EEAS are working on an update of the 2013 cyber security strategy. The adoption of the new strategy is envisaged

[111] Joint Communication to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, Cybersecurity Strategy of the European Union: An Open, Safe and Secure Cyberspace, JOIN(2013) 1 final, 7.2.2013

for the last quarter of 2017. As part of the Strategy, in August 2016, the Directive on security of network and information systems (the NIS Directive)[112] entered into force, thus enhancing national capabilities and EU-level cooperation against cyber incidents. The Directive also requires operators of energy, transport, banking and health services as well as key internet platforms and public administrations to take appropriate risk management measures and to report significant incidents to their national competent authority.

In an effort to tackle European vulnerability to cyber security incidents, the European Commission adopted in 2001 a Communication on Network and Information Security[113]. A European Network and Information Security Agency (ENISA) was also created in 2004. In 2006, it adopted a Strategy for a Secure Information Society and has adopted an Action Plan and a Communication on Critical Information Infrastructure Protection (CIIP)[114].

In 2016, the European Commission adopted a Communication on Europe's cyber resilience system and the cybersecurity industry[115].

Finally, on hybrid threats, the Commission and the High Representative/Vice President adopted in April 2016 a Joint Framework on Countering Hybrid Threats[116]. The Joint Framework proposes 22 operational actions aimed at raising awareness, building resilience, better responding to crises and stepping up cooperation between the EU and NATO.

Actions outlined in the EU Joint Framework on countering hybrid threats aim to improve awareness on hybrid threats through a dedicated mechanism to exchange information with Member States and to coordinate the EU's capacity to deliver strategic communications For instance, an EU Hybrid Fusion Cell has been established, which aims to receive analyses and share classified and open source information specifically relating to internal and external aspects of hybrid threats affecting the EU and its neighbourhood.

[112] Directive (EU) 2016/1148 of the European Parliament and of the Council of 6 July 2016 concerning measures for a high common level of security of network and information systems across the Union, 19.7.2016, OJ L 194, pp.1-30

[113] Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions, Network and Information Security: Proposal for a European Policy Approach, COM(2001) 298 final, 6.6.2001

[114] Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions, A Strategy for a Secure Information Society: "Dialogue, Partnership and Empowerment", COM(2006) 251 final, 31.5.2006

[115] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, Strengthening Europe's Cyber Resilience System and Fostering a Competitive and Innovative Cybersecurity Industry, COM(2016) 410 final, 5.7.2016

[116] Joint Communication to the European Parliament and the Council, Joint Framework on countering hybrid threats: a European Union response, JOIN(2016) 18 final, 6.4.2016

Table 12: Cyber-attack risk in National Risk Assessments (DG ECHO)

National assessment	Risk type / Scenario	Relative risk (likelihood/impact) [117]	Climate change	Cross-border risk	Cascading effects
Belgium	Cyber terrorism	Top 10 risk: 4/5 L. - 2.5/5 I.			
	Cyber intrusion into critical infrastructure	Top 10 risk: 3.5/5 L.- 3/5 I.			Vital infrastructure disruption
Cyprus	X				
Denmark	X	Critical risk			Vital infrastructure disruption
Estonia	Significant cyber incident	High risk: Medium L. / Serious I.			
Hungary	X	Very likely Substantial I.			
Ireland	X	Likely High Impact			
Latvia	Significant IT security incident	Medium risk: Very high L. Medium I.			
Lithuania	Attack on electronic services	Very high L. Insignificant health/envi I. High soc/pol I.		Response requires international cooperation	
Luxembourg	X	Medium L. / Serious I.			
Netherlands[118]	Cyber espionage	Highly likely Very serious I.			
	Cyber hacktivism	Somewhat likely Substantial I.			
Norway	Attack on financial infrastructure	Low L. Large I.			
	Attack on electronic communications infrastructure	Low L. High to very high I.			Vital infrastructure disruption
Poland	Cyber disruption of telecommunication systems	Moderate risk			
Sweden	X				
United Kingdom	Attack on infrastructure	Medium-low L. 3/5 Impact			
	Attack on data confidentiality	High Likelihood 1/5 Impact			

[117] L: Likelihood; I: Impact
[118] Undertaken in previous versions of the National Risk Assessment

For more information:

- European Commission Directorate General for Communications Networks, Content and Technology
  https://ec.europa.eu/digital-single-market/en/cybersecurity
- European Union Agency for Network and Information Security
  http://www.enisa.europa.eu/

- Relevant research and capacity-building projects
  Relevant research projects: SPARKS (Smart grid protection against cyber attacks), https://project-sparks.eu/; PRECYSE (Prevention, protection and reaction to cyber-attacks to critical infrastructure), http://precyse.eu/; SEGRID (Security of smart electricity grids), https://segrid.eu/; SCOUT (Multitech security system for interconnected space control ground stations), http://www.scout-project.eu/; PROGRESS (Protection and resilience of ground based infrastructures for European space systems), http://www.progress-satellite.eu/; ASGARD (Analysis system for gathered raw data), http://www.asgard-project.eu/; RAMSES (Internet forensic platform for tracking the money flow of financially-motivated malware), http://ramses2020.eu/

4. New and Emerging risks

The interconnections that shape the current risk landscape call for an ever stronger degree of cooperation and solidarity. At the same time, new and emerging risks are increasingly assessed by national emergency management authorities to represent main disaster risks on a national scale. In certain cases, recent major developments in Europe have brought new risks to the forefront of emergency management activities.

This section highlights, but is not limited to, a number of these risks drawn from NRAs that could require special attention to reinforce the capacities at national and European levels to integrate such risks into the assessment process, thereby enhancing the effective management of these risks and building on the growing wealth of evidence available.

4.1. Sudden influx of refugees and migrants

Between 2015 and early 2016, close to 1.1 million persons, seeking international protection, made their way to the EU along the Eastern Mediterranean route. Asylum applicants attempting to reach Europe have been escaping conflict in their own countries or are seeking a better and safe life. The Syrian crisis has sparked an urgent need for relief, equipment and services which are essential to respond to the humanitarian needs of these people. As a consequence, the EU is potentially facing, for the first time since the Second World War, the potential of wide ranging humanitarian consequences on its own territory.

The crisis triggered the first activation of the EU Integrated Political Crisis Response (IPCR) arrangements by the Council Presidency in October 2015. The Commission and the External Action Service (EEAS) have produced regular integrated situational awareness and analysis (ISAA) to support political response and coordination at EU level.

On 15 March 2016, the Regulation on providing emergency support within the Union was adopted by the Council[119], following the recommendation by the European Council for the Commission to "put in place the capacity for the EU to provide humanitarian assistance internally"[120]. Since April 2016, EU humanitarian funding is allocated by the European Commission for emergency support projects to assist refugees in Greece. The projects address the most urgent humanitarian needs and have led to tangible results across all sectors for more than 45,000 beneficiaries spread across more than 30 sites on the islands and on the mainland in Greece.

The emergency support funding is made available to Member States whose own response capacities are overwhelmed by urgent and exceptional circumstances, such as the sudden influx of refugees and migrants but also caters for any type of natural or man-made disasters with wide-ranging humanitarian impact within the EU. The assistance is complementary to Member States actions and provided in close coordination with the Member State concerned, as well as the Commission humanitarian partner organisations such as UN agencies, non-governmental organisations and international organisations[121]. This funding can be used for the provision of basic necessities such as food, shelter, health services, protection activities (e.g. of unaccompanied minors), access to education, etc.

[119] Council Regulation (EU) 2016/369 of 15 March 2016 on the provision of emergency support within the Union, OJ L 70, 16.3.2016, p. 1.
[120] European Council Conclusions of 19 February 2016, EUCO 1/16.
[121] Partner organisations with which the Commission has signed Framework Partnership Agreements or a Financial and Administrative Framework Agreement.

The Commission supports refugees in Turkey who have fled conflict in both Syria and Iraq. Since the beginning of the Syrian crisis in 2011, over EUR 450 million of humanitarian assistance to Turkey has been provided by the European Commission, including through both humanitarian aid and longer-term assistance. In November 2015, the EU set up the Refugee Facility for Turkey[122]. EU institutions and Member States committed to funding up to €3 billion to be coordinated via this Facility – A First Annual Report on the Facility for Refugees in Turkey was produced by the European Commission[123]. The Facility has a particular focus on vulnerable people situated in Turkey but living outside of refugee camps. The Emergency Social Safety Net (ESSN), financed with EUR 348 million by the EU and its Member States under the Facility is the largest ever humanitarian programme signed by the European Union.

Since the beginning the refugee crisis, assistance has also been provided by the European Commission to the Western Balkans and along the Eastern Mediterranean route, notably Serbia and the Former Yugoslav Republic of Macedonia. Aid is channelled via humanitarian partner organisations to the most vulnerable people, and consists of distribution of emergency assistance (food, water, hygiene, non-food items, health, and basic protection).

The European Commission has also contributed humanitarian support to Libya since mid-2014, supporting internally displaced people and other vulnerable groups through assistance targeting protection, health care, cash support, psycho-social assistance, as well as non-food and hygiene items.

Through the UCPM and the ERCC, the European Commission coordinates the delivery of immediate material to support Member States and neighbouring countries facing major peaks in the refugee crisis that overwhelm their immediate response capacities. The assistance, provided only upon the request of the affected country, is based on voluntary contributions from countries participating in the Mechanism.

The Mechanism has been activated to help cope with an increased refugee influx several times since 2015. Hungary, Serbia, Slovenia, Croatia and Greece have received material assistance such as winterised tents, beds and blankets from countries participating in the Mechanism, in order to help them better cope with the arrival of refugees and asylum seekers.

4.2. Climate- and environment-induced migration

Worsening environmental conditions, combined with increased extreme natural phenomena and climate change, may trigger unanticipated social and economic processes and impact the availability and/or productivity of natural resources leading to a geographical redistribution of capital and labour. It is generally acknowledged that three types of climate impacts can significantly affect patterns of human mobility: sea-level rise, changes in precipitation patterns and water stress, and the increased intensity of natural hazards.

Evidence currently available would suggest that most movements will happen in an intra-state context or within developing regions, and mainly from rural to urban environments[124]. Given that international migration requires substantial resources, sudden large-scale international

[122] Managing the Refugee Crisis: The Facility for Refugees in Turkey, https://ec.europa.eu/neighbourhood-enlargement/sites/near/files/frit_factsheet.pdf
[123] Communication from the Commission to the European Parliament and the Council, First Annual Report on the Facility for Refugees in Turkey, COM(2017) 130 final, 2.3.2017
[124] Commission Staff Working Document, Climate Change, environmental degradation, and migration, SWD(2013) 138 final, 16.4.2013

population movements to developed regions such as Europe are unlikely. However, there is currently a significant level or rural-urban migration in Africa, largely driven by environmental disruptions on agricultural systems. African megacities can become overwhelmed by these migration influxes, and thus unable to meet or sustain the needs of their inhabitants with regard to jobs, housing or basic services. As a result, some will continue their migration journey towards Europe, where they are referred to as 'economic migrants'.

The reality of migration in a climate change context present challenges (and opportunities) to both countries/areas of origin and destination, in particular in the developing world[125]. Although no legal framework addressing the specific case of environmentally-induced migration currently exists, a number of international and national instruments in areas such as international human rights law, international asylum law, and environmental law may provide frameworks for addressing related challenges (e.g. the UN Guiding Principles on Internal Displacement for the protection of victims of natural disasters).

In the EU strategy on adaptation to climate change[126], the European Commission stresses that further work on slow-onset environmental degradation should focus on identifying disaster risk management mechanisms that can avoid or reduce the need for migration. This can be achieved through contributions to disaster risk reduction with actions in water management, biodiversity, forests, desertification, coastal erosion, energy, health, social policy and research.[127] Better management of the risks and opportunities arising from climate variability and change will also rely on developing and incorporating science-based climate information and prediction into planning, policy and practice, including data from Copernicus[128].

On a global scale, the EU is contributing to the Executive Committee of the Warsaw International Mechanism for Loss and Damage, under the framework of the UN Framework Convention on Climate Change. One of the central action areas of the executive committees looks at enhancing the understanding of and expertise on how the impacts of climate change are affecting patterns of migration, displacement and human mobility, and the application of such understanding and expertise[129]. The work of the Nansen agenda, and of its follow up initiative, the Platform on Disaster Displacement, supported by Germany, France and Switzerland, provides tools and instruments to prevent and better prepare for climate displacement.[130]

4.3. Space weather hazards

Space weather can impact on daily life in various ways. While evidence shows that solar storms are not a new hazard, the severity of this meteorological hazard has increased with the emergence of technologies exposed to the threat. The assessments of risks at a national level reflect a bourgeoning attention to the potential disaster risk of this hazard. Finland, Hungary, the Netherlands, Sweden, the United Kingdom and Norway have included space weather as a priority risk. The UK Met Office has created a 24/7 space weather forecasting capability and provides UK-centric advisories to government, military and critical-infrastructure sectors.

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[125] See also: European Commission, *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on Maximising the Development Impact of Migration*, COM(2013) 292 final, Brussels, 21.5.2013.
[126] Council of the EU, Conclusions on an EU strategy on adaptation to climate change, 18 June 2013, 11151/13
[127] *Ibid.,* 24. United Nations Framework Convention on Climate Change (UNFCCC), *Report of the Conference of the Parties on its eighteenth session, held in Doha from 26 November to 8 December 2012*, 28.02.2013, available at: http://unfccc.int/resource/docs/2012/cop18/eng/08a01.pdf.
[128] http://climate.copernicus.eu/
[129] http://unfccc.int/adaptation/cancun_adaptation_framework/loss_and_damage/items/9682.php
[130] http://disasterdisplacement.org/

The growing use of susceptible technologies by governments and businesses increases exposure and vulnerability to space weather hazards. In the case of severe space weather, ensuing disturbances may significantly affect space assets and ground-based infrastructure.

Numerous space-weather impacts on infrastructures have already been observed and documented. For example, space weather affects the power grid through the induction of telluric currents that can damage high-voltage transformers and lead to grid collapse and prolonged power outages. Aviation will be impacted via increased radiation levels that affect air traffic on transpolar routes, but also through a loss of communications over oceans and deserts, since commercial aeroplanes are required to be in contact with ground services. It will also disturb the propagation of radio signals passing through the ionosphere in the GNSS bands (L-Band) and higher frequency bands as those used by space-borne synthetic aperture radar systems. Railway infrastructure may also suffer disruptions to signalling systems or to on-train equipment.

Solar events may degrade the performance of Global Navigation Satellite Systems (GNSS) services or even render them unavailable, sometimes for quite long periods. At the same time, more and more other infrastructures (e.g. aviation, maritime, rail and road transport, power grids, telecommunications and financial trading) are coming to rely on GNSS signals for precise timing or positioning.

The consequences of an extreme solar event could be very severe and while awareness of the risk to infrastructure is growing among operators and regulators, important gaps in space-weather risk reduction remain[131]. For example, significant knowledge gaps in physical and impact modelling persist, which affect early-warning capabilities and preparedness in industry. Furthermore, extreme space weather can affect multiple infrastructures at the same time, potentially leading to impacts that cross national boundaries and posing a significant challenge for emergency response.[132]

The policy framework behind the monitoring and forecasting of ionospheric disturbances (no matter whether they originate from a space weather event or not) is its impact on the services offered by the EU GNSS Programmes Galileo and EGNOS, which are managed by the European Commission[133]. In addition, the European Programme on Critical Infrastructure Protection (EPCIP) is a key initiative that provides a policy background for protecting critical infrastructure from all hazards.

National experience: Finland

The Finnish Meteorological Institute's (FMI) Earth Observation unit together with the Weather and Safety Centre and the Arctic Research unit are responsible for 24/7 monitoring, forecasting and warning of space weather phenomena that can cause danger or harm. Experts are constantly monitoring solar activity and space weather, and analysing the scale and probability of the risk.

[131] Krausmann E., et al., *Space Weather and Critical Infrastructures: Findings and Outlook*, EUR 28237 EN, European Union, 2016.
[132] World Economic Forum, The Global Risks Report 2017, 12th Edition, Insight Report, 2017, p.55
[133] Regulation (EU) No 1285/2013 of the European Parliament and of the Council of 11 December 2013 on the implementation and exploitation of European satellite navigation systems and repealing Council Regulation (EC) No 876/2002 and Regulation (EC) No 683/2008 of the European Parliament and of the Council, 20.12.2013, OJ L 347, pp.1-24

The ReSoLVE[134] Centre of Excellence studies long-term solar variability and its effects, the SOLE project studies solar storms and their frequency, and the SAFIR[135] project's 'Extreme weather and nuclear power plants' (EXWE) - subprojects study the impact of solar storms on nuclear safety.

4.4. (Re-) Emerging infectious threats including antimicrobial resistance

Emerging infectious diseases are newly identified or previously unknown infections that cause public health challenges. Re-emerging infectious diseases are due to both the reappearance of and an increase in the number of infections from a disease that is known but which had formerly caused so few infections that it was no longer considered as a public health problem.

A range of factors is responsible for the (re-)emergence of infectious diseases, altering the epidemiology and spread of disease in a changing global environment. These include ecological, environmental or demographic factors that place people at increased contact with a previously unfamiliar microbe or its natural host or promote dissemination. These factors are increasing in prevalence – this increase, together with the ongoing evolution of viral and microbial variants and selection for drug resistance suggests that infections will continue to emerge and probably increase. Recent global trends indicate that the occurrence of (re-)emerging infectious diseases will continue to increase[136]. The past has taught us how epidemics and pandemics have repeatedly changed the course of human history, by sweeping through human societies, causing suffering and death, political and social disorder, and economic disruption. Modelling from the World Bank suggests that a 'Spanish flu-like' outbreak today would kill more than 33 million people in 250 days, costing more than €3.4 trillion or 4.8% of global GDP[137]. The impact of any infectious disease outbreak, independent of the size, occurs on many different levels, and will often last long after the outbreak is over.

Antimicrobial resistance (AMR) is by nature a cross-border risk which affects populations in Europe and beyond. Antimicrobial resistance can be defined as "*the ability of microorganisms to withstand treatment with drugs to which they were once susceptible*"[138].

The World Economic Forum identifies as one of seven global societal risks and one of ten global risks scoring above the average risk score of the risk assessment Global Risks Landscape 2014.[139] The risk of AMR is not currently assessed to be a main disaster risk for a large majority of emergency management authorities in Europe: the United Kingdom is the only European country to have addressed the issue in its NRA.

Antimicrobial agents, in the case of antibiotics for example, have led to a dramatic reduction in the number of deaths from infectious diseases since their introduction 70 years ago. However, the overuse and misuse of these agents have caused many micro-organisms to become resistant to them. This development is a growing concern as these agents have become essential tools for modern medicine, being used in many surgical operations.

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[134] Additional information http://www.spaceclimate.fi/resolve/

[135] http://safir2014.vtt.fi/

[136] The European Centre for Disease Prevention and Control (ECDC) defines emerging (or re-emerging) infectious disease as "*a disease (i) that arises through evolution or change in existing pathogens, (ii) was previously unrecognised or (iii) is already known but spreads to new geographic areas, or new populations, or reappears after having been eradicated*": http://ecdc.europa.eu/en/healthtopics/emerging_and_vector-borne_diseases/Emerging-and-vector-borne-diseases-programme/Pages/about-the-programme.aspx

[137] http://www.worldbank.org/en/events/2015/11/24/world-bank-seminar-pef

[138] Transatlantic Taskforce on Antimicrobial Resistance, "Recommendations for future collaboration between the US and EU", *Tatfar Report*, 2011, available at: http://ecdc.europa.eu/en/activities/diseaseprogrammes/tatfar/documents/210911_tatfar_report.pdf.

[139] World Economic Forum, Global Risks 2014, Ninth Edition, Insight Report, 2014, pp.13-15.

According to the European Centre for Disease Prevention and Control (ECDC)[140], some 25,000 deaths annually are the result of antimicrobial resistance (AMR) and incur related costs of over EUR 1.5 billion in healthcare expenses and productivity losses. Data from the European Antimicrobial Resistance Surveillance Network (EARS-Net[141]) shows developments in the AMR situation in Europe through large variations with regard to pathogen types, antimicrobial agents and geographical regions: in its annual report, the EARS-Net states that *"the already high percentages and increasing trends of antimicrobial resistance in gram-negative bacteria in Europe […] illustrate the continuous loss of effective antimicrobial therapy against these microorganisms and emphasise the need for comprehensive strategies targeting all health sectors".*[142]

Over the last five years, the Commission implemented its Action plan against AMR[143]. The Action Plan identified 7 priority areas in which measures are most necessary: ensuring appropriate use of antimicrobials in both humans and veterinary medicine; preventing microbial infection and spreading; developing new effective antimicrobials or alternative treatments; joining forces with international actors to contain the risk of spreading AMR; improving medical surveillance and monitoring; promoting research and innovation; and improving communication, education and training. A recent evaluation of that Action Plan has shown it provided the political stimulus for concrete actions within Member States, strengthened international cooperation and presented a framework to guide and coordinate activities on AMR at national and global levels. It also boosted research and innovation via a range of funding initiatives including the establishment of the New Drugs for Bad Bugs programme within the Innovative Medicines Initiative[144]. However, the evaluation also demonstrated that AMR is a persistent problem requiring continued actions to be taken.

The European Commission is continuing and scaling up its work on AMR, with the launch in 2017 of a second One-Health Action Plan setting out broad actions aimed at tackling AMR both at EU and global levels. This second Action Plan will take the form of a Commission communication to the European Parliament and the Council and will focus on supporting Member States, particularly in establishing, implementing and monitoring their National Action Plans, bring together EU funds and instruments in order to promote innovation and research against AMR and strengthen the EU's leading role in global fora, notably within international organisations and with major trade partners.[145]

[140] ECDC, http://www.ecdc.europa.eu/en/Pages/home.aspx.
[141] EARS-Net is based on a network of representatives from Member States collecting routine clinical antimicrobial susceptibility data from national AMR surveillance initiatives; see: http://www.ecdc.europa.eu/en/healthtopics/antimicrobial_resistance/database/Pages/database.aspx.
[142] European Centre for Disease Prevention and Control, "Antimicrobial resistance surveillance in Europe", *Surveillance Report*, 2012, 1, available at: http://ecdc.europa.eu/en/publications/Publications/antimicrobial-resistance-surveillance-europe-2012.pdf.
[143] European Commission, *Communication from the Commission to the European Parliament and the Council on an Action Plan against the rising threats from Antimicrobial Resistance*, COM(2011) 748 final, 15.11.2011.
[144] http://www.nd4bb.eu/
[145] See Commission Roadmap: http://ec.europa.eu/smart-regulation/roadmaps/docs/2016_sante_176_action_plan_against_amr_en.pdf

4.5. Biodiversity loss

The Commission Communication on "Our life insurance, our natural capital: an EU biodiversity strategy to 2020"[146] stresses that biodiversity — the extraordinary variety of ecosystems, species and genes that surround us — is our life insurance, giving us food, fresh water and clean air, shelter and medicine, mitigating natural disasters, pests and diseases and contributing to regulating the climate.

Biodiversity is also our natural capital, delivering ecosystem services that underpin our economy. Biodiversity loss, though not striking suddenly, is a threat to living conditions on earth, fragilising the capacity for resilience of natural and man-made ecosystems, and related ecosystem services. Its deterioration and loss jeopardises the provision of these services: loss of species and habitats and the wealth and employment to be derived from nature, and endangerment of wellbeing. The relative importance of climate change as a major driver of biodiversity and ecosystem change is projected to increase further in the future. In Europe, 14% of habitats and 13% of species of interest have been assessed to already be under pressure because of climate change[147].

In the case of the Common Agricultural Policy (CAP) for example, one of the priorities under the support for rural development is promoting resource efficiency and supporting the shift towards a low-carbon and climate resilient economy in agriculture, food and forestry sectors (where one of the focuses is on increasing efficiency in water use) while restoration, preservation and enhancement of ecosystems related to agriculture and forestry (including focus on improved soil and water management) is another priority. Member States have to specify their agriculture-environment-climate measures and may also opt to support forest-environment and climate commitments that go beyond basic standards (measures often include provisions for soil but also water and biodiversity). Moreover Member States may support the preventive actions of natural disasters and the restoration of agricultural production potential damaged by natural disaster and climatic events. In addition, Member States have to establish a comprehensive farm advisory system offering advice to beneficiaries, including on the relationship between agricultural management and climate change. The CAP cross-compliance system related to direct payments incorporates basic standards comprising climate change aspects.

Current rates of species extinction are unparalleled. Climate change is already affecting ecosystems and biodiversity. Projections show that climate change impacts will become an increasingly important driver of changes to ecosystems and biodiversity in the future.[148]

Furthermore terrestrial and marine ecosystems play an important role in regulating climate. They currently absorb roughly half of man-made carbon emissions. Coastal ecosystems like wetlands, mangroves, coral reefs, oyster reefs, and barrier beaches all provide natural shoreline protection from storms and flooding in addition to their many other services. Forest and other vegetation cover stabilise the soil and counteract landslides and erosion. Green Spaces, green roofs and walls buffer the urban heat island effect. Conserving nature and restoring ecosystems reduce vulnerability and increase resilience and thus contribute to disaster risk reduction and

[146] European Commission, *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on Our life insurance, our natural capital: an EU biodiversity strategy to 2020,* COM(2011) 244 final , 3.5.2011.
[147] EEA Report No 1/2017, *op.cit.*
[148] Ibid, p.153

disaster preparedness. These ecosystem-based approaches to disaster risk reduction (eco-DRR) are ready for use and easily accessible. They have emerged as a key instrument offering multiple benefits in a potentially cost-effective manner, whereas continued biodiversity loss and ecosystem degradation will increase vulnerability and disaster risk.

5. Main observations

Disaster risk policies at a European level deal with a range of issues including natural and man-made disasters, health threats, industrial and nuclear risks, terrorist and malicious threats, and others. Some regions have developed valuable expertise for particular types of risks. Risk assessments are a first step in seeking to mitigate such risks and establish appropriate mechanisms to prevent as much as possible their occurrence and impacts. Sharing these experiences will help further reduce the impacts of hazards and allow better cooperation in facing challenges ahead.

The 11 most frequently identified disaster risks are addressed in two different categories of this overview: natural hazards (flooding, extreme weather, wildfire/forest fire, seismic and volcanic activity, pandemics, epizootics / animal diseases) and man-made hazards (industrial accidents, radiological incidents, infrastructure disruption, cyber security and terrorism).

Each risk has been individually analysed qualitatively using information provided by Member States (summaries of the main elements of NRAs, in line with UCPM Article 6) and complemented with information retrieved from existing EU policy and operation instruments as well as various other reports (Global Risk Report, etc.). A background for each risk and relevant work carried out at European level accompanies each analysis, presenting existing cooperation and pointing to potential areas for future cooperation. Information on the risk assessment approaches, methodologies and a set of good national practices is provided in the Annexes.

The cross-border dimension of the risks is central to the purpose of this overview and is clearly underlined across the NRAs received. The hazards addressed in this document present cross-border risks due to their geographical nature (earthquakes, fires, severe weather and floods), as well as the volatility and scale of their impacts (pandemics, livestock epidemics, nuclear/industrial accidents). The human, economic or environmental impacts of these hazards, as well as their likelihood of occurrence exist irrespective of national borders.

The likely impact of climate change on disaster risks is underlined throughout this overview. Work carried out by Member States in their NRAs underlines the extent to which climate change constitutes a threat multiplier and the importance of climate adaptation and increasing resilience: either directly or indirectly, fast and slow-onset environmental degradation increase the likelihood (transport accidents, industrial accidents, etc.) as well as the impacts (floods, forest fires, severe weather, etc.) of the hazards assessed. In fact, NRAs make reference to the potential increasing severity and likelihood of non-natural hazards as a result of more extreme natural disasters due to climate change and ecosystem degradation.

As stated in the introduction, learning from the main disaster risks in NRAs has contributed to improving understanding of European exposure, commonalities and shared challenges, and potential needs to further reduce and prevent vulnerabilities and strengthen disaster management cooperation in the EU. In addition, research funded by the Commission under its research framework programmes can also contribute to the anticipation of existing as well as new and emerging risks, e.g. future migration flows and forced displacements.

Key observations can be used as a basis for reflection on disaster risks that would benefit from further attention both at national and European levels. These are:

- **Better understanding the regional dimension of certain disaster risks through assessments and planning assumptions of a regional scale (e.g. earthquake, extreme weather, pandemic, animal diseases, terrorism, cybercrime) could reinforce the value added for European disaster management cooperation (pandemic, epizootic, terrorism, cybercrime). Disasters happen irrespective of national borders: either through small-scale events localised in border regions; or with large-scale events with impacts across different countries (e.g. Central European floods, 2010; Balkan floods, 2014; Volcanic eruption 2010). Such risks have so far been assessed at national levels, irrespective of the broader scale of the events. Risks of a regional scale ought to be assessed and planned for on a regional scale, through appropriate cooperation and a common vision.**

- **Addressing the interdependencies and cascading effects of disaster risks could improve the management of complex disasters by bringing together competent authorities and streamlining approaches at all levels of disaster risk governance (vital infrastructure disruption, epizootic, extreme weather).**

- **Increasing awareness, including through research and foresight, of a changing risk landscape sheds light on new and emerging risks that could be more of a focus in NRAs (such as the sudden mass influx of migrants and refugees, terrorism threat, climate-induced migration, anti-microbial resistance, space weather and loss of diversity).**

- **Impact of climate change is a risk dimension that could benefit from stronger recognition in the assessment of disaster risks to appropriately inform emergency planning and preventive measures. Current timescales of risk assessments reflect a focus on immediate response needs. Defining trends and longer-term preventive measures to reduce future burden on response requires the integration of climate change impacts, in particular for natural disasters.**

The European Commission will continue working closely with Member States and other relevant stakeholders. The Overview of Risks will be regularly updated to reflect the most recent developments in NRAs, as well as in European policy, science and research.

Annexes

Annex 1: Good practices in National Risk Assessment methodologies and processes

Varying assessment methodologies and processes exist across Participating States in the UCPM in undertaking National Risk Assessments. A number of commonalities and challenges can be identified across the national contributions made available to the European Commission. Developing a coherent and comprehensive picture of approaches to NRAs, while building on commonalities, would contribute to addressing common types of risks and common challenges in preventing, preparing for and responding to these risks.

In the present document, the NRAs provided by the countries are reviewed in order to present the main processes and methods to identify, analyse and evaluate risks at a national level. Together with these, several practices are displayed as examples.

1. Approach to the risk assessment process

NRAs tend to cover all the potential risks with importance at the national level, due to, for example, their magnitude, endangered assets or the resources to mobilize. As the overview highlights, countries take an all-hazards approach to their risk assessments: all countries assess risks of natural and man-made – both malicious and accidental - disasters. For that reason, a multidisciplinary and multi-sector approach, considering the links between risk, vulnerability and hazards, are important components of a NRA. The results will mainly provide input to the capability assessment process.

1.1. Scope

The scale of risks addressed in NRAs is duly defined according to varying understandings of what is an acceptable level of risk in terms of national requirements for capability assessment and planning, or prevention planning (underlying causes of an event, dynamic pressures, physical/socio-economic conditions, etc.).

For example, Denmark states that the NRA provides an overview of the most serious natural and man-made risks from a Danish view-point. [149] Particularly, and related to the selection of incidents, these need to have such a considerable magnitude, geographical extent and/or duration that could not be manageable at local administrative level, demanding a national response. The UK NRA[150] covers all kinds of emergencies that meet the definition given in the Civil Contingencies Act 2004 but not every conceivable instance of an emergency, and not everyday occurrences, that can directly and significantly damage human welfare or the environment somewhere in the UK, and not events that happen overseas unless they directly affect the UK. It clearly states that it does not consider longer term risks such as climate change or technological advances.

Impact of climate change

In a limited number of cases, and varying from one hazard type to the other, NRAs take into account the role of climate change as a multiplier of threat and vulnerabilities (examples include Hungary, Portugal, Malta, Cyprus) – see box 1. Projected impacts for Europe of

[149] Danish Emergency Management Agency (DEMA), Danish National Risk Profile, 2013, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/419549/20150331_2015-NRR-WA_Final.pdf

[150] UK Cabinet Office, National Risk Register of Civil Emergencies, 2015, https://www.gov.uk/government/collections/national-risk-register-of-civil-emergencies

climate-related extreme events – on which several research projects have been carried out – suggest recording field and historical data is necessary to improve existing models and predictions, and to better understand the effects of climate change on the hazard impact and likelihood.

Box 1 – Taking into account climate change (Portugal)

The NRA of Portugal was produced based on two previous works: The National Civil Protection Plan and the National Strategy for Climate Change Adaptation. The latter is, in turn, based on the knowledge created by the SIAM Project[151], which evaluated the impacts and adaptation measures for climate change in Portugal. In this research project, different strategic sectors were identified and the security of population and property was one of them. Different climatic and socioeconomic scenarios were defined, and from these, a set of adaptation measures were listed. The results obtained in SIAM project, at the same time, are a source of valuable information for the NRA scenarios.

Sources: Portugal, National Risk Assessment, 2014

Cross border / regional dimension

Hazards identified for analysis in NRAs can have origins beyond national borders, due to the nature of the event (such as earthquakes or severe weather) and/or because of their volatility and scale of impacts (in the case of pandemics or nuclear/industrial accidents). The cross-border dimension of risks is usually underlined across NRAs, and can serve as a basis for further work to improve understanding and preparedness planning of risks on a regional level.

1.2. Timeframe

Risk assessment, like risk management, is better understood as an on-going process, as risk 0 does not exist. Therefore, it is necessary to continuously identify threats and build scenarios to prioritise policy decisions.

A time horizon of 3 or 5 years may be suitable for the more urgent measures in response and preparedness but the NRA can also illustrate longer horizons, such as 10 or 25 years, leaving space for strategic policy in prevention.

Some countries regularly carry out risk analysis activities. This approach requires the NRA process to be integrated in the various activities throughout the disaster risk management cycle – see box 2. This could be addressed through a consistent legal framework, or by tackling institutional strategies.

Box 2 – Annual risk analysis report (Germany)

Every year, a risk analysis in civil protection is carried out to guarantee that the civil protection is well prepared and could respond if facing an event. There is a yearly report which describes the state of implementation of measures at national and state/federal level together with the risk analysis of some risks. For example, in 2014, it was presented the risk analysis for a Storm Surge and a Nuclear Power Plant Release.

Germany, Bericht zur Risikoanalyse im Bevölkerungsschutz 2014. Drucksache 18/3682, 2014

[151] SIAM Project, 2002, http://www.circle-era.eu/np4/%7B$clientServletPath%7D/?newsId=679&fileName=4_FDSantos.pdf

1.3. Multi-stakeholder involvement

Hazards and disastrous events may be dealt with by different government agencies or research organizations and even at different governance levels, like at regional scale, so it is indispensable to understand the competence of each, and decide on the relevant actors and the correct moment.

NRAs are the starting point for the elaboration of adequate emergency preparedness and response plans as well as prevention and mitigation strategies. NRA exercises bring together stakeholders involved in: operational response, early warning, preparedness planning, prevention and disaster risk reduction.

The scientific community provides the instruments and tools necessary to contribute the evidence and knowledge central to understanding disaster risks, and the hazard types addressed. Natural and climate risk scientists and academics from universities or research organizations, geo-political experts like political scientists or economists and individuals from national or even regional think-tanks contribute to the comprehensive approach to a NRA exercise – see box 3. Expertise from natural and applied sciences, like health and engineering, is usually well covered but it is highly profitable to use all the types of science available including social sciences and humanities.

The participation of the private sector together with the public organizations may also contribute positively to the NRA process through specialised expertise, levels of exposure and perceptions, and new insights through innovation and citizen participation. In the case of critical infrastructure, facility owners and operators prepare security plans and exercises for the protection and resilience of the services, and represent a key sector to be involved in a multi-stakeholder NRA process.

Box 3 – Multi-sector expertise for risk assessment (Netherlands)

The 'National Security and Safety Strategy' establishes a multi-sectoral process based on government-wide cooperation to identify risks nationally. The Network of Analysts for National Security (ANV) is the group appointed to carry out the risk assessment. It is composed of a permanent core of six organizations, called the NRA Task Group, plus a network of institutions, civil services and research organizations engaged in building up and/or analysing the scenarios.

The NRA Task Group is composed of:
- The National Institute for Public Health and the Environment (RIVM), an independent agency from the Ministry of Health, Welfare and Sport, specialized in the field of public health, nutrition, safety and the environment.
- The General Intelligence and Security Service (AIVD).
- The Netherlands Organisation for Applied Scientific Research (Clingendael Institute), a Dutch think tank and a diplomatic academy specialized in international relations.
- The Research and Documentation Centre (WODC), which is a research centre on security, criminal, civil and administrative justice and migration issues.
- The International Institute of Social Studies at the Erasmus University Rotterdam.
- The Netherlands Organization for Applied Scientific Research (TNO), an independent research organization regulated by public law.

The different actors involved can play three different roles: scenario author, contributor and/or participant in the scoring session, determining likelihood and impact.

The selection of themes to be analysed, however, are pointed out by another group: The National Steering Committee for National Safety and Security (SNV), composed of Ministries. This group also participates in building scenarios and approves the products of the ANV.

Netherlands, National Institute for Public Health and the Environment, 2014

In the case of a number of national experiences, one or more multi-stakeholder working groups have been set up, bringing together expertise from different government offices and research organizations considering the nature of hazards and their possible impacts. Such groups may define which risks will be included (or excluded) from the assessment process, and may define the methodology and scoring criteria used in the assessment – see box 4.

Box 4 – NRA process with working groups (Malta)

The Maltese NRA relied on extensive research and a number of meetings with relevant stakeholders in order to identify, analyse and evaluate the existing and potential risks of the country. The process was coordinated by the Critical Infrastructure Protection Directorate (CIPD) within the Cabinet Office, in the Office of the Prime Minister (OPM).

Up to 54 formal and preparatory meetings were conducted with sectoral and specialist forums, government agencies, academia, civil society, critical infrastructure operators and the private sector, among others, to gather information and to access the necessary expertise regarding risk in Malta.

A systems approach has been used for the assessment of critical infrastructure (CI) assets and systems. The assessment of CI's was not conducted as a separate exercise from the remainder of the risk assessment. Rather, the identification of hazards and threats, and the analysis and evaluation of the risks thereof, have been conducted simultaneously with the assessment of critical infrastructure assets and systems. This combination of the contingency and systems approaches was proven highly useful and has been a major improvement to the overall outcome compared with traditional risk assessment approaches.

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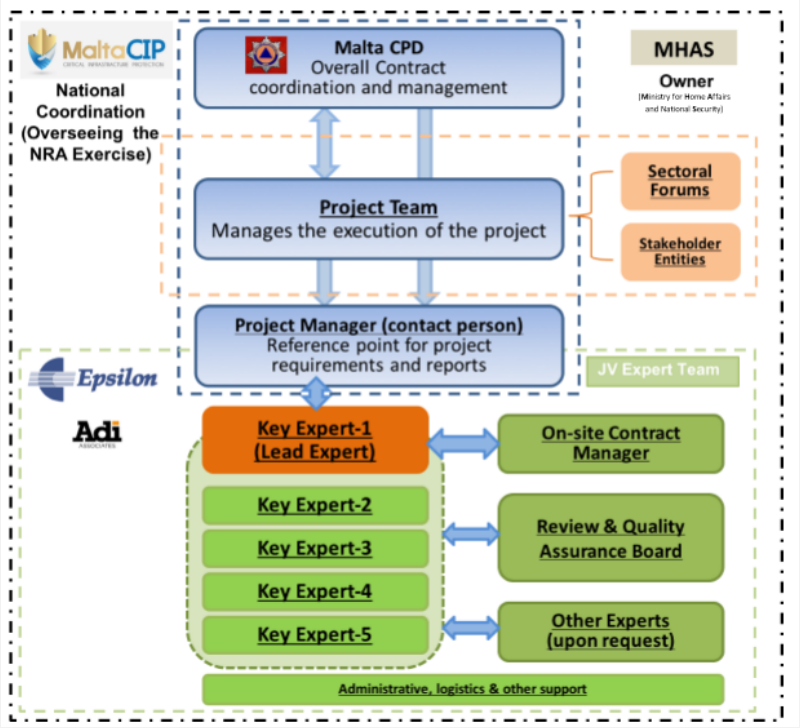

Organizational chart for the National Risk Assessment exercise (Malta National Risk Assessment, 2015)

Alongside the specialised communities directly involved in the development of the NRA process, a broader scope of stakeholders is taken into consideration: the communication of NRA results to interested stakeholders and potentially to a wider audience requires a user-friendly approach, built on transparency and accountability. A strategy may help fine-tuning to relevant audiences as well as making the NRA transparent and traceable – see box 5.

Box 5 – National examples of risk communication (Estonia, Cyprus)

Estonia:
The risk assessment is drawn up by a competent body for each field, which includes groups and individuals with different expertise. After, the Ministry of the Interior prepares a summary for the Government of the Republic in order to facilitate its task of defining priority activities to prevent and mitigate risk.

Cyprus:
Different reports are prepared for each relevant sector of the economy of the country. In order to be consistent, three points are defined to be addressed:

1. The current situation of the sector based on the hazard, describing (or quantifying, if possible) the current effect over the system and the current actions to manage the threat or to take advantage, together with the uncertainties of the analysis.
2. Consideration of key drivers of change, pointing which socio-economic factors could influence the threat/opportunity and potential interactions, together with the planned or potential actions to adapt.
3. Summaries of each chapter showing the significant threats and opportunities now and in the future, together with the research that needs to be carried out in the future.

Considering the diversity of audiences and the complexity of the issues studied, different meetings and spaces for review and discussion would be established in order to respond to

queries and address gaps and points of special interest to the sector.

Cyprus Civil Defence Department, Ministry of interior (2015). Estonian Ministry of the Interior (2015)

1.4. Use of data and scientific tools

Previous incidents

Historical records and databases of events, impacts and recorded losses and damages – see box 6 – are the most common sources of information used by Member States in their NRA. Databases, which may be managed by different bodies and even available at different governance level, provide evidence and understanding of past events: its occurrence, magnitude and even its consequences.

Box 6 – Recording of disaster loss data

Disaster loss data recording is the result of a systematic, consistent, coordinated process to collect human, physical, and economic losses as well as social and environmental consequences immediately following an emergency or a disaster. The utility of this practice is usually related to compensation schemes and policy monitoring but the process of loss data recording generates also crucial and unique evidence regarding risk trends, exposure, vulnerability, coping capacity, mitigation and response to the disaster, very profitable for the NRA.

For example, at EU level there is the Major Accident Reporting System (eMARS[152]), which is the official reporting system for industrial accidents established following the Seveso legislation. EU Member States must report them and it is voluntary for non-EU and UNECE countries, so the system has collected incidents since 1982. The information collected and analysed is useful to share lessons learned in order to improve prevention and mitigation of chemical accidents.

EU expert working group on disaster damage and loss data, Guidance for Recording and Sharing Disaster Damage and Loss Data: Towards the development of operational indicators to translate the Sendai Framework into action, 2015, http://drr.jrc.ec.europa.eu/Portals/0/Loss/JRC_guidelines_loss_data_recording_v10.pdf

Lessons learned

Besides official databases, taking a look to previous events in the country or in nearby countries, especially for emerging risks or risks that seem possible in the country but not experienced. Understanding the response and how the rehabilitation and the reconstruction phase took place is a source of knowledge – see an example in box 7.

Box 7 – Lessons learned from the Fukushima Accident (Japan)

Following an earthquake that hit Japan in 2011, a 15-metre tsunami wave affected the power supply and cooling systems of three reactors from the Fukushima Daiichi Plant, causing a nuclear accident. The reactors proved resilient to the seismic impact, but were severely damaged by the impacts of the tsunami.

As a response to the Fukushima Accident, risk and safety assessments have been carried

[152] eMARS: https://emars.jrc.ec.europa.eu/

out on all nuclear power plants in EU countries, together with neighbouring countries such as Switzerland and Ukraine. The assessments were conducted by National Authorities based on three points: natural hazards, loss of safety systems and severe accident management. As a result of the assessment, up-to-date safety requirements were identified, in particular for earthquake and flooding, and the compliance with current safety requirements was assessed to determine possible improvements.

Nuclear plants are one of the focal infrastructures of a study of the EU Framework Programme 7 project 'Risk Analysis of Infrastructure Networks in Response to Extreme Weather' (RAIN[153]), which aims to quantify the complex interactions between weather events and transport, energy and telecommunication infrastructure systems.

Sources:

European Commission, 2016, http://ec.europa.eu/energy/en/topics/nuclear-energy/nuclear-safety/stress-tests

Relevant research, innovation and scientific projects

The identification and assessment of risk requires large amounts of detailed information, which may already exist for the NRA. The studies and tools could have been carried out by Research and academic institutions in the country or abroad, or even in projects carried within governmental bodies and in Public Private Partnership. These organizations could be already engaged in disaster risk management officially or be only participating when specific scientific input is necessary.

For example, agencies responsible for operational response usually have models and tools to simulate the behaviour of hazards and to get information on the possible impact on population and assets in specific areas. These types of tools can be directly used in the assessment process. Equally, the Early Warning Systems Groups or the agencies in charge of forecasting and warning the population develop and work with simulators, which can produce information for the assessment. See a concrete example from Italy in box 8.

Box 8 – Modelling, risk mapping and forecast tools for forest fires (Italy)

Tools for fire risk mapping, fire danger forecasts and propagation models used by the Italian Civil Protection Department and the Forestry Corps before and during forest fires are produced by the CIMA Research Foundation.

There are two types of tools used by Italy regarding forest fires: risk maps, which are static, and forecast models. While the first tool gives valuable information for prevention, the second is basic for the response phase.

For example, the system RISICO, which simulates and predicts the behaviour of fire given the moisture content of vegetation, wind and topography, provides information before the event, allowing to distribute and allocate resources in the more exposed areas. Another simulator, named PROPAGATOR, is under evaluation and aims to provide the probability of spread of fire based on the fire line dynamics.

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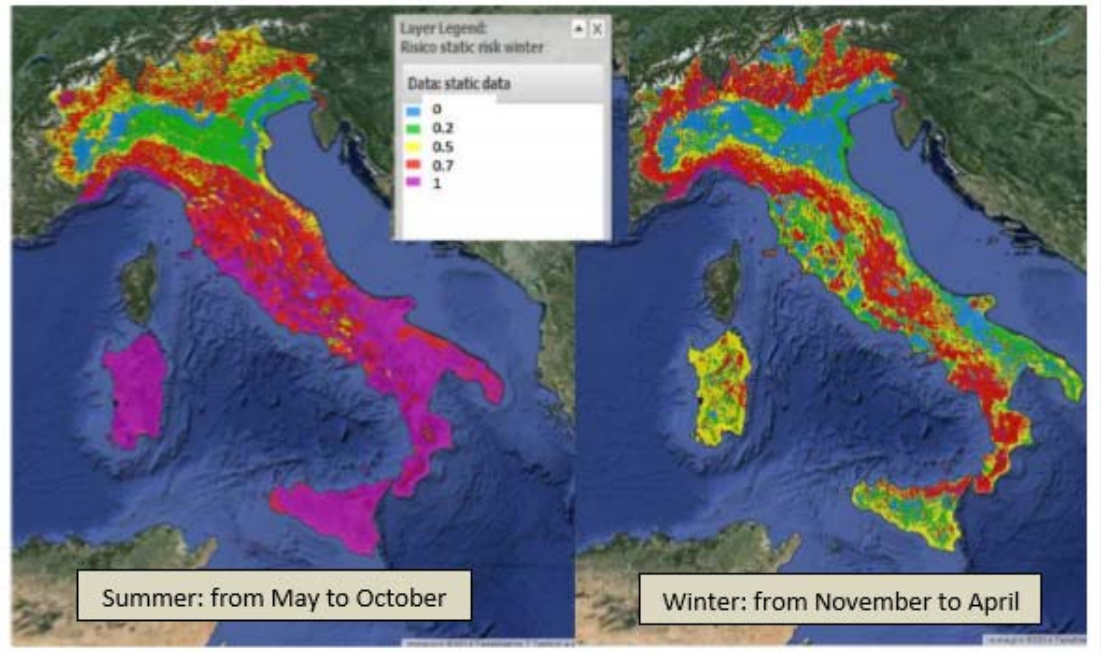
[153] EU RAIN Project (2016): http://rain-project.eu/



Static forest fire risk map, in summer (left) and winter (right) (Italian Department of Civil Protection, 2015)

A number of EU research and scientific projects on disaster risk management will provide knowledge and evidence to inform the risk assessment process, such as the development scenarios and the study of likelihood and impact of diverse events – box 9 provides an example of such a project. A number of European platforms exist through which to identify relevant research projects (CORDIS; Horizon2020; Community of Users; Disaster Risk Management Knowledge Centre; Knowledge Centre for Migration and Demography; Climate-Adapt platform; ERNCIP Project platform; etc.).

Box 9 – European Regional Development Fund Project 'BRISK' (2009-2012)

The BRISK project focuses on the risk of spill of oil and hazardous substances in the Baltic Sea.

Taking into account the increasing number of ships navigating in the Baltic Sea area and their size, as well as the growing number of shipping accidents, this project aims to strengthen the preparedness of all Baltic Sea countries to respond to major spills. As outputs, the project did a risk analysis to identify the areas with highest risk for spills and environmental damage. From these, it was possible to give guidelines for future investment in emergency response capacities.

The results have been used by international bodies working in the area, like the Baltic Marine Environment Protection Commission (HELCOM), to national authorities engaged in emergency response and environmental protection. The NRA of Latvia and Finland use its results on likelihood and impact to build their scenarios regarding maritime accidents.

Source: Sub-regional risk of spill of oil and hazardous substances in the Baltic Sea (BRISK) (2016): http://brisk.helcom.fi/home/en_GB/home/

Scientific tools

A number of other initiatives in place provide monitoring and an inventory of data for different hazards, such as the ARISTOTLE project for multi-hazard early warning systems; Global Disaster Alert and Coordination System (GDACS); the European Forest Fire Information System (EFFIS), which displays up to date information of the fire situation in Europe, forecast the situation and has information of past events; the European Flood Awareness System (EFAS), which monitors and forecasts floods across Europe and has a centre of data collection; the Airbase database; the European Severe Weather Database (ESWD); or the Cross-border Danube System for Earthquake Alert (DACEA) – see box 10.

Box 10 – DACEA project (Bulgaria and Romania)

The DACEA project (Cross-border Danube System for Earthquake Alert) started in 2010 to increase capacity to respond to disasters generated by earthquakes in the cross-border area of Romania and Bulgaria by developing an early warning system integrated network and building capacities in both countries regarding the risk.

Cross-border area of the DACEA project, with the seismic stations (DACEA, 2013, http://www.quakeinfo.eu/en/)

Sixteen seismic stations were installed in the area of interest, and the emergency authorities of both countries were provided with equipment to receive the alert. The system implemented uses shake-maps that are generated automatically after an earthquake and based on these, together with exposure and vulnerability studies previously carried out, the structural damage estimates inflicted by the ground shaking are obtained. This way, a near-real-time earthquake damage assessment is obtained, which is crucial for rescue and recovery actions.

2. Risk Assessment methodologies

Due to lack of expertise and data regarding likelihood and impact, which is mentioned by many, Member States agree on criteria and weighing to categorize the likelihood and impact of hazards when using a semi-quantitative analysis.

Considering that risks are complex and dynamic, and that countries are affected by a wide variety of risks, interacting with each other in time and space, the most comprehensive approach to risk assessment is a multi-hazard one, rather than one that analyses every hazard individually. Due to the challenges of multi-hazard risk assessments, NRAs tend to follow a single-hazard approach, albeit taking into consideration existing interdependencies and cascading effects.

2.1. Risk identification

Throughout Member States' risk assessments, two different approaches stand out: some take a look at different databases and historical data to determine which are the most common events, hazards and consequences faced in the country, and some others base their identification on the assets they want to protect. Some others combine both approaches – see national examples in box 11.

Box 11 – Different national approaches to risk identification (Finland, Hungary, Denmark)

As a starting point of the process led by the Ministry of Interior of Finland, each branch of administration launched the project by writing 'risk cards' of the most critical risks affecting their branch. More than 60 risk cards were made. From these, 21 event scenarios were selected on the basis of the probabilities and impacts of the events registered in the cards, considering the impacts on humans, the economy, the environment or on society.

Similarly, in Hungary, risks were identified in working sessions by experts who were able to take an informed view of the seriousness of a risk considering events which are a serious threat to human welfare, which can cause serious damage to the environment or the economy of the country, and an attack or threat that could cause serious damage to the security of Hungary.

In particular, a modified Preliminary Hazard Assessment (PHA)[154], developed by scientific consultants, was used. At the beginning, the established working groups, composed of the representatives of several institutes and authorities with expertise in the topic of the scenario, gave an overview of the risks and vulnerabilities regarding their area of responsibility. If the incident impacted over one or more societal values, then it was selected. Later, every scenario was better developed by experts on the topic.

For the purpose of identifying the possible consequences that would need to be managed at national level, the Danish Emergency Management Agency (DEMA) uses a checklist. In this checklist, besides harm to life, property and the environment, there is a long list of critical societal functions that can fail (such as energy supply, information and communications, water supply or transport) to be considered as priorities for the NRA.

Sources:
Danish Emergency Management Agency (DEMA) (2013). National Risk Profile - NRP
Finland National Risk Assessment (2015)
Report on Hungary's National Disaster Risk Assessment. Methodology and its Results (2014)

[154] The PHA is a systematic approach for identifying, evaluating and controlling the hazards of processes involving highly hazardous chemicals

Nonetheless, in addition to recorded disaster losses resulting from past event, the process could consider potential estimated losses resulting from events which could occur in the future. NRAs addressing extreme risks will have a forward-looking approach and will facilitate the identification of potential gaps in the capability planning for prevention, preparedness and response – see a national example in box 12.

Box 12 – STEEP framework in the NRA (Norway)

DSB, the Norwegian Directorate for Civil Protection, uses the STEEP framework as a starting point to depict long-term possibilities in the country. The framework consists of five main factors (societal, technological, economic and environmental), which are used in trend analysis. As an example of this work, the Norwegian NRA presents three relevant areas to consider in the future: a cyber-attack, a heatwave and antibiotic resistant bacteria.

Source: Norway, National Risk Assessment 2014

In order to later analyse hazard likelihood and its impacts, and explicitly in building scenarios, the risks must be well described. It is necessary to distinguish within the main event selected the hazard(s) and the trigger factor(s) – see box 13 for a national example. For example, a riverine flood is a main event and it can be caused by heavy rainfall but also by melting snow and ice or high tides. Particularly for technological disasters, there is sound evidence that natural hazards can trigger technological events. On the contrary, if a hazard is described at first, then it becomes easier to determine which are the possible consequences and other hazards that may appear as cascading effect.

Box 13 – Identification of trigger events in the NRA (Poland)

The NRA of Poland depicts a scenario for each possible incident whose effects can harm national security and affect a considerable number of people`s lives, health, property and/or the environment. For each scenario, the trigger events are listed, as is each effect on occurrence and consequences. For example, for flood incidents, five different causes are identified and described: rainfall, snowmelt, jamming, storms and damage of hydro-technical facility.

(cont.)

FLOOD DUE TO RAINFALL	FLOOD DUE TO SNOWMELTS	FLOOD DUE TO JAMMING
		CAUSES
difficult meteorological conditions: long-term and moderate rainfall or intense and very heavy rainfall, usually connected with a storm	rapid melting of snow cover, often exacerbated by a sudden warming and rainfall	relatively frequent due to blocking or limiting the cross-section of the river-bed by accumulated ice float
usually occurs from early to late spring	predominates during the winter and early spring	occurs in winter and early spring
		LOCATION
• floodplains of the following rivers: Vistula, Oder, Warta, Prosna, Noteć, San, Wisłoka, Lusatian Neisse, Bóbr, Lubsza, Kwisa, Bug, Wieprz, Bystrzyca, Krzna, Tyśmienica, Huczwa, Drwęca, Brda, Wda, Osa, Mątawa as well as smaller water-courses and areas protected with flood embankments • rivers which belong to river basins of Oder, Vistula, Warta and Przemsza • Elbląg Żuławy, coastal areas of the Vistula Lagoon • docks of Szczecin, Świnoujscie and small seaports • Szczecin Lagoon, Dąbie lake • rivers of West and Central Coastal Region		

Description of the causes and the location of floods based on different triggering factor (Poland, RCB, 2015)

Note that hazard identification should be reviewed periodically, as it is difficult to find all the possible hazards in a specific area and changes may occur over time. However, it should be noted that Participating States also follow varying cyclical review processes for conducting NRAs.

Scenario building

To assess risk factors Member States usually build scenarios. The main purpose of this is to help decision makers acquire knowledge and understanding to anticipate the context in which they have to act. A risk assessment of a specific hazard type may be carried out based on one or two scenarios related to the main event, such as floods, industrial accidents or terrorism. The context is presented together with the possible trigger event(s) and the consequences, mainly based on previous experiences. For that reason, scenarios normally represent an adverse but possible event.

Box 14 – Working with scenarios (Netherlands)

The Dutch National Safety and Security method starts by answering the following questions: What is threatening the Netherlands and how serious is it? The proposed methodology proposed involves a series of scenarios, where specialists from different departments develop scenarios in their policy field of expertise.

Scenarios cover the threats to national safety and security in the medium term (up to five years), containing: (1) the incident, the event impacting the country; (2) the (underlying) causes and processes, and the trigger which "activates" the hazard; (3) the context of the events; (4) the consequences of the incident together with the response and control measures; and, (5) the effects of the incident over vital infrastructure.

It is assumed that scenarios are possible although they may have different likelihoods, as the incident scenarios identified can be realistic (they are experienced incidents) or incidents that are subject to developments and are affected by climate change or population ageing.

For this reason, two time periods are described: for the next five years and in longer term (for a five-year period in 20 -25 years from now). In the scenario, the impact of the incident and the likelihood of it, the two elements for assessment, must be well covered.

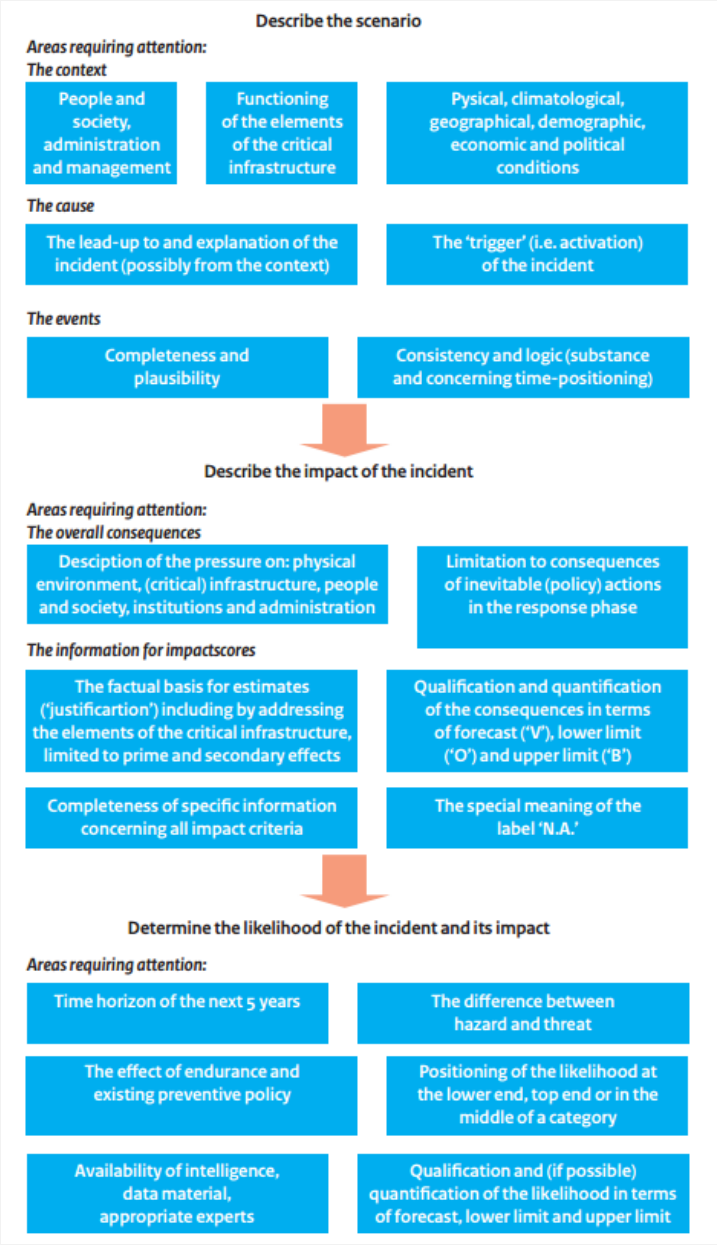


Diagram for development of scenarios (Netherlands, Ministry of the Interior and Kingdom Relations, 2009)

Important components of a scenario-based risk assessment:

- Different scenarios for an incident, covering different magnitudes and different interactions among hazards.
- Defined time and space scope of each scenario (for example, four or five years long and happening in the whole country or a specific part of the country).

- Most of the scenarios may require a bigger picture than the national scope, because the source of risk is or can be abroad, such as nuclear accidents, pandemics or cross border river basins.
- The underlying cause(s) and important trends need to be recognized, such as climate change, urbanization grow or ageing of population.
- There should be at least one scenario overwhelming national capacity to respond: i.e. a highly improbable event but for which the country could have notable difficulties to respond.

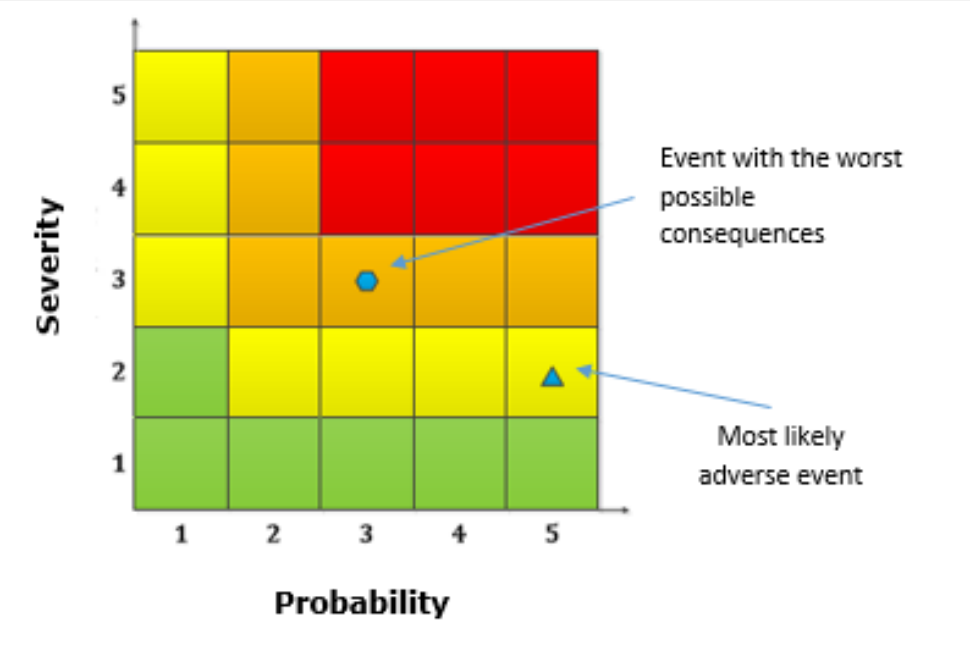
This type of scenario will illustrate which resources are needed in the future, nationally or with the cooperation of Member States, informed by a capability assessment.

Box 15 – Worst possible case scenario (Croatia)

It was decided that for every event identified, two types of scenarios were developed: the most likely adverse event and the event with the worst consequences.

For example, for fires, two scenarios are presented. As the most likely scenario, it is described a situation which usually occurs in summer where there are forest fires, which occasionally threaten people and properties but that are handled relatively quickly (from hours to some days). For the worst possible scenario, it is described a situation with extreme weather conditions (strong wind, high temperatures, lightning strikes and drought) which favour the development of multiple and simultaneous forest fires (of big size) in the coastal area of the country. Many resources are engaged, even from other parts of the country, to extinguish the fires. The response lasts days or even weeks, due to the extreme weather conditions. The threat requires large amounts of people to be evacuated, including tourists. The fires have threatened critical infrastructure and have led to congestion in road, rail, air and maritime transport.

Each scenario is assessed, showing the difference in likelihood but specially in impact of each possible scenario.



DUZS – National Protection and Rescue Directorate, Croatia (2015). Disaster Risk Assessment

Scenarios can be developed along different time frames: short term (from now to 5 years in time), medium term (happening in 10 – 15 years) and long term (happening in around 25 years). Depending on the time window, the results could be used for disaster response and preparedness, for disaster prevention and mitigation and even, for land-use planning. As mentioned before, the scenarios should contain a developed chain of cause(s) and effect(s), defining the trigger(s) and its (their) impact(s).

When assessing multi-hazard scenarios, cascading effects and potential interdependencies are taken into consideration. Hazards may be independent or mutually exclusive, but one can happen triggered by another or due to the same triggering event.

For every scenario included in the NRA, there has been an assessment related to the estimations used in the risk analysis. Three indicators are presented to evaluate the strength of the knowledge base: the access to relevant data and experience, the comprehension of the event analysed and the degree of agreement among the experts engaged in the process. The uncertainty associated with the risk assessment is considered to provide a full picture of the reliability of the scenario-based risk assessment – see box 16.

Box 16 – Uncertainty assessment (Norway)

Uncertainty assessment

INDICATORS OF THE KNOWLEDGE BASE	EXPLANATION
Access to relevant data and experience.	Some information from earlier major solar storms (100-year storms) and so-called super storms (100 to 500 year storms), but no experience with such powerful solar storms in our modern society.
Comprehension of the event that is being analysed (how known and researched is the phenomenon?)	Solar storms are considered to be a little known and researched phenomenon, compared with other types of events that have been analysed in the NRA. It is uncertain how a major solar storm will affect today's technology and infrastructure.
Agreement among the experts (who have participated in the risk analysis).	No major disagreements among the experts.
Sensitivity of the results	
To what extent do changes in the assumptions affect the estimates for likelihood and consequences?	The key assumption for the assessment of likelihood is the coincidence of electromagnetic radiation, a proton shower and a geomagnetic storm. The duration of consequential power outages and satellite disruptions are critical assumptions for consequence assessments. The sensitivity of the results is assessed as moderate.
Overall assessment of uncertainty	The uncertainty associated with the assessments of likelihood and consequences is assessed as moderate.

Source: Norway, National Risk Assessment 2014

It is worth mentioning that among Member States there is no common approach when building scenarios and sometimes these are not fully described or included in the documents. Together with the different terminology used in some cases (Annex 2 and 3), this hinders potential comparability of results at European level.

2.2. Risk analysis

Once risks are well defined, their probability and the severity of their potential impacts are measured based on a set of categories that measure the risk factors: “likelihood” and “impact”. Based on past experiences, some studies and expert input, a value of the occurrence and consequences of the described scenarios is given. These two are combined to get the risk value. The results are presented in a risk matrix.

Likelihood

The likelihood of occurrence of a specific event, which can be qualitatively or quantitatively assessed, is the chance that the event will happen. Member States generally prepare a set of criteria to categorize likelihood of all hazards, sometimes reflecting the probability of occurrence, from (very/highly) likely events to (very) unlikely or remote events. The number and definition of categories change from country to country, as summarized in box 17. See annex 3 for a complete overview.

Box 17 – Varying likelihood categories (Estonia, Finland, Croatia, Ireland, Portugal)

For semi-quantitative risk analysis, a specific likelihood or probability assessment table containing the categories and its definition is established. The difference among Member States is notable:

Estonia	Finland	Croatia	Ireland	Portugal
Very low **> 0,005% (>1 in 20000 years)**	Very low Less often than once every 1,000 years	Extremely small <1% (1 event in 100 years and less)	Extremely unlikely Once every 500 or more years	Low Annual probability: <0.005 Return period: >200 years
Low **>0,05% (>1 in 2000 years)**	Low Once every 500 – 1,000 years	Small 1-5% (1 event in 20 to 100 years)	Very unlikely May occur once every 100-500 years	Medium-Low Annual probability: 0.005 to 0.02 Return period: [50 - 200]
Medium **>0,5% (>1 in 200 years)**	Average Once every 100 – 500 years	Moderate 5 – 50% (1 event in 2 to 20 years)	Unlikely May occur once per 10 – 100 years	Medium Annual probability: 0.02 to 0.05 Return period: [20 - 50]
High **>5% (>1 in 20 years)**	High Once every 10 – 100 years	High 51-98% (1 event in 1 and 2 years)	Likely Probably occur once per 1 – 10 years	Medium-high Annual probability: 0.05 to 0.2 Return period: [5 - 20]
Very high **>50% (> 1 in 2**	Very high More often than once every	Very high >98% (1 event in a year or	Very likely Probably occur more than once	High Annual probability: ≥ 0.2

years)	10 years	more)	a year	Return period: ≤ 5 years

Sources: Summaries of National Risk Assessment, Estonia, Finland, Croatia, Ireland and Portugal

Note that due to the nature of events, likelihood categories can be different. For example, in one place, a "frequent" flood may happen up to once in 10 years, while a "frequent" earthquake may happen once in 100 years or less. For this reason, it is important for the probability and the return period to be specified.

The use of quantitative methodologies for measuring likelihood is quite developed for some hazards such as earthquakes, or industrial accidents, where the combination of frequencies and/or probabilities of individual events is common[155]. It remains common practice, nonetheless, for research organizations across the EU to work on the identification of possible scenarios/behaviour of hazards to calculate occurrence, map geographical impact, etc. An example for this is the volcanic hazards identification and modelling eruptive processes on the Island of Tenerife (Spain), used in the Spanish NRA.

Impact

As recommended by the Risk Assessment and Mapping Guidelines for Disaster Management (2010), Member States consider the impact on population, the economy, the environment and the political and social life.

Varying definitions of impacts exist across different NRAs on the categories and the criteria that compose them. These may be assessed at times quantitatively (with a clear magnitude: number, hectares, euro, hours/day) or qualitatively – see overview of impact definitions in Annex 3.

In the case of semi-qualitative analysis, for each criterion composing a category, a value is given based on the degree of damage, so impact moves from limited/insignificant/minimal to catastrophic/very significant. In some cases, criteria are weighted differently to provide a final value for an impact category. This also happens when the final value of impact is calculated, although generally impact categories are summed.

Based on the NRAs reviewed, it can be summarized that the categories and criteria are:

- Human impact, considering fatalities, injured and sick population and even people that needs to be evacuated or those that lose access to basic services. The criteria are usually quantified.
- Environmental impact, based on harm to natural resources and natural spaces. The criteria can be quantified, based on the cost of losses or to recover it, or assessed qualitatively, based on the damage or the time to recover the original state.
- Economic impact, which considers financial and material losses. Sometimes the cultural heritage is included in this category.
- Societal impact, including the disruption of daily life/use of critical facilities (energy, water, food, health, etc.) and social unrest. Sometimes in this category it is included psychological effects.
- Political impact, as the capacity to govern and control the country.

[155] See Krausmann, E., Cruz, A.M. & Salzano, E. *Natech Risk Assessment and Management - Reducing the Risk of Natural-Hazard Impact on Hazardous Installations, 2017*

Similarly to likelihood, the impact criteria and relevant threshold values are defined without differentiating among types of hazards. This can lead to overestimated or underestimated results, as some hazards would have different impacts depending on the magnitude of the event, the type of event and the time and area of incidence.

When defining the criteria that compose every type of impact, maintaining a uniform space-time window and appropriately defining the sub-criteria composing every category will help avoid double counting. For example, as part of human impact, there may be two sub-criteria: number of deaths and number of injured people – numbers of fatalities may increase over time. Similarly, it is important to also take into account the interdependencies that may exist between the categories of impact.

Box 18 – Disaster loss indicators to measure impacts (European Commission)

To define the criteria to assess the impact of disasters, it can be useful to take advantage of the established indicators from national disaster loss databases. Using the structure which already exists means not only linking the two items of disaster management and saving time and resources in the design of the NRA methodology, but also linking the NRA with future models and trends that could be developed from the data stored in these type of databases.

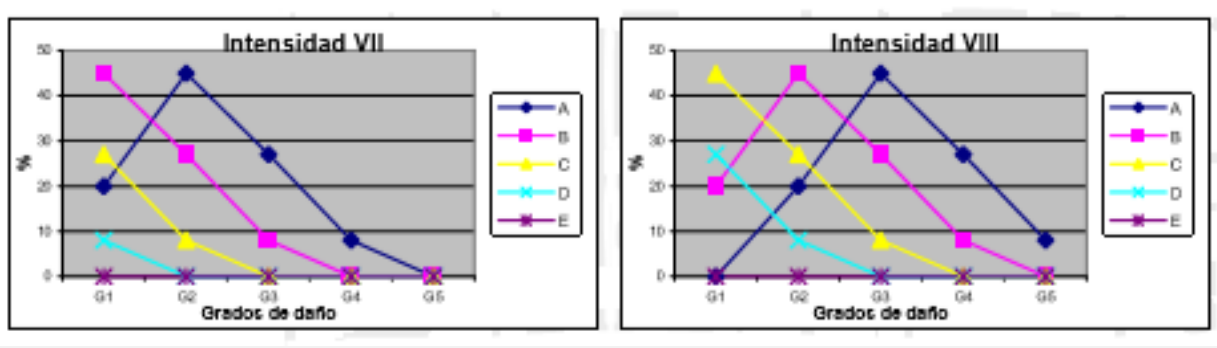
EU expert working group on disaster damage and loss data, 2015,op.cit.

Note that impacts are not always independent from likelihoods, and may also be expressed through an assessment of vulnerability and exposure – see a national example in box 19.

Box 19 – Earthquake risk assessment using exposure and vulnerability (Spain)

Vulnerability:
The NRA uses the studies made at regional level which consider that vulnerability depends on many factors (age, type of construction, use, geometry, height, conservation degree, etc.). For the assessment, three factors are defined regarding buildings:
- Age (before 1950, 1950-1975, 1976-1995, 1996-2001)
- Constructive and structural typology
- Use (residential, health, leisure, industry and services or singular buildings like big infrastructure).

Different matrices of vulnerability show the number of buildings that would suffer damages depending on the magnitude of the earthquake.



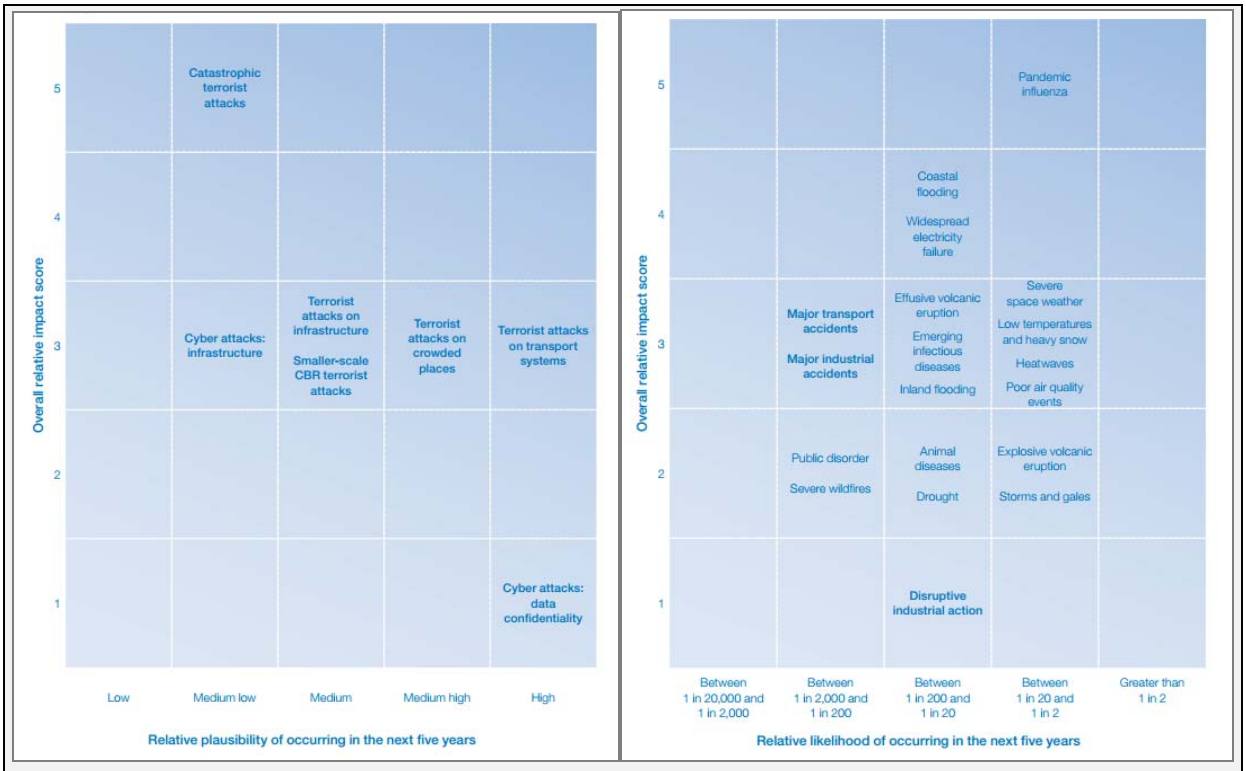
Vulnerability matrices, for: different types of buildings (A to E); for two intensities (VII and VIII). The degree of damage goes from light damage (G1) to collapse (G5) (Spain, Ministry of Interior, 2015)

Exposure:
In the absence of relevant studies, the NRA bases its indicators on the data of the Insurance Compensation Consortium, which covers for extraordinary incidents occurring in the country, and existing vulnerability studies.

Risk matrix

The value of likelihood and impact can be combined in a risk matrix, as defined in the European Guidelines for Risk Assessment and Mapping. The use of risk matrix for all scenarios analysed is recommended to draw a picture of the risk landscape on a national level. Grading of risk matrices tend to follow 4x4 or 5x5 approaches, depending on the number of likelihood/impact categories defined. See the United Kingdom matrix in box 20.

Box 20 – Risk assessment matrix (United Kingdom)



Risk matrices (UK Cabinet Office, National Risk Register of Civil Emergencies, 2015)

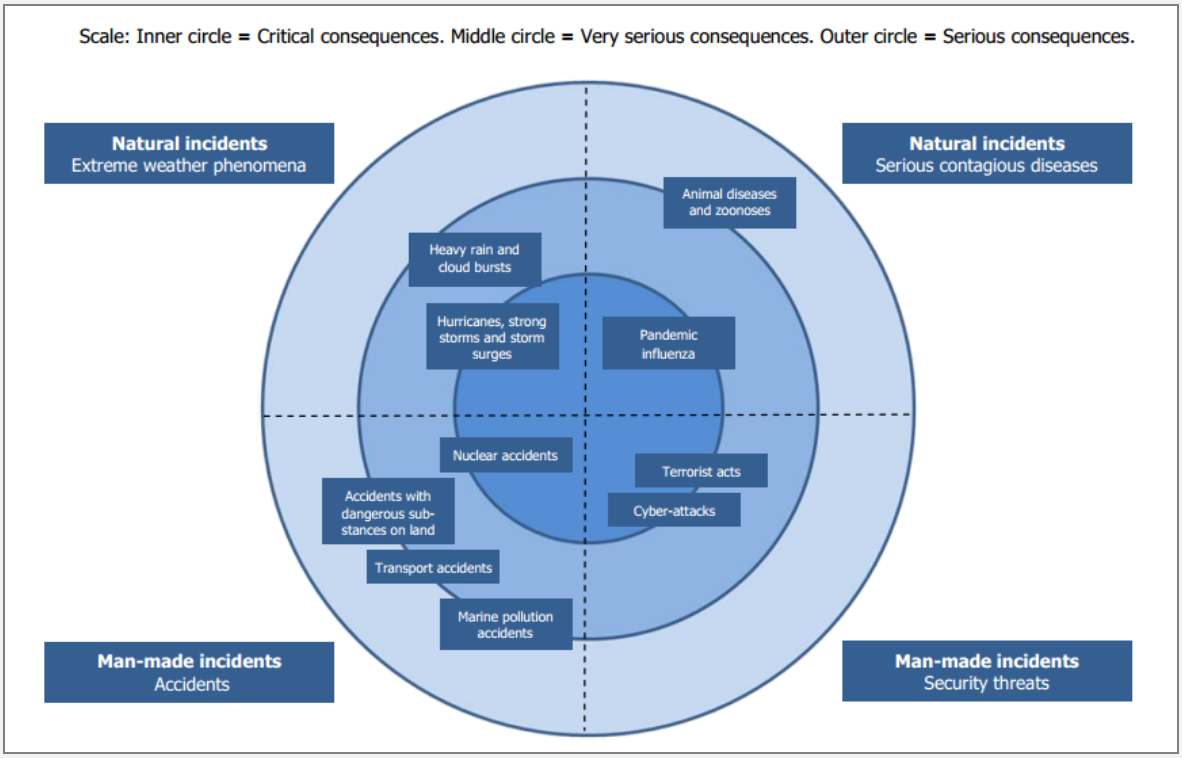
Two matrices are presented representing the key risks of the NRA, reflecting higher levels of sensitivity of information in the case of malicious incidents. Events are grouped and categorized based on plausibility rather than likelihood.

In the case of risk assessments not using a scenario-based approached – assessments based on historical events and not considering likelihood – risk matrices may take different forms, such as the Danish assessment in box 21.

Finally, the degree of uncertainty may also be represented to inform the reader on the reliability of the results.

Box 21 – Consequence assessment (Denmark)

The assessment is based on the consequences, so the final representation is a "target model", where the position of the incident determines the seriousness of the consequences. Incidents nearest to the centre are the ones with the most serious consequences, labelled here as "critical".



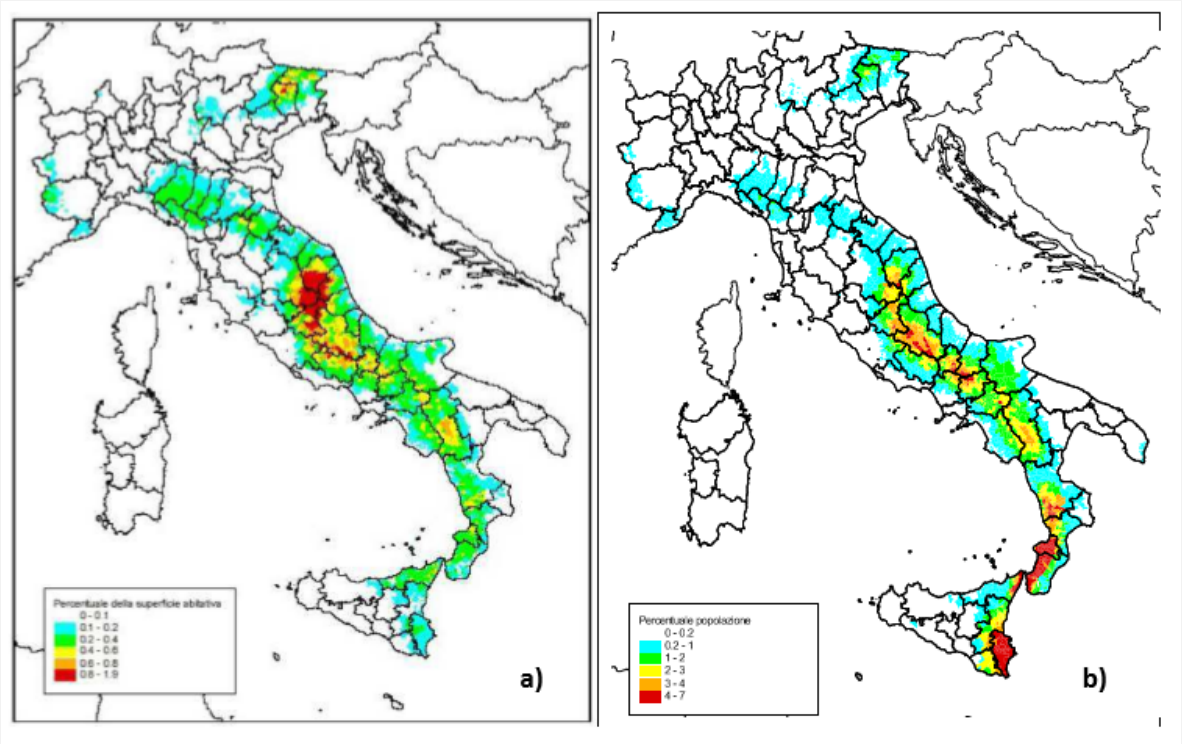
Overall consequence assessment of the incidents considered in the National Risk Profile (Denmark, DEMA, 2013)

NRAs using quantitative methodologies will present the combination of risk factors in the form of risk maps – see the case of Italy in box 22.

Box 22 – Risk maps (Italy)

The country has made an important effort to develop seismic risk maps at national level in the last years. The maps are based on recent seismic hazard studies and improved damage probability matrices and fragility curves. The vulnerability of residential building stock was modelled and categorized in 4 classes of vulnerability.

The result was the "loss risk", showing the percentage of damaged buildings, and the "life risk", showing the percentage of people involved in this building collapses.



"Loss risk" map (left) and "life risk" map (right), 100 year return period (Italian Department of Civil Protection, 2015)

From the maps, it appears that the major damages in property would most likely be in the centre of the country, where earthquakes are more frequent, while the highest risk of loss in lives would be in the south.

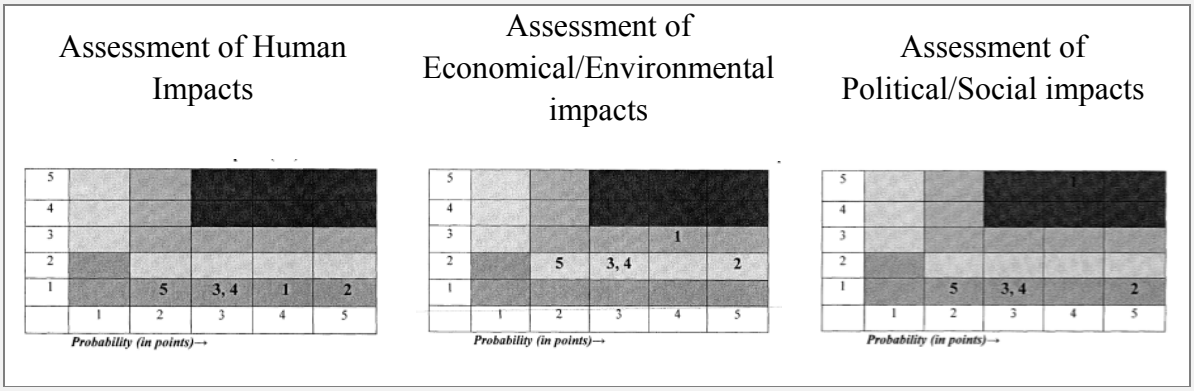
In order to have multi-hazard assessments, which consider the interaction among risks and vulnerability in the same area and/or time, it is necessary to move from single-hazard approaches to multi-risk analyses – see Lithuanian example in box 23.

Box 23 – Qualitative multi-risk analysis

The NRA of Lithuania first presents a scenario for each of the events selected, illustrating the possible trigger factors and the main consequences. In order to assess the sequential hazards and impacts depicted in the scenario, one or more sectors to be affected are selected.

For example, for the scenario of "Drought", five scenarios depicting the consequences over the agrarian sector, the forest sectors and the environmental quality are described. This way, from a situation of drought, other cascading hazards like forest fires or spread of pests emerge.

For each, historical data is presented and based on this, the likelihood and the impact criteria are valued. This way, a risk matrix with different sub-scenarios is depicted, multiplying its hazard probability and the impact in each category. The methodology considers three impact categories: human, economic and environmental and social and political.



Risk matrix of the five consequential scenarios from a drought event, depending on the category of impact (Ministry of Interior of Lithuania, 2013)

The general risk level for the main event is determined by summing up the risk level of all sub-scenarios.

2.3. Risk evaluation

In order to determine the level of risk, the results of the risk analysis are compared with risk criteria to determine whether the risk and/or its magnitude is acceptable or tolerable, as proposed in the European Guidelines for Risk Assessment. The determination of the "acceptable" or "tolerable" level of risk may be prescribed by societally determined acceptable levels in the form of legislative norms or standards. In the case of certain hazards, several EU legal acts and Eurocodes may exist that define specific prevention standards. If these don't exist, these may be determined through risk-cost-benefit approaches and risk social perception studies.

The output of this stage would be a list of risks over which is more urgent to act, normally reducing its likelihood and/or consequences. Defining which risks should be tackled is crucial in decision-making, as in the following step of Capability Assessment, requires a framework to describe capabilities and identify gaps (before, during and after a crisis) for future action.

3. Lessons identified

From the NRA reviewed it can be concluded that Member States periodically identify the hazards or events that would negatively affect their national safety and security. In order to assess the risk and then prioritize actions for disaster risk management, scenarios are built, generally illustrating an adverse but reasonable worst case. The opinion of experts is largely used through the whole process, especially for the assessment of impact, although historical records and databases of different nature are also used in the assessment. It is evident that there is political will for conducting assessments among Member States regularly and to learn from other experiences and already tested tools and methodologies.

NRA exercises follow a clear process, from identification to evaluation, in a transparent and a multidisciplinary approach. In some national cases, NRAs are embedded in the overall strategy for safety and security.

Due to at times limited availability and accessibility of data and resources, NRAs tend to rely on semi-quantitative methodologies. In addition, varying methodologies and scenarios from one national exercise to the next do not provide for replicable and comparable results.

Understanding the different methodologies and scenarios used helps uncover chains of cause and effect and the different factors interacting and assessed.

NRAs have extensively tapped into scientific and research projects and studies carried out nationally and abroad to inform their analysis of different hazards and events while undertaking their risk assessment.

A number of NRAs still rely on a single-hazard assessment approach. Undertaking a multi-hazard assessment, where the interaction of different threats and its consequences is considered, could reinforce the contribution of the risk assessment exercise for the emergency management decision-making process.

An observation of NRAs points to the lack of consideration of the risk evaluation stage of the risk assessment process. A more robust evaluation of risks in the assessment could contribute to exploring acceptable levels of risk, and in turn help use the risk assessment exercise to inform the prioritisation of investments.

Annex 2: Characteristics of National Risk Assessments[156]

Country	Risk selection criteria	Scenario	Time horizon	Methodology of the analysis		Management of Uncertainty	Link with capabilities assessments or proposal of future actions?
				Semi-qualitative	Quantitative		
AT	Mainly based on the Austrian Security Strategy and other relevant regulations regarding risk assessment	Reasonable worst case scenario. Single-risk scenarios considered and analysed a profound direct impact of cascading effects. There is a set of guiding questions to build each scenario, covering hazard, geographical extension and intensity, duration, warning, direct and indirect affected, past events, how would the authorities respond, etc. Based on historical events, available research and literature	Information not available in NRA summary	X		Takes into account the criteria of reliability (based on existing data, knowledge and consensus)	
BE	Identification of risks and multi-stakeholders thematic and generic surveys for expert consultation	(only risk identification undertaken)		X			
BG	Information not available in NRA summary			X			
HR	Risks identified and prioritized by a Working Group. Prior to the Risk Assessment Croatia has conducted a Hazard Assessment, based on HA findings list of 28 risks has been created. Based on that list members of the mRAWG (main Risk Assessment Working Group) conducted preliminary risk assessments in the form of small scale scenarios, simplified assessments of consequences and likelihood.	Scenarios are drawn up by working groups composed of experts in the particular area or topic, in accordance with the guidelines defined for the NRA. Scenarios, which focus in an adverse event (or more than one) to population, economy, social stability and policy, try to identify the trigger and the development of the phenomena. Two scenarios are presented describing two possible events: *most likely an adverse event* and *event with the worst possible implication* Besides the single hazards, Croatia developed a multi-hazard scenario, earthquake followed by flood in national capital.	Based on the scenario: days, weeks or years	X		Uncertainty is assessed qualitatively	X
CY			To be implemented				X

[156] Based on available information retrieved from summaries of National Risk Assessment submitted to the European Commission under Article 6 of the UCPM legislation

			for three time periods of 30-years (2020s, 2050s and 2080s)				
CZ	The Fire Rescue Service of the Czech Republic and representatives of ministries and other central administrative offices carried out the identification. From 72 types of threats identified, a preliminary analysis is done to highlight and further analyse the ones that represented a higher and unacceptable risk.						X
DK	An important criterion for the selection was that the consequences of the incident types were considerable in magnitude, geographical extent and/or duration seen from a national perspective. Also, the consequences should not be manageable at a local administrative level alone but demand external emergency response assistance. The consequences should broadly be detrimental to values such as life, health, wellbeing, property, the economy, the environment and one or more critical societal functions.	For each event studied, the characteristics and its possible consequences are described and assessed. Also, a detailed list of similar events is mentioned together with the possible future. The document has a descriptive approach, with emphasis on historical documentation of real incidents that have affected Denmark in the past.		X		Mentioned	X
EE	The Government establishes by an order a list of those emergencies for which a risk assessment shall be prepared.	For each hazard/event a brief description of causes and main impacts is given.		X			X
FI	Event scenarios that, if materialised, would cause considerable impacts on humans, the economy and the environment or on society. The critical infrastructure, the critical services and the vital functions for the Finnish society are listed in different policies	Scenarios consider the worst case, or the most probable case scenarios. Based on the selected events, responsible Ministries drafted scenarios, based on the issue at risk, together with expert from their branch of administration.	Varies according to the scenario	X		For each scenario a reliability value is determined.	X
FR							
DE	A Steering Committee, composed of the relevant federal ministries and coordinated by the Federal Ministry of the Interior) selects event which are relevant are national level	The scenarios are based on the plausible / plausible assumption of the worst - case scenario					
GR							

HU	Based on a preliminary hazard Assessment. The event needs to have an impact on the national scale and at least affect one of the social interests (life/health, nature/ environment, finance/ economy, stability of society, ability to govern and territorial control). Risks are identified in work sessions by the experts of working groups, composed with representatives of several institutes, organizations and authorities.	The scenario is plausible, but it is conservative in the sense that it is the "most serious imaginable" one. The scenario description gives factual supporting information about the context, the evolution of events, the potential consequences and the possible domino-effects. Different sources are used to analyse: historic events, case histories, statistics, failure data and expert opinions.	For the next 5 years and for a five-year period in the longer term (between 20 and 25 years from now)	X		Uncertainty is assessed based on the credibility of the scenario	X
IE[157]	Based on the hazards identified in the local and regional risk assessments, together with the identification made by the Departmental and Agency level	Reasonable worst case scenario, generally single-risk. Based on expert judgement and interpretation of appropriate data, if available.		X			
IT		Single-hazard	Varies according to the scenario		X		
LV		Risk scenarios were developed graphically to understand the causes and their possible consequences. Some scenarios consider different trigger hazards together with different consequences. Statistics were used to analyse and assess risks.		X			
LT	In accordance with the legislation in force, a national level disaster may be announced when its consequences exceed limits of the territories of 3 municipalities. 19 potential hazards were mapped. After a brief analysis, 11 were selected with impact at the national level.	For the events, different scenarios are considered, based on different consequences to specific sectors, taking into account cascading effects. The scenarios were selected and evaluated during participation of representatives of other competent civil protection system entities.	Varies according to the scenario: weeks or months	X			X
LU				X			
MT	The sources for the identification of hazards and risks were structured interviews with key experts and the review of existing literature.	Plausible scenarios for single and combined hazards, including climate change and cascading effects.					X

[157] NRA under review in 2016/17

NL	Selected by the National Steering Committee for National Safety and Security (SNV) - composed by Ministries – based on the advice of the Network of Analysts for National Security (ANV) – a network of research groups and institutions.	Requirements regarding impact and likelihood, and two horizon scopes. There is a guideline for its development: Working with scenarios… (2009)	Stated. In the next five years or within a five-year period situated in 20-25 years.	X		Uncertainty is considered and analysed in order to examine whether the position of the scenario is robust or not	X
PL	Threats were identified by different reports prepared by ministers, heads of central offices and province governors. Threats need to meet a set of criteria to be considered of national scope			X			
PT	Based on previous sectorial and climate change projects and civil protection plans which identified main risks.	Generally single-hazard.		X		Considered when analysing the risk together with climate change trends	X
RO	Based on the list of risks identified as representative at national level by the Government Decision on risk management	Worst case scenario		X			
SK	Identified at the "Territorial analysis from the perspective of potential emergencies in the Slovak Republic", drawn up at all levels of the State administration on the basis of Act of the National Council of the Slovak Republic No 42/1994 on civil defence as amended						
SI	A Decree specified 12 disasters that require a state-level risk assessment	Some of the risk scenarios fully consider the real events, and the consequences resulting from the risk analyses are either real (e.g. in two of the risk scenarios for drought), potential (e.g. all three risk scenarios for an earthquake) or real and potential (all risk scenarios for large wildfires, two risk scenarios for sleet, both risk scenarios for floods). Some risk scenarios and associated risk analyses are entirely hypothetical (i.e. both risk scenarios for terrorism, all risk scenarios for radiological disaster and nuclear disaster, the risk scenario for a train crash and drought etc.).		X		Stakeholders engaged assessed the reliability of risk scenarios and risk analyses. No quantitative criteria were determined, but each institution assessed the level of reliability of risk scenarios or risk analyses subjectively	X

ES		Single-hazard Extensive use of historical databases.	Varies according to the scenario		X		
SE	MSB ran a workshop on the identification and selection of risks, involving representatives from 29 agencies	The scenarios developed thus far are based on single incidents or multiple events in chains of cause and effect. They are the worst probable type, unlike worst case scenarios with significant or very significant impacts. Analyses are mainly based on interviews with stakeholders engaged in scenario building. Each scenario has been analysed based on the capability of society to prevent and respond to the scenario in respect of its potential impact on Sweden's national values of protection.	Varies according to the scenario: from days to months	X		X	For each event, the uncertainty has been assessed
UK	Based on experts' opinion in government departments.	Reasonable worst case scenario, which represents a challenging manifestation of the scenario after highly implausible scenarios are excluded.	Stated. From now to the next five years.	X			
NO	Dialogue with experts, agencies and academics	The scenarios are extreme but they are not inconceivable or unrealistic - not day-to-day accidents and not the most extreme events conceivable either. They present the most serious consequences that the event can have over the "societal assets". The scenarios consider the trigger events and the main adverse events, including the consequences and the events occurring at the same time as the main event. Assessed by expert analysis and available data.	Stated. 1 year	X		X	Assessment of uncertainty related to the analysis results
IS	Based on the identification of the Civil Protection Committees	Information of the event, previous events, the likelihood of it, the impact and consequences and the existing measures to prevent, mitigate, respond and recovery to it is provided.		X		Mentioned	

Annex 3: National Assessment Criteria[158]

Probability/likelihood

Country	Levels				
AT	1	2	3 Probability of occurrence of around 1 % per year or once every 100 years	4	5
BE	1	2	3	4	5
BG					
HR	Extremely small <1% of probability Frequency: 1 event in 100 years and less	Small 1-5% of probability Frequency: 1 event in 20 to 100 years	Moderate 5-50% of probability Frequency: 1 event in 2 to 20 years	High 51-98% of probability Frequency: 1 event in 1 to 2 years	Very High >98% of probability Frequency: 1 event a year or more
CY					
CZ	1 Unlikely	2 Probable	3 Very likely		
DK					
EE	*Very low* >0,005% within 4 years: >1 in 20,000	*Low* >0,05% within 4 years: >1 in 2,000	*Medium* >0,5% within 4 years: >1 in 200	*High* >5% within 4 years: >1 in 20 years	*Very high* >50% within 4 years: >1 in 2
FI	1 Very low Less often than once every 1000 years	2 Low Once every 500 – 1,000 years	3 Average Once every 100 – 500 years	4 High Once every 10 – 100 years	5 Very high More often than once every 10 years

[158] Based on available information retrieved from summaries of National Risk Assessment submitted to the European Commission under Article 6 of the UCPM legislation

FR					
DE					
GR					
HU	A. very unlikely <0.1% per 5 years A. No concrete indication and the event is not deemed conceivable.	B. Unlikely 0.1-1% per 5 years B. No concrete indication, but event is deemed far-fetched but conceivable.	C. Possible 1-10% C. No concrete indication, but event is conceivable.	D. Likely 10-100% D. The event is conceivable.	E. Very likely E. Concrete indication that the event will take place.
IE[159]	1. Extremely unlikely May occur only in exceptional circumstances; Once every 500 or more years.	2. Very unlikely Is not expected to occur; and/or no recorded incidents or anecdotal evidence; and/or very few incidents in associated organisations, facilities or communicates; and / or little opportunity, reason or means to occur; May occur once every 100-500 years	3. Unlikely May occur at some time; and /or few, infrequent, random recorded incidents or little anecdotal evidence; some incidents in associated or comparable organisations worldwide; some opportunity, reason or means to occur; may occur once per 10-100 years.	4. Likely Likely to or may occur; regular recorded incidents and strong anecdotal evidence and will probably occur once per 1-10 years.	5. Very likely Very likely to occur; high level of recorded incidents and/or strong anecdotal evidence. Will probably occur more than once a year.
IT					
LV	Very Low Less frequent than once every 100 years	Low Can happen once every 51 to 100 years	Medium Can happen once every 16 to 50 years	High Can happen once every 1 to 15 years	Very High Can happen once a year or more frequently
LT	1. Very low probability It may happen less than once in 100 years	2. Low probability It may happen once in 50 to 100 years	3. Medium probability It may happen once in 10 to 50 years	4. High probability It may happen once in 1 to 10 years	5. Very high probability It may happen more often than once a year
LU	Low	Average	High		
MT	Less than 10^{-5}/year Extremely unlikely but yet possible	10^{-4}-10^{-5}/year Highly unlikely	10^{-3}-10^{-4}/year Unlikely	10^{-2}-10^{-3}/year Likely	More than 10^{-2}/year Highly likely

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NL	A. very unlikely <0.05% per 5 years	B. Unlikely 0.05-0.5% per 5 years	C. Possible 0.5-5%	D. Likely 5-50%	E. Very likely 50-100%
PL	Very rare	Rare	Possible	Likely	Very likely
PT	Low Annual probability: <0.005 Return period: >200 years	Medium Low Annual probability: 0.005 to 0.02 Return period: [50 - 200]	Medium Annual probability: 0.02 to 0.05 Return period: [20 - 50]	Medium high Annual probability: 0.05 to 0.2 Return period: [5 - 20]	High Annual probability: ≥ 0.2 Return period: ≤5
RO	Very unlikely Events that can occur once every 1000 years or less	Unlikely Events that can occur between 100 and 1000 years	Conditionally unlikely Events that can occur between 10 to 100 years	Likely Events that can occur once between 1 to 10 years	Very likely Events that can occur several times each year
SK					
SI	1. Very low Once in more than 250 years (annual likelihood of up to 0.4 %) Almost no risk (threat)	2. Low Once in 100–250 years (annual likelihood of 0.4 %–1 %) Possible, but unlikely risk (threat)	3. Medium Once in 25–100 years (annual likelihood of 1 %–4 %) Possible risk (threat)	4. High Once in 5–25 years (annual likelihood of 4 %–20 %) General risk (threat)	5. Very high Once or multiple times in 5 years (annual likelihood above 20 %) Specific and immediat (permanent) risk (threat)
ES					
SE	Rare				Frequent
UK	Low Between 1 in 20000 and 1 in 2000	Medium low Between 1 in 2000 and 1 in 200	Medium Between 1 in 200 and 1 in 20	Medium high Between 1 in 20 and 1 in 2	High Greater than 1 in 2
NO	Very low	Low	Moderate	High	Very high
IS	1. Very unlikely (rare) 1 time every > 1000 years	2. Low probability (unlikely) 1 time every 50-1000 years	3. Medium probability (moderate) 1 time every 10-50 years	4. High probability (likely) 1-10 times a year	5. Very high probability (almost certain)

					More than 10 times a year

Impact/consequence

Country	Categories	Levels				
AT		1	2	3 economic impact is a damage threshold of 0.6 % GNI for the EU Solidarity Fund	4	5
BE		1	2	3	4	5
BG						
HR	1. Health and life of humans 2. Economy 3. Social stability and policies, considering the damaged critical infrastructure and the buildings of public social value damaged	1. Insignificant Health and life: <50 Economy: <250 CI: <250 Buildings of public value: <250	2. Small Health and life: 50-200 Economy: 250-700 CI: 250-700 Buildings of public value: 250-700	3. Moderate Health and life: 201-500 Economy: 700-1500 CI: 700-1500 Buildings of public value: 700-1500	4. Significant Health and life: 501-1500 Economy: 1500-7000 CI: 1500-7000 Buildings of public value: 1500-7000	5. Catastrophic Health and life: >1500 Economy: >7000 CI: >7000 Buildings of public value: >7000
CY						
CZ	1. Impact on the lives and health of people, 2. Environmental impact, 3. Economic impact, 4. Social impact.	1. *Low* Little local impact on the lives of people and health of these, property and environment	2. *Significant* Greater impact on the lives and health of people, property and environment, of regional character	3. *Catastrophic* A very large impact on the lives and health of people, property and environment, or economic or social stability nation-wide.		
DK	1. Consequences for life, health and well-being based on the numbers of dead, injured, sick, infected/contaminated and prevalence of	Serious consequences	Very serious consequences	Critical consequences		

	anxiety/insecurity/fear 2. Consequences for property and economy, based on material destruction, financial losses, loss of intellectual property rights, destruction/loss of cultural heritage 3. Consequences over the environment, based on the pollution of land environment, pollution of aquatic environment, harm to animal life, harm to plant life. 4. Consequences for the availability of critical societal functions, Breakdown of or extreme pressure on the availability of critical societal functions.					
EE	1. Human life and health, 2. Assets, 3. natural environment, 4. vital services	*Insignificant* Individual seriously or lightly injured persons No or light property damage (0 - 575000) No measurable change at the scene in population of any species or ecosystem function. This does not rule out natural fluctuations in the population of native species Temporary disruptions in the functioning of the service. No direct losses	*Light* Seriously injured who require immediate hospital care – up to 30, number of the injured does not exceed the possibilities afforded by regional health care resources 575 000 – 1 300 000 euros. Changes take place at the scene in the population levels or ecosystem function. The situation returns to the original state without human intervention. Short-term disruptions in functioning of service	*Serious* Some fatalities. Seriously injured who need immediate medical care – 31-170, number of injured exceeds possibilities of regional health care resources (except for Tallinn) necessary to involve other regions' resources. 1 300 000 – 3 200 000 euros Changes take place at the scene in the population of one or more species and ecosystem function. Situation does not return to original state without human intervention. More than one daily disruption in functioning of service. Necessary to implement backup systems or alternative measures	Very serious Tens of fatalities. Seriously injured who need immediate medical care – 171-400, number of injured exceeds the possibilities of the region's health care resources, necessary to involve entire country's health care resources 3 200 000 – 5 100 000 euros. Major changes take place at the scene in the population of one or more species. The value of the major change depends on the specific species. The death of one animal of a protected species is a major change. The death of even a large number of animals in an easily reproducing and common species may have low importance, especially if the change is within the bounds of	Catastrophic Many tens of fatalities, over 400 seriously injured. Number of injured exceeds health care resources of the entire country, international assistance is required. Assets Foreign assistance is necessary (expenses over 0.5% of GDP, over 5 100 000 euros). iving nature habitats at the scene are destroyed. Ecosystem function ceases or irreparably damaged. Impossible to 12 restore previous situation. The field/service has completely ceased to function.

					the natural fluctuation of the population. A change in the function of the ecosystem is a very serious consequence, the status quo is usually very hard to restore. The non-functioning of the service significantly reduces the security of society	
FI	1. Human impact 2. Economic impact 3. Environmental impact 4. Societal impacts (including Critical Infrastructure)	I Dead (No) <= 5 Injured (No) <= 15 Evacuated (No) <= 50 Material losses (MEUR) < 1 Consequential loss (MEUR) < 1 Environment (sq km) < 1 Duration: < week CI (No): 0-2 Duration: < day Vital functions (No): 0-1 Duration: < day	II Dead (No) 6-15 Injured (No) 16-45 Evacuated (No) 51-200 Material losses (MEUR) 1-10 Consequential loss (MEUR) 1-10 Environment (sq km) 1-10 Duration: < month CI (No): 3-4 Duration: 1 d - 6 d Vital functions (No): 2-3 Duration: 1 d - 6 d	III Dead (No) 16-50 Injured (No) 46-150 Evacuated (No) 201-500 Material losses (MEUR) 10-100 Consequential loss (MEUR) 10-100 Environment (sq km) 10-100 Duration: 1-6 months CI (No): 5-6 Duration: week - 2 weeks Vital functions (No): 3-4 Duration: week - 2 weeks	IV Dead (No) 51-200 Injured (No) 151-600 Evacuated (No) 501-2,000 Material losses (MEUR) 100-500 Consequential loss (MEUR) 100-500 Environment (sq km) 100-1,000 Duration: 6 months -1 year CI (No): 7-8 Duration: 2 weeks –month Vital functions (No): 5-6 Duration: 2 weeks –1 months	V Dead (No) > 200 Injured (No) > 600 Evacuated (No) > 2,000 Material losses (MEUR) > 500 Consequential loss (MEUR) > 500 Environment (sq km) > 1,000 Duration: over 1 year CI (No): 9-11 Duration: over 1 month Vital functions (No): 7 Duration: over 1 month
FR						
DE						
GR						
HU	1. Death, considering immediate death and premature death 2. Injuries and Illnesses, number of people	A. *Limited* consequences <10 immediate deaths, from 0 - 100 premature	B. *Substantial consequences* 10-100 immediate, 100-500 premature	C. *Serious consequences* 100-500 immediate, 500-1000 premature	D. *Very serious consequences* 500-100 immediate, more than 1000 premature	E. *Catastrophic consequences* More than 1000 immediate deaths

	3. Long term damage of nature and environment, based on the area affected and the duration of harm 4. Financial and material losses, based on the damage to property, health damage, financial loss, cost of combating the incident and others, in euros 5. Social unrest, on the number of days and people involved 6. Disturbance in daily life, on the number of days and people involved considering a list of services 7. Weakened ability to govern, based on different indicators such as reduced ability for national administration to operate or reduced ability for national financial system) and number of days 8. Weakened territorial control, based on the area and the number of days	<5 people <30 km² <50 million Between 1 - 7 days concerning less than 10.000 people Affecting less than 10.000 people up to 7 days / less than 100.00 up to 2 days 1 indicator for days At the level of towns for up to 4 weeks / at the level of counties for up to 6 days	6-19 people 30 - 300km² or less than 30 km² of harm lasting more than 10 years 50-500 million Between 1 week and 1 month concerning less than 10.000 people / Between 3 to 7 days concerning less than 100.000 people / Between 1 to 2 days concerning less than 1.000.000 people Affecting less than 10.000 people up to 1 month / less than 100.00 up to 7 days / less than 1.000.00 up to 2 days 1 indicator for weeks or 2 for days At the level of towns for up to 6 months / at the level of counties for up to 4 weeks	20-99 people 300- 3000km² / 30 - 300 km² of harm lasting more than 10 years / less than 3% area affecting natural parks 500 million - 5 billion More than 1 month concerning less than 10.000 people / Between 1 week and 1 month concerning less than 100.000 people / Between 3 to 7 days concerning less than 1.000.000 people / between 1 to 2 days concerning more than 1.000.000 people Affecting less than 10.000 people for more than 1 month / less than 100.00 up to 1 month / less than 1.000.00 up to 7 days / More than 1.000.000 for up to 2 days 1 indicator for months, 2 for weeks and more than 2 for days At the level of towns for more than 6 months, at the level of counties for up to 6 months, at the regional level for up to 6 days	100-1000 people More than 3000km² / 300 - 3000 km² of harm lasting more than 10 years / 3-10% area affecting natural parks / Less than 3% of area of natural parks with a harm lasting more han 10 years 5 billion - 50 billion More than 1 month concerning less than 100.000 people / Between 1 week and 1 month concerning less than 1.000.000 people / Between 3 to 7 days concerning more than 1.000.000 people Affecting less than 100.000 people for more than 1 month / less than 1.000.00 up to 1 month / More than 1.000.000 for up to 7 days 1 indicator for 1 year or longer, 2 for months, and more of 2 for weeks At the level of counties for more than 6 months or longer	More than 1000 people More than 3000 km² of harm lasting more than 10 years / More than 10% of area affecting natural parks / More than 3% of area of natural parks with a harm lasting more han 10 years More than 50 billion More than 1 month concerning less than 1.000.000 people / Between 1 week or more concerning more than 1.000.000 people Affecting less than 1.000.00 for more than 1 month / More than 1.000.000 for more than 1 week 2 indicators for 1 year or longer or more than 2 for months or longer At the level of counties for longer time and regional level for more than 6 months
IE[160]	There are four types: life, health, welfare, environment, infrastructure and social	1. *Very low impact* Life, health, welfare: Limited number of people affected; 0-4 fatalities and limited number of minor injuries requiring first aid treatment. Environment: Simple, localised contamination. Infrastructure: <4M Euros. Social: Localised disruption to community services or	2. *Low impact* Life, health, welfare: 4-8 fatalities; considerable number of people affected; serious injuries with hospitalisation and medical treatment required. Localised displacement of a considerable number of people for 2-8 days. Personal support satisfied through local arrangements Environment: Simple, regional contamination, effects of short	3. *Moderate* impact Life, health, welfare: Significant number of people in affected area impacted with multiple fatalities (8-20), multiple serious or extensive injuries (20), significant hospitalisation. Large number of people displaced for 2-8 days or possibly beyond; up to 4000 evacuated. Regional resources required for personal support. Environment: Heavy	4. *High impact* Life, health, welfare: 20 to 50 fatalities, up to 100 serious injuries, up to 16000 evacuated. Environment: Heavy contamination, widespread effects or extended duration. Infrastructure: 80-200M Euros Social: Community functioning poorly, minimal services available.	5. *Very high* impact Life, health, welfare: Large numbers of people impacted with significant numbers of fatalities (>50), significant injuries in the hundreds, more than 16000 evacuated. Environment: Very heavy contamination, widespread effects of extended duration. Infrastructure: >200M Euros. Social: Serious damage to

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		infrastructure (<48 hours).	duration. Infrastructure: 4-24M Euros. Social: Community functioning with considerable inconvenience.	contamination localised effects or extended duration. Infrastructure: 42-80M Euros. Social: Community only partially functioning, some services available.		infrastructure causing significant disruption to, or loss of, key services for prolonged period. Community unable to function without significant support.
IT						
LV	1. Injuries/victims 2. Deaths 3. Material damage (in euro) 4. Environmental damage 5. People Sick 6. Displaced people	*Minor* Injuries/victims: 1 to 100 Deaths: 1-10 Material damage (in euro): 50 thousand to 100 thousand, Environmental damage: 50 thousand to 100 thousand, Sick: less than 5 % Displaced persons: 10 to 100	*Significant* Injuries/victims: 101 to 1000 Deaths:11 to 100 Material damage (in euro): 100.000 to 1 million Environmental damage: 100.000 to 1 million Sick: 5-15% Displaced people: 101 to 1000	*Medium* Injuries/victims: 1001 to 5000 Deaths: 101 to 500 Material damage (in euro): 1 to 10 million Environmental damage: 1 to 10 million Sick: 15-20% Displaced people: 1001 to 5000	*Grave* Injuries/victims: 5001 to 10000 Deaths: 501 to 1000 Material damage (in euro): 10 to 100 million Environmental damage: 10 to 100 million Sick: 21-35% Displaced people: 5001 to 10000	*Catastrophic* Injuries/victims: more than 10000 Deaths: more than 1000 Material damage (in euro): more than 100 million Environmental damage: more than 100 million Sick: more than 35% Displaced people: more than 10000
LT	1. Human Impact 2. Environmental impact 3. Political/social impact	*1. Insignificant* No more than 10 residents died, but more than 50 residents were injured; residents do not need to be evacuated Up to 0.35% of GDP Assemblies of residents (meetings, pickets, demonstrations, processions, various parades, different peaceful unarmed assemblies), up to 1000 participants; Meetings not causing massive upheaval, public nuisances and/or not related with criminal offences are prohibited; Disturbances of supply or outage of energy and energy resources in the territory of one municipality; Strikes of individual economic entities or	*2. Limited* 10 to 20 residents died, 50 to 100 residents were injured; up to 300 residents need to be evacuated 0.35% to 0.9% of GDP Assemblies of residents from 1000 to 5000 participants; Meetings causing massive upheaval, rough public nuisances and/or related to performance of criminal offences in the territories of no more than 3 municipalities; Disturbances of supply or outage of energy and energy resources in the territory of more than one municipality but not exceeding the limits of territories of 3 municipalities; Strikes of civil servants and/or	*3. High* 20 to 50 residents died, 100 to 250 residents were injured; 300 to 1000 residents need to be evacuated 0.9% to 1.75% of GDP Assemblies of residents from 5,000 to 10,000 participants; Meetings causing massive upheaval, rough public nuisances and/or related to performance of criminal offences in the territories of 3 to 5 municipalities are prohibited; Disturbances of supply or outage of energy and energy resources in the territory of more than 3 municipalities but not exceeding one third of the country's territory; Strikes of civil servants and/or employees	*4. Very high* 50 to 100 residents died, 250 to 500 residents were injured; 1000 to 2000 residents need to be evacuated 1.75% to 2.6% of GDP Assemblies of residents 10,000 to 20,000 participants; Meetings causing massive upheaval, rough public nuisances and/or related to performance of criminal offences in the territories of 5 to 10 municipalities; Disturbances of supply or outage of energy and energy resources in more than one third of the national territory but not exceeding two thirds of the country's territory; Strikes of civil servants and/or employees of a sector causing	*5. Catastrophic* More than 100 residents died, more than 500 residents were injured; more than 2000 residents need to be evacuated More than 2.6% of GDP Assemblies of residents from 20,000 to 30,000 participants; Meetings causing massive upheaval, rough public nuisances and/or related to' performance of criminal offences in the territories of more than 10 municipalities; Disturbances of supply or outage of energy and energy resources in more than two thirds of the country's territory; Strikes of civil servants and/or employees of more than one sector causing negative

		strikes of civil servants and/or employees of public and municipal authorities and institutions not causing negative consequences on daily life conditions of residents; When activities of an activity area (sector) are disturbed for up to 6 hours; When the usual traffic on public highways and national roads is stopped for up to 3 days	employees of a part of a sector not causing negative consequences on daily life conditions of residents; When activities of an activity area (sector) is disturbed from 6 to 24 hours; When the usual traffic on public highways and national roads is stopped for up to 10 days	of a sector not causing negative consequences on daily life conditions of residents; When activities of an activity area (sector) is disturbed from 1 to 3 days; When the usual traffic on public highways and national roads is stopped for up to 20 days.	negative consequences on daily life conditions of residents; When activities of an activity area (sector) is disturbed for 3 to 30 days; When the usual traffic on public highways and national roads is stopped for up to 40 days	consequences on daily life conditions of residents and/or activities of public or municipal authorities or institutions; When activities of an activity area (sector) is disturbed for more than 30 days; When the usual traffic on public highways and national roads is stopped for more than 40 days.
LU		Minor	Considerable	Severe	Very severe	
MT		*Limited* Less than "minor" effects	*Minor* Injuries and/or illness treatable with first aid. Shutdown of critical facilities and services for 24 hours or less. Less than 10 percent of property severely damaged	*Moderate* Injuries and/or illnesses do not result in permanent disability. Complete shutdown of critical facilities for more than 1 week. More than 10 percent of property is severely damaged	*Significant* Injuries and/or illnesses result in permanent disability. Complete shutdown of critical facilities for at least 2 weeks. More than 25 percent of property is severely damaged	*Catastrophic* Multiple deaths. Complete shutdown of critical facilities for 30 days or more. More than 50 percent of property severely damaged
NL	1. Territorial safety: 1.1 Encroachment on the territory of the Netherlands; 1.2 Infringement of the international position of the Netherlands 2. Physical security: 2.1 Fatalities; 2.2 Seriously injured and chronically ill; 2.3 Physical suffering (lack of basic necessities of life) 3. Economic security: 3.1 Costs; 4. Ecological security: 4.1 Long-term impact on the environment and on nature (flora and fauna); 5. Social and political stability: 5.1 Disruption to everyday life; 5.2 Violation of the democratic system; 5.3 Social psychological	A. Limited consequences	B. Substantial consequences	C. Serious consequences	D. Very serious consequences	E. Catastrophic consequences

	impact					
PL	1. Potential consequences for the population: Causalities, injured, increased incidence of certain diseases, necessity of evacuation, disruption of transportation, panic stress, increased rate of crime/public disturbance 2. Potential impact on the economy/property/infrastructure: Damage to/ disturbance in the functioning of the ICT infrastructure, Losses in the national heritage, Damage to breeding and/or harvest, Damage to/disturbance in the functioning of residential and public buildings, Damage to/ disturbance in the functioning of supply infrastructure (electricity, gas, heat, water), Possible increase in unemployment rate, Damage to/ disturbance in the functioning of transport infrastructure 3. Potential consequences for the environment: Degradation, Damage to/degradation of valuable natural areas or protected areas, Damage, Possible extinction/ reduction of population of given animal/plant species, Contamination	Irrelevant	Small	Moderate	Large	Catastrophic
PT	1. Population (dead, evacuation and injured) 2. Environmental impact	*Residual* There are no injuries or fatalities. There is no change / withdrawal	*Limited* Reduced number of standard victims4 (less than 50). Withdrawal of persons for a	*Moderate* Moderate number of standard victims (50 to 200) Withdrawal of persons for a	*Intense* Acute number of standard victims (200 to 500). High number of people withdrawing for a period more	*Critical* Very high number of standard victims (greater than 500). Large-scale evacuation for a long period. Support and

	3. Socioeconomic impact	of people or only one Number for a short period (up to 12 hours). Little or any necessary support staff (there is no support neither monetary nor material). Damage without meaning. There is no impact on the environment. There is not a reduced level of constraints in the services. There is no financial loss.	period of less than 24 hours. Some support and reinforcement staff needed. Some Damage. Small impact on environment with no lasting effects. Socioeconomics Disruption (less than 24 hours). Small financial loss.	period of 24 hours. Some Necessary technical staff. Some damage. Impact on environment with no lasting effects. Some disruption in the community (less than 48 hours). Some financial loss.	than 24 hours. External resources required to support staff. Significant damages that require external resources. Some impacts with long-term effects. Partial community operation with some unavailable services. Significant loss and need of financial assistance	reinforcement staff needed. Significant environmental impact and / or permanent damage. The community can no longer function without significant support
RO	1. Population impact: Deaths, Injured, Evacuees, people with no access to basic services 2. Economic and environmental impact: Material and financial losses and Environmental impact 3. Social and psychological impact: Disruption of daily life and Psychological impact on society	Very low	Low	Moderate	High	Very high
SK						
SI	1. Human impact 2. Economic and environmental impacts and impacts on cultural heritage 3. Political and social impacts 4. Impacts on internal political stability 5. Financial stability 6. Foreign political stability or international stability	Very low: 1. up to 5 casualties; up to 10 injured; up to 20 evacuated 2. up to 0.3% GDP / €100 million	Low: 1. 5-10 casualties; 10-50 injured; 20-50 evacuated 2. 0.3%-0.6% GDP / €100-220 million	Medium: 1. 10-50 casualties; 50-200 injured; 50-200 evacuated 2. 0.6%-1.2% GDP / €220-440 million	High: 1. 50-200 casualties; 200-1000 injured; 200-500 evacuated 2. 1.2%-2.4% GDP / €440-880 million	Very high: 1. 200+ casualties; 1000+ injured; 500+ evacuated 2. More than 2.4% GDP / more than €880 million

ES						
SE	1. Human impact 2. Economic/ Environmental impact 3. Political/ Social impact	Limited	Substantial	Serious	Very serious	Catastrophic
UK	The number of fatalities directly attributed to the emergency Illness or injury Levels of social disruption Economic harm Psychological impact	1	2	3	4	5
NO	1. Life and health: Death and Serious injuries and illness 2. Nature and the environment: long-term damage to the natural environment and Irreparable damage to the cultural environment 3. Economy: Direct financial losses and Indirect financial losses 4. Societal stability: Social and psychological reactions and Effects on daily life 5. Democratic values and capacity to govern: Loss of democratic values and national capacity to govern and Loss of control over territory	Very small	Small	Moderate	Large	Very large
IS	1. Lives and health of the population 2. The environment	1. *Insignificant* Small direct effects on health and lives	2. *Minor* Moderate direct effects on health and lives,	3. *Major* Significant direct or moderate serious effects on health	4. *Critical* Extremely large direct or significant indirect effects on	5. *Extreme* Many fatalities and seriously injury. Catastrophic direct/

	3. Great economic values 4. Great social values – function of society	Extremely limited damage to environment Extremely limited damage to property Extremely limited disruptions to societal functionality	Limited damage to the environment – little effect, Limited damage to property Limited disruptions to societal functionality, transient mistrust towards several social institutions	Serious short time damage to the environment Serious damage to property Disruptions in societal functionality, continued mistrust towards several social institutions or changed behaviour	health, Extremely serious damage to environment long-term effect Extremely serious damage property Extremely serious disruptions to societal functionality, continued distrust towards several social institutions and changed behaviour	extremely large indirect effects on health and lives" Catastrophic direct/ extremely large indirect effects on Health and lives Catastrophic damage to the environment – long-term and permanent Catastrophic damage to property Solid mistrust towards social institutions and general instability, extreme disruptions in societal functionality.