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Disaster damage and loss data for policy

Pre- and post-event damage assessment and collection of data for evidence-based policies

Montserrat Marín Ferrer
Afonso Do Ó
Karmen Poljanšek
Ainara Casajus Vallés
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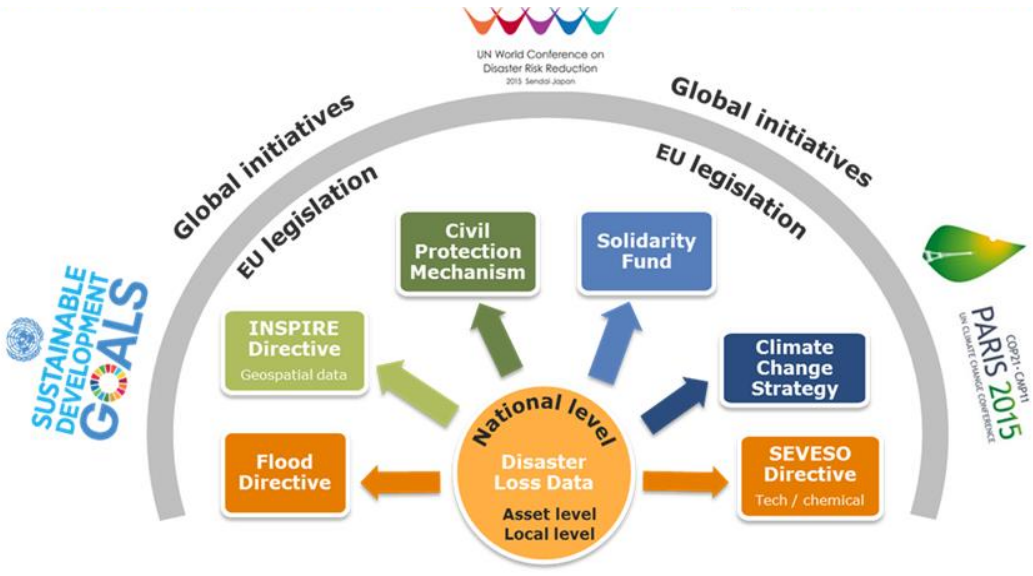

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Contact information
Name: Montserrat Marin Ferrer
Address: Joint Research Centre, Via Enrico Fermi 2749, TP 266, 21027 Ispra VA, ITALY
Email: Montserrat.MARIN-FERRER@ec.europa.eu
Tel. +39 0332785810

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Abstract
This report follows the work carried out over the last few years by the European Commission Joint Research Centre (JRC) and, since 2015, by its Disaster Risk Management Knowledge Centre (DRMKC), in collaboration with DG European Civil Protection and Humanitarian Aid Operations (ECHO). In particular, it follows the three previously published reports dedicated to the relevance of continuous, accurate and well established collection of disaster damage and loss data, and takes account of the most recent policy developments in the field. In this fourth report the emphasis has been put on strengthening the link across a number of policies, both at the European Union level and at the global level, aiming to improve the resilience of societies. These policies share a common need for reliable disaster loss data, in order to secure a more coherent, coordinated and hence effective implementation.

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Authors

Montserrat Marín Ferrer

Afonso Do Ó

Karmen Poljanšek

Ainara Casajus Vallés

Executive summary

This report follows the work carried out over the last few years by the European Commission Joint Research Centre (JRC) and, since 2015, by its Disaster Risk Management Knowledge Centre (DRMKC), in collaboration with DG European Civil Protection and Humanitarian Aid Operations (ECHO). In particular, it follows the three previously published reports dedicated to the relevance of continuous, accurate and well established collection of disaster damage and loss data, and takes account of the most recent policy developments in the field. In this fourth report the emphasis has been put on strengthening the link across a number of policies, both at the European Union level and at the global level, aiming to improve the resilience of societies. These policies share a common need for reliable disaster loss data, in order to secure a more coherent, coordinated and hence effective implementation.

Policy context

EU Member States and associated countries are required, within the framework of Decision No 1313/2013/EU of the European Parliament and of the Council on a Union Civil Protection Mechanism (UCPM) ([1]), to prepare regular national risk assessments (NRAs) and accordingly to assess their risk management capabilities, while preparing the resulting risk management plans. The preparation of evidence-based NRAs requires a sound collection of disaster damage and loss data for a wide range of events of different natures. Similarly, other EU and global policies require different indicators to assess the risk of forthcoming events, to monitor the efficiency and the results obtained so far with the measures undertaken and to consolidate a holistic, solid, evidence-based framework for resilience.

This common need calls for a more structured, harmonised, effective and coordinated collection of disaster damage and loss data, together with the corresponding aggregated reporting procedures.

At the global level, the need for data and the consequent need for science to analyse it, in an attempt to anticipate future evolutions, has evolved significantly over the last several years, namely through the establishment of the Sendai Framework for Disaster Risk Reduction (SFDRR) ([2]), the approval of the Agenda 2030 sustainable development goals (SDGs) ([3]) and the entry into force of the Paris Agreement on Climate Change ([4]).

This report is a first attempt to map the requirements in terms of data necessary to provide rigorous evidence for some of the most relevant global policy frameworks, together with some of the main EU policies aiming to enhance resilience. The final scope is to collect data only once, but serving multiple policies. This process would by itself lead to improved coherence in implementing the different policies linked to the same original data.

Key conclusions

The analysis of the EU and global policies most relevant to (and dependent on) loss data shows wide variation in terms of indicators, metadata and methodologies proposed, each one having a different level of detail. Following the recommendations in the previous JRC reports — standardised procedures for both loss data collection and reporting — the idea of having a single and unified disaster loss database could greatly respond to EU Member States' requirements on a wide array of policies, at both the EU and the global level.

More importantly, using already-existing statistical information on exposed people, assets and activities, and through a thorough and accurate process of recording disaster losses,

([1]) http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1401179579415&uri=CELEX:32013D1313
([2]) http://www.unisdr.org/we/coordinate/sendai-framework
([3]) https://sustainabledevelopment.un.org/?menu=1300
([4]) http://unfccc.int/paris_agreement/items/9485.php

Member States have the possibility to build up their own national disaster loss databases, tailored to their specific needs and requirements. While allowing for much more efficient disaster risk management (DRM), these databases will also deliver any requirements arising from EU policies and international agreements.

Main findings

The minimum common requirements for loss data set out in previous JRC reports ensure compliance with the reviewed global policies and agreements. At the EU level, more specific and tailored requirements are needed to respond to the wide array of policies using and depending on loss data in order to determine disaster loss accounting and compensation, assist disaster forensics and feed risk modelling.

Although the timings for loss data collection and reporting are necessarily different, one mechanism feeds the other, and both should be consistent in terms of methodologies, metadata and procedures, and also in terms of the roles and mandates of relevant stakeholders and institutions, for specific scales and scopes of action. On these grounds, it may well justify the development and implementation of cross-policy guidance for the harmonised collection of disaster and damage loss data analysis, as a key tool to support EU efforts to improve DRM and increase resilience across the territory of the European Union.

Related and future JRC work

Indirect impacts, which often exceed direct ones, need to be approached as quantitatively as possible, either by using indirect indicators, by taking cascade effects into consideration, by conducting quantifying surveys or by other methods, as long as a certain degree of error and uncertainty is taken in consideration and explicitly reported.

New approaches are needed that include other sectoral needs for loss data, such as the insurance schemes conducted by both private companies and public arrangements, which need data to assess damage and calculate liabilities, or the standard Eurocodes for rebuilding (structural design), which require data for assessing the vulnerability of built assets.

Finally, scientists ought to be consulted in order to confirm what specific data are needed to feed each economic or risk model, either as input data or for the validation of outputs. Collection methods, the embedded level of uncertainty and the geographic level of disaggregation are all aspects to be taken in consideration.

This bridging effort, linking scientific and policy requirements with actors, is at the heart of the DRMKC's mission, and will be the focus of future research and developments in this field. This would greatly contribute to another major step envisaged in the near future, which will be to connect different national sectoral databases to allow common national collecting and reporting mechanisms, serving Member States at first, but also EU and global policy requirements.

1. Introduction

The DRMKC has been working intensively on disaster and damage loss data since its launch in 2015, building upon the work conducted previously at the JRC, namely through the three previously published Science and Policy Reports:

— *Recording disaster losses — Recommendations for a European approach* (De Groeve et al., 2013) provided technical requirements for standardising loss data recording and databases within the EU, defining a conceptual framework for the utility of loss data that considered loss accounting, disaster forensics and risk modelling to be key applications;

— *Current status and best practices for disaster loss data recording in EU Member States* (De Groeve et al., 2014) reviewed, compared and presented the current state of play in the Member States, identifying the common basis in methodology and technical specifications of collecting and recording losses;

— *Guidance for recording and sharing disaster damage and loss data* (JRC, 2015) proposed an assessment methodology that could be adapted to the needs of each Member State, based on a minimum set of loss indicators that should be part of any operational disaster loss database and on simplified aggregated figures following a common data exchange format, thus allowing Member States to share and communicate loss data in a structured and shared way.

Based on the findings and recommendations of these reports, Member States could respond, using a single structured data-collection and processing system, to the various risk-related EU directives and policies, to the global disaster risk reduction (DRR) targets (particularly as defined by the SFDRR — UN, 2015a) and to the EU's commitments to the post-2015 SDGs (UN, 2015b).

Nevertheless, the current practice in disaster loss data recording across the EU shows that there are hardly any comparable disaster damage and loss databases (JRC, 2015). Differences exist in the methods of data recording and in the governance approaches to managing disaster damage and loss data. The lack of standards for damage and loss data collection and recording represents a key challenge for damage and loss data sharing and comparison, especially for cross-border cooperation within the EU. Furthermore, there is a clear need for improved articulation between the EU level, that of policy integration, cooperation and subsidiarity; the national level, with its governmental and non-governmental stakeholders; and the local level, where citizens and local authorities and stakeholders suffer and respond to losses while playing a critical role in data collection, recording and reporting.

This fourth JRC Science for Policy Report on loss data will focus particularly on the different requirements of disaster-related international policies and agreements and on how the JRC's proposed minimum requirements can deliver results to all from a single database structure. This reporting mechanism, together with a systematic mechanism for collecting and recording loss data — with a legal background and mandated institutions — right after disasters occur, would contribute greatly to improving disaster resilience across the territory of the EU.

2. Scope and objectives

The JRC Science and Policy Report "*Guidance for recording and sharing disaster damage and loss data* (JRC, 2015) synthesised the minimum set of loss indicators that should be part of any operational disaster loss database. This work was conducted with the main goal of allowing EU Member States and all stakeholders involved in DRM to share and communicate loss data in a structured and common data-exchange format.

This kind of common framework could bring significant value and advantages to systematic reporting by Member States relating to risk-related EU directives and policies, while delivering on indicators for global DRR targets, particularly under the SFDRR (UN, 2015a) and under EU and Member States' commitment to the post-2015 SDGs (UN, 2015b).

Under the SFDRR, which coordinates global efforts to compile loss data, the United Nations Office for Disaster Risk Reduction (UNISDR) recently published (in December 2017) a document for consultation called *Technical guidance for monitoring and reporting on progress in achieving the global targets of the Sendai Framework for Disaster Risk Reduction* (UNISDR, 2017). This document was delivered to support the *Report of the open-ended intergovernmental expert working group on indicators and terminology related to disaster risk reduction*, adopted by the United Nations General Assembly in February 2017 (UN, 2017). It provides technical suggestions and considerations related to applicable definitions and terminology, possible computation methodologies, data standards and critical issues.

Taking into account this new and globally relevant information, in the present report the DRMKC delivers an overview of the most significant policies for the European and global framework for DRM, with a particular focus on the indicators proposed in previous JRC Science and Policy reports (De Groeve et al., 2013, 2014; JRC, 2015) and on the SFDRR technical guidance (UNISDR, 2017). Based on this review of the different EU and global policies most relevant to DRR, the opportunity for a single collection and reporting structure is analysed and explored in order to:

- respond systematically and consistently to the requirements of multiple EU and global policies;
- guarantee the interoperability and comparison of databases and data sets;
- facilitate the exchange and sharing of data between Member States.

3. Policy review

The establishment of national loss databases, when existent, is often a response to specific disasters or to the disaster management needs of each country. Besides their scope, such databases also vary in terms of institutional endorsement and legal context, and do not always fit in with relevant DRR policies and frameworks, either within Member States or at the EU level.

Based on EU enquiries (De Groeve et al., 2014), only six Member States have binding legislation on the establishment of national databases or the collection of damage and loss data from disasters (Belgium, Bulgaria, Spain, Austria, Romania, Slovenia and Sweden). However, this does not guarantee the development of a loss database or the resources needed for its operation and maintenance. Similarly, it does not cover the establishment of standards or guidelines for loss data recording.

In fact, legislation is not a compulsory requirement in order for a Member State to establish a loss database. There is simply a need for sustained engagement at country level in order to institutionalise the collection and recording of loss data following a common and agreed methodology. Additionally, mechanisms for public investment should be put in place to ensure the maintenance of loss databases.

The overview of the current practices in recording disaster loss data in EU Member States provided in De Groeve et al. (2014) shows that the methodologies implemented in each are rather fragmented and sectoral. Making the available databases compatible with requirements for sharing data, both between Member States and with international organisations, would require adjustments to both the recording process and the processing of data. Loss-recording practices also would need to be strengthened to make the data useful at the national level beyond narrowly defined objectives, such as for prevention policy and risk assessment.

The lack of a common framework for disaster loss data recording within the EU is not new. In the last decade several research projects, dedicated studies and EU initiatives have attempted to portray the loss data recording profiles of EU Member States (De Groeve et al. 2014). Furthermore, many initiatives have proposed and built their own database structure, according to the hazard-specific or particular purpose to be served, at both the national and EU levels.

Despite these multiple efforts, methodologies for disaster loss data collection and recording in the EU are heterogeneous, available loss databases vary in their level of completeness and detail, and IT systems vary in their purpose, complexity and openness. The combination of these factors precludes the reliable and representative aggregation of loss data at the EU level.

The European Commission's DRMKC has been working actively in support of the UCPM, which is paving the way for more resilient communities by including key actions related to disaster prevention, such as developing NRAs and refining risk management planning. The JRC has developed a broad set of project tools and initiatives to ensure minimum standards for a systematic, robust and harmonised data collection process, allowing for comparison and improved knowledge sharing between Member States, more effective cooperation (particularly for cross-border disasters) and better policy building.

There are global policy frameworks and international agreements related to DRR, which set the context for recording and sharing loss data. The SFDRR is the most relevant and detailed, and therefore its technical proposals for delivering the indicator results are hereafter analysed and reviewed in detail.

Subsequently, a set of EU and global policies that are considered most relevant, following the generic review described in Section 1.3 of De Groeve et al. (2014), is reviewed in the light of the proposed databases, indicators, metadata and recording methodologies.

3.1. The Sendai Framework for Disaster Risk Reduction

The Open-ended Intergovernmental Expert Working Group (OIEWG) developed and proposed a set of 38 indicators in relation to the four priorities and seven global targets agreed to measure global progress in the implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030 (UNISDR, 2017). These priorities and targets should guide the actions and reporting of UN member states, due in 2019 and biannually thereafter.

Although all of these indicators are quantitative, the differences are quite significant, ranging from the number of people affected (eight indicators from targets A and B), the estimated economic losses (six from target C) and the number of affected facilities and services (eight from target D) to the number of initiatives, countries, reports or processes relating to targets E, F and G (16, although G-3 and G-6 refer to population coverage, as a percentage).

Annex 1 shows the list of indicators approved by the UN General Assembly on 2 February 2017 (UN, 2017), which are subject to an open consultation process until the end of 2017.

The indicators will measure progress in achieving the global targets of the SFDRR, and some will monitor global trends in risk and loss reduction. These metrics, together with indicators that can be employed by countries to measure nationally determined targets, should allow an appraisal of the impact actions of stakeholders to achieve the outcomes, goals and targets of the SFDRR. Nevertheless, by allowing countries to determine their own targets nationally, comparison will be restricted and should take the different goals carefully into consideration.

The UNISDR report (December 2017) *Technical guidance for monitoring and reporting on progress in achieving the global targets of the Sendai Framework for Disaster Risk Reduction* proposes specific minimum data requirements and metadata for each indicator, e.g. for targets A (number of deaths and missing persons) and B (number of affected people), disaggregation of the affected population by hazard, geography, sex, age, disability and income is recommended. Furthermore, data collection, sources and metadata are considered in detail, along with the identification of limitations and challenges (e.g. double counting, proxy indicators, etc.).

3.1.1. Targets A to D

Starting with global **target A**, on Sendai indicators A-2 (dead people) and A-3 (missing people; A-1 is a composite indicator), UNISDR (2017) recommends disaggregation of the people recorded dead/missing by hazard, geography, sex, age, disability and income, thus following the minimum requirements proposed by the JRC (2015) and specifying some of the features defined there. Other features were overlooked for the sake of feasibility, such as marital status, education and employment, but most high risk categories (children under 5, disabled, aged) are covered by Sendai's proposed disaggregation.

Collecting data on the sex, age, disability and income of affected people is not straightforward, and is likely to depend on a robust and direct post-disaster field survey. Some key challenges relate to the attribution of impact to a single event or the extent of direct cause, and the cut-off date for attributing losses to an event (quite different challenges are posed by sudden- and slow-onset events).

The proposed indicators under **target B** are more complex, and combine people affected in terms of their health (B-2), their dwellings (B-3 and B-4) and their livelihoods (B-5), with different data requirements and considerations for each.

Indicator B-2 follows the same approach as indicators A-2 and A-3, while indicators B-3 and B-4 consider hazard and geography as minimum disaggregation requirements, but propose an additional field (number of destroyed/damaged dwellings/houses) as a means

to indirectly calculate the number of affected people (if an average number of people per household is available), whenever *in situ* measurements are not possible. This proxy indicator is not very useful for EU Member States due to existing safety and security regulations. The EU is likely to have more people affected in terms of their health conditions and/or their livelihoods (depending of course on the type of disaster) than in terms of their dwellings, among other reasons because of compulsory insurance schemes in place across the territory of the EU.

Indicator B-5 is even more complex, and therefore UNISDR suggests that if *in situ* measurements are not possible it may calculate the indicator based on several target C indicators, namely:

- number of hectares of crops damaged or destroyed by disaster (C-2a),
- number of livestock lost in disaster (C-2b),
- number of productive assets/facilities damaged or destroyed by disaster (C-3a)

The proposed data will be used to calculate the number of workers affected, which poses serious challenges and great uncertainty (as the proxies are not efficient based on average numbers, and require data per facility/company/property).

In the EU it is unlikely that such a proxy would be useful, given the existing records and remote detection technologies readily available to deliver reliable data on affected enterprises, be they agricultural, industrial, commercial or other services facilities, whenever jobs are lost or sources of income are affected.

Overall, target B indicators must be handled carefully to avoid double counting and ensure that affected people are classified into mutually exclusive fields that can be aggregated to a total number of people in need (De Groeve et al 2014, p. 71).

Moving on to **target C**, all indicators relate to direct economic losses, aggregated in different key sectors: agriculture (C-2), other productive assets (C-3), housing (C-4), critical infrastructure (C-5) and cultural heritage (C-6). The proposed computation methodologies (and minimum input data requirements) vary, and imply quite a detailed level of data collection and availability.

Indicator C-2 (direct agricultural loss) includes crops, livestock, forestry, aquaculture and fisheries, and is subdivided into production and asset losses. The former relates to changes in economic flows, both inputs (e.g. stored merchandise) and outputs (e.g. decline in sales), and the latter to the cost of replacement and/or recovery of affected facilities, equipment and related infrastructure. This requires quite a detailed and complex economic valuation of losses (including partial damages), which is not always available, and even when it is possible is often based on average values (damage percentage, value per productive unit, etc.) that tend to substantially reduce accuracy.

For the territory of the EU, large asset losses are easily estimated by remote-sensing techniques (e.g. satellite imagery), but finer items will require field survey (equipment, animals, etc.). For production losses, long-run statistics may be needed to infer indirect losses related to business disruption, reduction of monetary flows and/or loss of future use.

Because of the complexity of direct economic valuation, a set of proxy subindicators is proposed: number of hectares, number of head of livestock, etc. Nevertheless, as in indicator B-5 (affected livelihoods), this will greatly increase uncertainty. On the other hand, the recommended data disaggregation should not pose serious obstacles to reporting countries: basically, by hazard, geography, totally destroyed/partially damaged and type of classified sector affected (which crop, which livestock, which asset, etc.). Besides ensuring a basic metadata structure, this disaggregation is also crucial for avoiding duplicated records in other indicators.

The UNISDR-proposed indicators under target C aim at direct economic losses only, but even its metadata accommodate some indirect losses (such as sales decline). As some of

the major economic impacts are indirect but closely connected to the direct ones, it is recommended that EU Member States conduct a collection of indirect loss data, based on long-run statistical analysis of economic flows.

Indicators C-3, C-4 and C-5 all include a similar disaggregation level and minimum data requirements, but propose proxy quantification of damages by defining classes of facilities and/or assets (by size, by economic value of construction area, by the equipment–infrastructure percentage ratio), allowing for indirect economic loss estimates. Furthermore, in order to facilitate country reporting, UNISDR proposes an optional choice of methodology (from four proposed approaches) so that each country can determine direct economic losses to assets. These optional approaches range from a minimum 'affected asset reporting', based only on the number and type of impacted assets and on an estimated affected ratio, to a full 'individual asset reporting', based on a case-by-case estimate of reconstruction/repair costs.

This optional recording of asset losses, together with the indirect and complex estimates of production losses, contributes greatly to a high degree of uncertainty and variability in data accuracy, and reduces data comparability and aggregation feasibility. Two error interval procedures are proposed in order to represent at least part of the variability in the outcome measurements: a min/max interval (to be used in parallel with average values); and a confidence interval per level of geophysical stressor, based on clusters of probability. Given the high level of uncertainty associated with overall economic loss estimates, these error procedures are strongly recommended for EU Member States. Furthermore, full individual asset reporting is to be sought whenever possible, using both field survey and remote-sensing techniques, and avoiding the use of proxies and class-based quantification to a minimum.

Indicator C-6 (on cultural heritage) is quite specific, and therefore the minimum requirement data is also very specific, quantifying what is possible (number of affected buildings/monuments, number of affected movable assets such as artworks, cost of rehabilitation/reconstruction of such assets, cost of acquisition) and assuming that the greatest losses may be subjective and unmeasurable.

Still, in the context of the EU (as in many other parts of the world), cultural heritage assets are of significant economic importance in relation to tourism and dependent services, and in some local contexts are crucial for the livelihoods of a significant part of the population and for the sustainability of the community as a whole. This requires Member States to implement indirect economic loss procedures to collect relevant data, mainly in statistical form.

On **target D** (critical infrastructure and basic services), eight specific indicators were approved, in two groups of four (one for destroyed/damaged facilities, another for disrupted services): a compound indicator (D-1/D-5), health facilities/services (D-2/D-6), educational facilities/services (D-3/D-7) and other critical infrastructure (D-4/D-8).

For the facilities group of indicators (D-1 to D-4), a set of minimum data requirements and disaggregation is proposed that is similar to that for indicator C-5. In fact, there is quite a lot of overlap between the two that is not adequately addressed in the UNISDR (2017) report. A recommendation is provided (p. 83) for the Secretariat (of the SFDRR) to 'define an additional set of codes that may correspond to types of assets that are not productive … such as roads, bridges, railroads, ports, airports, power generation facilities, water facilities, etc.' Although this attempt to separate productive and non-productive assets aims to clarify the classification of assets under targets C or D, this has proved quite difficult to actually determine, as most of these facilities have an indirectly productive component with a great deal of influence.

Furthermore, the 'other critical infrastructure' in indicators D-4 and D-8 is rather vague, and does not translate into the framework the importance of such critical infrastructure to societies (particularly for developed countries), and to disaster response itself (namely transportation networks, telecommunications, energy grids, water supplies, etc.).

Nevertheless, the proposed methodology is useful to assess both direct physical damage and indirect losses to critical infrastructure. Following a similar approach for the direct collection of indirect losses as proposed above for target C, further detailed in terms of critical infrastructure classification and addressing the external economic implications of their disruption, should prove sufficient to cover the most significant impacts of damage to these crucial facilities

The reference under indicators D-6 to D-8 that disrupted services refer to a partial or total interruption, a degradation of the quality level and/or a reduction in service coverage also proves relevant. Furthermore, an exhaustive list is provided in order to classify the 'other services' under indicator D-8, and it is highly recommended that EU Member States follow this list in order to allow for proper impact assessment, data comparison and aggregation.

3.1.2. Targets E to G

Concerning global targets E, F and G, these follow the structure of the indicators proposed under the previous Hyogo Framework for Disaster Reduction (2005-2015), and are particularly related to the self-assessment of countries regarding their progress on governance and risk management. Although these targets lack an objective quantitative dimension, several strategies, policies and actions taken at different levels of governance contribute directly to these indicators and to the assessment of progress and performance. Furthermore, the technical considerations and suggestions (as well as the limitations and specific issues highlighted) are quite relevant and should be taken into consideration for a minimum DRR approach and use of loss data.

Specifically on **target E**, the OIEWG proposes two indicators, one at the national level and the other at the local level. E-1 refers to the number of countries adopting and implementing national DRR strategies in line with the SFDRR. A set of 10 core requirements and four benchmark levels (from little to full achievement) is proposed for countries to self-assess their performance. While the methodology is clear and simple, the self-assessment forcibly biases the results. At the EU level, shared independent assessment should be put in place that allows for joint reporting and more reliable comparison, and accounts for accomplishing other risk-related policies accomplishment.

Indicator E-2 covers the proportion of local governments that adopt and implement DRR strategies in line with the national strategies covered in E-1. Although the methodology is not detailed and requires further deliberation, this is a critical element for countries that wish to pursue an effective DRR strategy based on an accurate loss data process. It is at the local level that national strategies become operative, defining the responsibilities of actors at different stages of the disaster management cycle. Furthermore, it is at the local level that the appropriate collection of sectoral and asset-specific data may allow for adequate modelling and processing, delivering key results for both loss data reporting and for DRR policy building.

Target F covers international cooperation with developing countries and includes a set of eight indicators: one composite indicator (F-1); six specific indicators on the number of different types of actions, programmes and initiatives classified as official development assistance and other official flows (F-2 to F-7); and a final indicator (F-8) on the number of developing countries supported by such initiatives to strengthen their DRR-related statistical capacity.

The minimum disaggregation suggested is the identification of the donor and of the recipient, while other desirable requirements include the type of finance and the type of support. Monetary values are not included, upon recognition of the difficulties to capture integrated DRR budgets and flows across multiple and inter-sectoral aid tools.

As one of the world's largest donors, the EU has privileged access to dedicated budgets for DRR assistance and to DRR budgetary components in cross-sectoral or lateral programmes and initiatives. With the support of other global organisations collecting data on developing countries assistance (Organisation for Economic Cooperation and

Development, World Bank, International Monetary Fund, etc.), a monetary estimate may be provided by EU Member States and reported within the framework of Sendai reporting.

Finally, on **target G**, six indicators are proposed to tackle the availability of and access to multi-hazard early warning systems and disaster risk information and assessments. G-1 is a compound indicator of the following four (G-2 to G-5), which cover the following key elements:

— number of countries with multi-hazard early warning systems (G-2, focused on monitoring and forecasting);

— proportion of people covered by early warning information through local governments or through national dissemination mechanisms (G-3, focused on communication);

— proportion of local governments that have a plan to act on early warnings (G-4, focused on preparedness);

— number of countries with relevant disaster risk information and assessments available at the national and local levels (G-5, focused on knowledge and assessment).

A sixth specific indicator is proposed (G-6) on the percentage of the population exposed to disasters who are protected through pre-emptive evacuation following an early warning.

The OIEWG proposal recognises the subjective nature of the proposed indicators (as for targets E and F), and therefore aims to balance precision and practicality through a method of weighted hazard types and levels of achievement (as for indicator E-1).

These methodologies were derived from UN-related work and participative forums, and focus particularly on assessing the progress and achievements of reporting countries in relation to the global targets. As the proposed metadata are even more prone to subjectivity, it does not facilitate comparison between different countries. Consistency of information and double counting are quite relevant issues in this set of indicators, and should be appropriately acknowledged. For instance, there is clear scope for overlapping with target E indicators.

At the EU level, existing (and most common) single-hazard early warning systems should be added and checked on a cumulative basis, in parallel to any pertinent multi-hazard approaches, as the former are needed to lay the grounds for the latter.

The overall policy coverage enabled by the UCPM has significant synergies with these proposed Sendai indicators, and could contribute to defining more accurate metadata, closely linked to the different parts of the DRM cycle.

Generally, the OIEWG report stresses the need to support UN member states in ensuring reliable and comparable data sets, for example through: (i) minimum standards and metadata for disaster-related data, statistics and analysis; (ii) methodologies for the measurement of indicators and the processing of statistical data; (iii) technical support for member states to conduct a review of data readiness with respect to the indicators; (iv) technical-guidance material for the testing and rolling out of the indicators and the web-based monitoring system (Section 20 of the global indicators endorsement report — UN, 2017).

Furthermore, it underlines the need for countries to fix metadata and data collection methods and procedures throughout the entire time span of the SFDRR reporting (2015-2030) so as not to affect the detection of trends and patterns in achieving the targets.

This approach is pertinent to allowing for an overview of trends and achievements throughout the world, but it is important to remember that comparability remains very limited as long as there are different metadata, methods and processes for data collection and processing. Furthermore, countries should also remember that while this global methodology allows for national reporting at the global level, the identification of

national priorities, needs and actions for reducing disaster risks requires regional and local data to be collected.

A final note on the EU action plan on the Sendai Framework for Disaster Risk Reduction (European Commission, 2016b), which includes a strong focus on climate-change adaptation, linking it to DRR and fostering strengthened coherence between climate-change adaptation strategies and risk management plans at the national level in the EU.

3.2. Sustainable development goals/Agenda 2030

The Inter-Agency and Expert Group on Sustainable Development Goal Indicators proposed the use of the SFDRR indicators recommended by the OIEWG to measure specific global targets of SDGs 1 (End poverty in all its forms everywhere), 11 (Make cities and human settlements inclusive, safe, resilient and sustainable) and 13 (Take urgent action to combat climate change and its impacts), within the global indicator framework for the goals and targets of the 2030 Agenda for Sustainable Development. This will provide for simultaneous and coherent monitoring and reporting on both the SFDRR and the SDGs.

Annex 2 shows the relationship between SDG and SFDRR indicators. A quick look at the table shows that the SDGs broadly make use of the compound Sendai indicators on dead, missing and affected people (A-1 and B-1), direct economic losses (C-1), damage to critical infrastructure and disrupted services (D-1 and D-5) and the governance indicators at the national (E-1) and local (E-2) levels.

As for Sendai, the basic structure for disaster damage and loss data collection proposed by the European Commission (JRC, 2015) could fit and deliver the indicators required for Member States to monitor and target the SDGs.

There are a number of relevant EU actions related to the implementation of these SDGs, both externally through fostering the sustainable economic, social and environmental development of developing countries, and internally by supporting and complementing the Member States' policies. These should be taken into account whenever Member States and the EU assess the effectiveness and performance of their risk management policies and capabilities, as its contribution to DRR in the EU has proven quite significant. An analysis of the main contributing EU policies and tools is presented in Section 3.4 below.

3.3. UNFCCC-COP22 (Paris Agreement)

Parties to the United Nations Framework Convention on Climate Change (UNFCCC) must submit annual national reports on the implementation of the convention to the Conference of the Parties. The required contents of national reports and the timetable for their submission are different for Annex I and non-Annex I parties, in accordance with the principle of 'common but differentiated responsibilities' enshrined in the convention. Annex I parties (which includes EU Member States) are required to report vulnerability assessments, but not reporting specifically to related disaster events and not requiring loss data recording.

The EU strategy on adaptation to climate change (European Commission, 2013a) provides a framework and mechanisms to improve the preparedness of the EU for current and future climate-change impacts, thus contributing to a more climate-resilient society. It is structured around three strategic objectives: promoting action by Member States; better-informed decision-making; and 'climate-proofing' EU action by mainstreaming adaptation measures into EU policies and programmes and promoting adaptation in key vulnerable sectors.

It comprises a set of documents and guidelines, one of which, the Green Paper on the insurance of natural and man-made disasters (2013), is particularly relevant for DRR. This document addresses some critical issues related to impact and loss data collection and suggests some relevant approaches, namely the use of spatial- and time-dynamic

scenarios; the development of multi-hazard risk scenarios; the application of probabilistic methods to generate coherent probabilistic risk scenarios; and the use of an agent-based approach that explicitly quantifies the risk exposure of the various parties to a risk-sharing transaction (e.g. insurers, reinsurers, bond holders, governments, householders and businesses).

Although it does not benefit directly from a shared loss database structure, the UNFCCC would greatly benefit from a shared, common database and indicator structure, allowing the assessment of the time and space distribution of extreme-event-related losses and a closer correlation with the impacts of climate change.

Furthermore, the relevance of the EU's policies and instruments related to climate-change adaptation (as described above under the EU's contribution to achieving SDG 13) needs to be highlighted, as it contributes significantly to climate-change mitigation and adaptation, and thus to DRR.

3.4. EU policies and directives

Enforced EU policies related to natural, technological and man-made disasters are in most cases sectoral and have a specific focus. References and requirements related to loss data collection and reporting are often at a general level in relation to policy monitoring or assessment aspects. Still, it is critical to ensure the transparency, credibility and validity of results; to measure the achievement of targets; to account for losses and understand their causes; and to justify recovery efforts.

A brief (non-exhaustive) overview of the most relevant EU policies currently in place is presented hereafter. It shows how this diversified set of policies (and others) would greatly benefit from a systematic approach and methodology on loss data collection and reporting, along with procedures being harmonised and the compatibility of data sets ensured. Furthermore, it highlights the need for increased and more efficient networking among all stakeholders involved.

3.4.1. Union Civil Protection Mechanism national risk assessments

At the EU level, the UCPM is the key legal instrument covering DRR, and thus orients decisions at both EU and national levels. Under this framework, Member States are obliged to report on both their NRAs and mapping (European Commission, 2010a) and on their risk management capability assessments (European Commission, 2015b). The former is due in December 2018 and the latter in August 2018, and each is then due every 3 years thereafter.

The risk assessment and mapping guidelines for disaster management indicate the following three categories of impacts for which loss data should be collected (European Commission, 2010a, p.17).

- Human impacts (number of affected people): the number of deaths; the number of severely injured or ill people; the number of permanently displaced people.
- Economic and environmental impacts: the cost of cure or healthcare; the cost of immediate or longer-term emergency measures; the cost of restoration of buildings, public transport systems and infrastructure, property, cultural heritage, etc.; the cost of environmental restoration and other environmental costs (or environmental damage); the cost of disruption of economic activity; the cost of insurance payouts; indirect costs to the economy; indirect social costs; other direct and indirect costs as may be relevant.
- Political/social impacts: these are usually rated on a semi-quantitative scale and may include categories such as public outrage and anxiety; encroachment of the territory; infringement of the international position; violation of the democratic system; socio-psychological impacts; impact on public order and safety; political implications; psychological implications; damage to cultural assets; other factors considered

important that cannot be measured in single units, such as certain forms of environmental damage.

Furthermore, these guidelines highlight critical issues of data quality, comparability, recording and reporting methods. They propose several quantification methods (such as risk matrices) for qualitative and/or indirect impact data that rely largely on estimates or may be biased by perception.

Risk management capability assessments are intended to assist Member States in the self-assessment of their risk management capability, based on a survey-type structure with 51 relevant questions. One of these (question 15) explicitly asks Member States to 'describe what sources of information and data are used and whether databases exist to carry out risk assessments' (p. 10).

Although they have been envisaged, so far no specific indicators or metrics have been approved by the European Commission, although significant efforts are being made to do so. Overall, the UCPM policy framework ensures that a common set of principles is shared and agreed upon, namely the multi-hazard approach (including natural and man-made disasters); the subsidiary principle that ensures resources and capabilities are shared among Member States; the participatory approach and the involvement of non-governmental actors; and the full coverage of the DRM cycle.

The DRMKC has been working to assist Member States in delivering exchangeable and reliable loss databases and recording procedures. These databases are the main input into complex multi-variable models that enable evidence-based risk assessment, and from there are the grounds for risk management policies and actions. Simultaneously, data collection that feeds the models provides the local and multi-sector input needed for the consistent implementation of DRR actions and activities.

Minimum baseline requirements are being proposed and discussed within the EU Loss Data Expert Group in order to allow Member States to build reliable loss databases while ensuring the fulfilment of their EU and international commitments. The common baseline loss data requirements proposed by the JRC (2015), and partially endorsed by UNISDR (2017) guidelines, could well provide the main framework for NRAs and for a comparable and shared EU loss database framework.

3.4.2. EU Solidarity Fund requests

The EU Solidarity Fund provides emergency financial support to countries or regions affected by exceptional circumstances, such as major disasters, with different thresholds for regional, national and cross-border events.

To apply for the Solidarity Fund (EU, 2014) Member States have to deliver quantified economic loss data on 'Physical damage' and 'Intervention costs' (row 17 of the application form table):

- network infrastructure (water/waste water, transport, bridges, energy, telecom, etc.),
- public assets (airports, ports, hospitals, schools, etc.),
- businesses (commercial and industrial activities),
- agriculture,
- forestry,
- residential (private homes and assets),
- cultural heritage,
- cleaning up,
- cost of emergency operations/rescue services,
- provisional accommodation,

- others (to be specified).

Among the intervention costs, countries are also asked to quantify the economic losses for (row 24):

- restoration to working order of infrastructure and plant (in the fields of energy, water/waste water, telecoms, transport, health, and education),
- securing of preventive infrastructure,
- measures of protection of cultural heritage,
- cleaning up of disaster-stricken area/natural zones,
- immediate restoration of affected natural zones to avoid immediate effects from soil erosion.

Based on the common baseline loss data requirements of JRC (2015) and UNISDR (2017) guidelines, countries could easily report on any major disaster requiring the assistance of the Solidarity Fund, simply adding economic data related to emergency response and recovery costs.

Such integrated databases, based on validated and harmonised risk assessment models and methods, could quickly provide early post-disaster estimates and speed up the response process when funds are needed and time is a crucial issue. Hence, the European Commission would ensure a facilitated procedure, based on fund-request methods validated and approved in 'normal' times.

3.4.3. The flood directive

The flood directive was approved in 2007 (European Commission, 2007a) and requires Member States to undertake a preliminary flood risk assessment. The first national reports were due in 2012, and reports are to be provided every 6 years thereafter (the next reports are due by December 2018).

In order to undertake flood-risk assessment Member States need to gather georeferenced information on people, assets and activities at risk — specifically the directive refers to impacts on human health, the environment, cultural heritage and economic activity. According to the guidelines for reporting, published in 2013 (European Commission, 2013b), Member States have to summarise the methods (including criteria) used to determine, for each flood scenario:

- the indicative number of inhabitants affected (Article 6(5)(a)),
- the type of economic activity affected (Article 6(5)(b)),
- the location of integrated pollution prevention and control installations (Article 6(5)(c)),
- the impact on water framework directive protected areas (Article 6(5)(c)).

These impact categories (described as 'types of consequences') are further detailed as follows.

(i) Human health

Human health: Adverse consequences to human health, either as immediate or consequential impacts, such as might arise from pollution or interruption of services related to water supply and treatment, and would include fatalities.

Community: Adverse consequences to the community, such as detrimental impacts on local governance and public administration, emergency response, education, health and social work facilities (such as hospitals).

(ii) Environment

Waterbody status: Adverse permanent or long-term consequences ecological or chemical status of surface waterbodies or chemical status of ground waterbodies affected, as of concern under the water framework directive. Such consequences may arise from pollution from various sources (point and diffuse) or due to hydromorphological impacts of flooding.

Protected areas: Adverse permanent or long-term consequences to protected areas or waterbodies, such as those designated under the birds and habitats directives, bathing waters or drinking water abstraction points.

Pollution sources: Sources of potential pollution in the event of a flood, such as integrated pollution prevention and control and Seveso installations, or point or diffuse sources.

(iii) Cultural heritage

Cultural assets: Adverse permanent or long-term consequences to cultural heritage, which could include archaeological sites/monuments, architectural sites, museums, spiritual sites and buildings.

Landscape: Adverse permanent or long-term consequences on cultural landscapes, that is cultural properties which represent the combined works of nature and man, such as relics of traditional landscapes, anchor locations or zones.

(iv) Economic activity

Property: Adverse consequences to property, which could include homes.

Infrastructure: Adverse consequences to infrastructural assets such as utilities, power generation, transport, storage and communication.

Rural land use: Adverse consequences to uses of the land, such as agricultural activity (livestock, arable and horticulture), forestry, mineral extraction and fishing.

Economic activity: Adverse consequences to sectors of economic activity, such as manufacturing, construction, retail, services and other sources of employment (types of economic activities may be further specified and listed in accordance with NACE codes).

As in previous policy cases described above, the availability of a common baseline loss database, as proposed in this document by the JRC (2015) and UNISDR (2017) guidelines, could greatly benefit and facilitate the reporting obligations of Member States and increase their efficiency in flood risk management.

3.4.4. The Seveso III directive

Single chemical accident releases involving dangerous substances in chemical installations, petrochemical and oil refineries continue to happen fairly frequently in Europe and demonstrate the need for better and more efficient control of major industrial hazards.

The Seveso directive (EU, 2012) aims at preventing such major accidents involving dangerous substances. However, as accidents may nevertheless occur, it also aims at limiting the consequences of such accidents not only for human health but also for the environment. It covers establishments where dangerous substances may be present (e.g. during processing or storage) in quantities exceeding a certain threshold.

In support of the Seveso III directive, the Major Accident Hazards Bureau of the European Commission's Joint Research Centre has developed two major database reporting systems, which are mandatory for EU Member States.

— eSPIRS (Seveso Plants Information Retrieval System), encompassing information on establishments that are considered to present major hazards due to the potential accident risk associated with the presence of dangerous substances, as defined by the Seveso III directive. The minimum information collected, in accordance with

Article 21(3) of this directive, includes the name or trade name of the operator, the full address of the establishment and the activity of the establishment.

— eMARS (Major Accident Reporting System), containing reports of chemical accidents and near misses provided by EU Member States (and adherent European Economic Area, Organisation for Economic Co-operation and Development and United Nations Economic Commission for Europe countries under the Convention on the Transboundary Effects of Industrial Accidents), whenever a Seveso establishment is involved and the event meets the criteria of a 'major accident', as defined by Annex VI to the Seveso III directive. The minimum information collected includes the date of the accident, the Seveso site classification, the industry type and any special circumstances (i.e. involvement of contractors or domino effects, Natech - natural-hazard triggered technological accidents – events, or transboundary impacts).

Furthermore, operators, competent authorities and Member States shall report on the circumstances of the accident, including the dangerous substances involved, along with the immediate effects on human health and the environment, the causes of and lessons learned from such accidents and the preventive measures taken to prevent a recurrence (Articles 16, 17, 18 and 21).

As such, it is critical to harmonise metadata and methodologies for loss data collection and reporting in order to incorporate impacts related to dangerous substances in the overall framework for risk management.

3.4.5. The European programme for critical infrastructure protection

The EU directive on critical infrastructure (European Commission, 2008) was mainly oriented to identify and designate European critical infrastructure (ECI) assets, mainly to protect these from terrorist attacks. In 2013 (European Commission, 2013c) this concept was broadened to protect ECI from other man-made and natural hazards. Although the envisaged connections with DRR activities at the EU level, in particular with the UCPM, are not evident (there are only a couple of minor references related to training and post-disaster recovery expertise), the directive classifies the major ECI into two major categories (energy and transport, disaggregated into more detailed subcategories), which ought to be taken in consideration for further activities on this field.

Nevertheless, mainly due to cascading effects following disasters and to its strategic relevance (both in terms of impact potential and of response capability), critical infrastructure is at the centre of Member States' concerns on post-disaster situations, and needs to be carefully integrated into loss data collecting and reporting efforts.

3.4.6. The Inspire directive

Inspire is an EU initiative to establish an infrastructure for spatial information in Europe geared towards making spatial or geographical information more accessible and interoperable for a wide range of purposes supporting sustainable development. The Inspire directive (European Commission, 2007b) lays down the general framework for a spatial data infrastructure for the purposes of EU environmental policies and policies or activities that may affect the environment. It is based on the infrastructure for spatial information established and operated by the Member States, addressing 34 spatial data themes needed for environmental applications.

To ensure that the spatial data infrastructure of Member States is compatible and usable in a community and transboundary context, the Inspire directive requires that additional legislation or common implementing rules be adopted for a number of specific areas (metadata, interoperability of spatial data sets and services, network services, data and service sharing, and monitoring and reporting).

Hence the significance of Inspire for loss data recording. Even if aggregate disaster damage and loss data are strictly speaking not spatial data sets, the database is spatial, and it is recommended that the natural risk zone specifications defined by Inspire be

adhered to and that its metadata requirements be complied with in order to ensure compatible and spatially representable databases.

3.4.7. Other EU policy tools

Other by the EU institutions and the Member States contribute significantly to the prevention and reduction of disaster risks. Besides the key policies analysed in the sections above, the following also deserve to be mentioned, not least for their contribution, more or less directly (as well as transversally), to the achievement of the abovementioned SDGs and of the SFDRR global targets, within the European Union (European Commission, 2016a).

- The **EU cohesion policy** and the Cohesion Fund (EU, 2013a), its main investment policy, the core mission of which is to achieve economic, social and territorial cohesion by reducing disparities between the levels of development of the various regions. For the 2014-2020 period it is providing about EUR 350 billion of investment in smart, sustainable and inclusive growth.
- The **Cohesion Fund** thematic objective dedicated to promoting social inclusion and combatting poverty and discrimination. It contributes to poverty reduction through its investments in housing, employment creation, the regeneration of deprived urban and rural areas, the modernisation of public services and many other areas.
- Addressing rural poverty, the **common agricultural policy** (European Commission, 2010b) aims inter alia at ensuring a decent standard of living for farmers and viable rural communities. Agriculture is a key vector for poverty reduction, in rural areas in particular.
- Similarly, the **common fisheries policy** (European Commission, 2013c) aims at achieving a fair standard of living for fishermen and fishing communities.
- The **European disability strategy** 2010-2020 (European Commission, 2010c) aims at supporting the implementation in the EU of the UN Convention on the Rights of Persons with Disabilities. One key issue is to reduce the current existing poverty-risk gap between those with disabilities and the rest of the population.
- The **European Solidarity Corps** (European Commission, 2017) enables young people across the EU to volunteer their help where it is needed most, for example related to activities addressing social challenges, such as social exclusion and poverty.
- In the 2014-2020 funding period more than EUR 100 billion from the **European Regional Development Fund** (EU, 2013d) will be invested in cities to create better opportunities for sustainable urban mobility, energy efficiency, urban renewal, research and innovation capacity and economic and social regeneration of deprived communities. Linked to this, the EU's urban agenda was adopted in 2016 and seeks to ensure that urban areas will benefit from an innovative collaborative approach to developing and implementing policies with a local focus but a significant European dimension.
- One of the horizontal priority objectives of the **seventh environment action programme** (EU, 2013e), the agreed framework for EU environment policy until 2020, is to make the EU's cities more sustainable. Many of the EU's policies and legislative instruments are vital for sustainable urban development, such as the clean air package, air quality and noise legislation, the circular economy package, legislation on the environmental assessment of projects and plans, the EU's biodiversity and green infrastructure strategies, drinking water and urban wastewater treatment legislation and the framework on the energy performance of buildings.
- Innovation in urban areas is fostered through EU research and innovation actions, for example **Horizon 2020** (EU, 2013f) support for the transition to sustainable cities through nature-based solutions and cultural heritage-led regeneration.

— The EU policy on smart cities, and more specifically the **European Innovation Partnership on Smart Cities and Communities** (European Commission, 2012), brings together cities, industry and citizens to improve urban life through more sustainable integrated solutions.

— The **Europe 2020 strategy** (European Commission, 2010d), and more specifically the headline targets to cut greenhouse gas emissions by 20 % compared to 1990 (or even 30 % if the conditions are right), to ensure 20 % energy is provided by renewable sources and to ensure a 20 % increase in energy efficiency.

— The **energy union** (European Commission, 2015a), which supports the shift towards a resource-efficient, low-carbon economy to achieve sustainable growth. A legislative framework is being put in place to support these policies. Most importantly, within its energy union the EU has set up a 2030 climate and energy policy framework that sets three key targets for the year 2030: a cut of at least 40 % in greenhouse gas emissions (compared to 1990 levels), a share of at least 27 % for renewable energy and an improvement of at least 27 % in energy efficiency.

— The **emissions trading system** (ETS; European Commission, 2003), the EU's key tool for cutting greenhouse gas emissions from large-scale facilities in the power and industry sectors, and in the aviation sector. The Commission has already made a proposal for a revision of the ETS for the period after 2020 to ensure the EU meets the 2030 greenhouse gas emission-reduction targets. National emission-reduction targets cover those sectors that are not in the ETS (such as building, agriculture, waste and transport, excluding aviation). The emission-reduction targets are set for the period up to 2020, and the Commission recently adopted a proposal for targets up to 2030, including how to integrate the land-use sector into the EU 2030 climate and energy framework. These proposals will ensure the EU is on track to reduce greenhouse gas emissions domestically by at least 40 % by 2030.

— The full implementation of the **circular economy package** (European Commission, 2015c) will direct resources and efforts in the direction of technologies and business models that will be more resource and energy efficient, thus contributing significantly to the mitigation of greenhouse gas emissions.

In a particular reference to climate-change mitigation, it is important to stress that binding energy efficiency and renewable energy measures are in place, supported by numerous sectoral policies that contribute to reducing emissions. These include regulations improving the efficiency of appliances and other tools, standards improving the CO_2 efficiency of cars and policies improving the energy performance of buildings, among other things. In order to respond to challenges and investment needs related to climate change, the EU aims to spend at least 20 % of its budget in the 2014-2020 period on climate-change-related actions. To achieve this increase climate actions have been integrated into all major EU spending programmes, in particular cohesion policy, energy, transport, research and innovation, agriculture and rural development.

4. Next steps and final remarks

As referred to early in Section 2, the response requirements of Member States in relation to the different EU policies allow countries to respond to other international agreements as well. The minimum requirements to allow effective sharing between different stakeholders (including the European Commission and Member States) were synthesised in the document *Guidance for recording and sharing disaster damage and loss data* (JRC, 2015; Tables 7 to 9).

The UNISDR-based OIEWG proposes a set of indicators, metadata and methodologies for the SFDRR that closely follow the EU report recommendations, with some simplifications (and, in some cases, in-depth developments) related to the global scale of the agreement, and the greater variability on loss data quality recording and processing among UN member states. This confirms that, for EU Member States, a single and unified disaster loss database may respond to a wide set of policy and agreement requirements, at both the EU and the global level.

More importantly, using already existing statistical information on exposed people, assets and activities, and through a shared, thorough and accurate process of recording and reporting disaster losses, Member States have the possibility of building up their own national disaster loss database, tailored to their specific needs and requirements, but transferable and comparable with other Member States by relying on a common set of basic indicators, metadata and methodologies. While allowing for much more efficient DRM, these databases will also easily deliver any requirements from EU policies and international agreements.

Similarly, indirect impacts, which often exceed direct ones, need to be approached as quantitatively as possible, either by using indirect indicators, by taking cascade effects into consideration, by conducting quantifying surveys or by other methods, as long as a certain degree of error and uncertainty are taken in consideration and explicitly reported.

New approaches are needed that include other sectoral needs for loss data, such as the insurance schemes conducted by both private companies and public schemes, which need data to assess damages and calculate liabilities, or the standard Eurocodes for rebuilding (structural design) which require data for assessing the vulnerability of built assets.

Finally, modellers ought to be consulted in order to confirm what specific data are required to feed each model, either as input data or for the validation of outputs. Collection methods, the embedded level of uncertainty and the geographic level of disaggregation are all aspects to be taken into consideration. This bridging effort, linking scientific and policy requirements and actors, is at the heart of the DRMKC's mission, and will be the focus of future research and developments in this field. This would greatly contribute to another major step envisaged for the near future, which will be to connect national databases to allow common collecting and reporting mechanisms (serving Member States at first, but also EU and global policy requirements), and building up a common EU repository, within the framework of global policies and initiatives.

As a final word, we should underline that although the timings for loss data collection (post-disaster) and reporting are necessarily different, one mechanism feeds the other, and both should be consistent in terms of methodologies, metadata and procedures, and also in terms of the roles and mandates of relevant stakeholders and institutions, for specific scales and scopes of action. On these grounds, shared efforts should be made to put in place a cross-policy EU process for collecting and reporting disaster and damage loss data, in order to support the EU's efforts to improve DRM and increase resilience across the territory of the European Union.

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Annexes

Annex 1. SFDRR global indicators

Global target A: Substantially reduce global disaster mortality by 2030, aiming to lower average per 100,000 global mortality between 2020-2030 compared with 2005-2015.	
A-1 (compound)	Number of deaths and missing persons attributed to disasters, per 100,000 population.
A-2	Number of deaths attributed to disasters, per 100,000 population.
A-3	Number of missing persons attributed to disasters, per 100,000 population.
	The scope of disaster in this and subsequent targets is defined in paragraph 15 of the Sendai Framework for Disaster Risk Reduction 2015-2030 and applies to small-scale and large-scale, frequent and infrequent, sudden and slow-onset disasters caused by natural or man-made hazards, as well as related environmental, technological and biological hazards and risk.

Global target B: Substantially reduce the number of affected people globally by 2030, aiming to lower the average global figure per 100,000 between 2020-2030 compared with 2005-2015.	
B-1 (compound)	Number of directly affected people attributed to disasters, per 100,000 population.
B-2	Number of injured or ill people attributed to disasters, per 100,000 population.
B-3	Number of people whose damaged dwellings were attributed to disasters.
B-4	Number of people whose destroyed dwellings were attributed to disasters.
B-5	Number of people whose livelihoods were disrupted or destroyed, attributed to disasters.

Global target C: Reduce direct disaster economic loss in relation to global gross domestic product (GDP) by 2030.	
C-1 (compound)	Direct economic loss attributed to disasters in relation to global gross domestic product.
C-2	Direct agricultural loss attributed to disasters. *Agriculture is understood to include the crops, livestock, fisheries, apiculture, aquaculture and forest sectors as well as associated facilities and infrastructure.*
C-3	Direct economic loss to all other damaged or destroyed productive assets attributed to disasters. *Productive assets would be disaggregated by economic sector, including services, according to standard international classifications. Countries would report against those economic sectors relevant to their economies. This would be described in the associated metadata.*
C-4	Direct economic loss in the housing sector attributed to disasters. *Data would be disaggregated according to damaged and destroyed dwellings.*
C-5	Direct economic loss resulting from damaged or destroyed critical infrastructure attributed to disasters. *The decision regarding those elements of critical infrastructure to be included in the calculation will be left to the Member States and described in the accompanying metadata. Protective infrastructure and green infrastructure should be included where relevant.*
C-6	Direct economic loss to cultural heritage damaged or destroyed attributed to disasters.

Global target D: Substantially reduce disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities, including through developing their resilience by 2030.	
D-1 (compound)	Damage to critical infrastructure attributed to disasters.
D-2	Number of destroyed or damaged health facilities attributed to disasters.
D-3	Number of destroyed or damaged educational facilities attributed to disasters.

D-4	Number of other destroyed or damaged critical infrastructure units and facilities attributed to disasters. *The decision regarding those elements of critical infrastructure to be included in the calculation will be left to the Member States and described in the accompanying metadata. Protective infrastructure and green infrastructure should be included where relevant.*
D-5 (compound)	Number of disruptions to basic services attributed to disasters.
D-6	Number of disruptions to educational services attributed to disasters.
D-7	Number of disruptions to health services attributed to disasters.
D-8	Number of disruptions to other basic services attributed to disasters. *The decision regarding those elements of basic services to be included in the calculation will be left to the Member States and described in the accompanying metadata.*

Global target E: Substantially increase the number of countries with national and local disaster risk reduction strategies by 2020.	
E-1	Number of countries that adopt and implement national disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015-2030.
E-2	Percentage of local governments that adopt and implement local disaster risk reduction strategies in line with national strategies. *Information should be provided on the appropriate levels of government below the national level with responsibility for disaster risk reduction.*

Global target F: Substantially enhance international cooperation to developing countries through adequate and sustainable support to complement their national actions for implementation of this framework by 2030.	
F-1	Total official international support, (official development assistance (ODA) plus other official flows), for national disaster risk reduction actions. *Reporting of the provision or receipt of international cooperation for disaster risk reduction shall be done in accordance with the modalities applied in respective countries. Recipient countries are encouraged to provide information on the estimated amount of national disaster risk reduction expenditure.*
F-2	Total official international support (ODA plus other official flows) for national disaster risk reduction actions provided by multilateral agencies.
F-3	Total official international support (ODA plus other official flows) for national disaster risk reduction actions provided bilaterally.
F-4	Total official international support (ODA plus other official flows) for the transfer and exchange of disaster risk reduction-related technology.
F-5	Number of international, regional and bilateral programmes and initiatives for the transfer and exchange of science, technology and innovation in disaster risk reduction for developing countries.
F-6	Total official international support (ODA plus other official flows) for disaster risk reduction capacity-building.
F-7	Number of international, regional and bilateral programmes and initiatives for disaster risk reduction-related capacity-building in developing countries.
F-8	Number of developing countries supported by international, regional and bilateral initiatives to strengthen their disaster risk reduction-related statistical capacity.

Global target G: Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to the people by 2030.	
G-1 (compound G2-G5)	Number of countries that have multi-hazard early warning systems.
G-2	Number of countries that have multi-hazard monitoring and forecasting systems.
G-3	Number of people per 100,000 that are covered by early warning information through local governments or through national dissemination mechanisms.
G-4	Percentage of local governments having a plan to act on early warnings.
G-5	Number of countries that have accessible, understandable, usable and relevant disaster risk information and assessment available to the people at the national and local levels.
G-6	Percentage of population exposed to or at risk from disasters protected through pre-emptive evacuation following early warning. *Member States in a position to do so are encouraged to provide information on the number of evacuated people.*

Annex 2. Relationship between SDG and SFDRR global indicators

SDG indicators		SFDRR indicators
Goal 1. End poverty in all its forms everywhere		
1.5.1	Number of deaths, missing persons and directly affected persons attributed to disasters per 100 000 population	A1 and B1
1.5.2	Direct economic loss attributed to disasters in relation to global gross domestic product	C1
1.5.3	Number of countries that adopt and implement national disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015-2030	E1
1.5.4	Proportion of local governments that adopt and implement local disaster risk reduction strategies in line with national disaster risk reduction strategies	E2
Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable		
11.5.1	Number of deaths, missing persons and directly affected persons attributed to disasters per 100 000 population	A1 and B1
11.5.2	Direct economic loss in relation to global gross domestic product, damage to critical infrastructure and number of disruptions to basic services, attributed to disasters	C1, D1, D5
11.b.1	Number of countries that adopt and implement national disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015-2030	E1
11.b.2	Proportion of local governments that adopt and implement local disaster risk reduction strategies in line with national disaster risk reduction strategies	E2
Goal 13. Take urgent action to combat climate change and its impacts		
13.1.1	Number of deaths, missing persons and directly affected persons attributed to disasters per 100 000 population	A1 and B1
13.1.2	Number of countries that adopt and implement national disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015-2030	E1
13.1.3	Proportion of local governments that adopt and implement local disaster risk reduction strategies in line with national disaster risk reduction strategies	E2

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