

# Indicators for adaptation to climate change at national level - Lessons from emerging practice in Europe



Authors:

Kirsi Mäkinen (SYKE), Andrea Prutsch (EAA), Eleni Karali (CMCC), Markus Leitner (EAA),  
Sonja Völler (EAA), Jari Lyytimäki (SYKE), Patrick Pringle (UKCIP), Wouter Vanneuville (EEA)

European Environment Agency  
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Cover design: Stephanie Ferguson

Layout: Eleni Karali

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European Topic Centre on Climate Change Impacts, Vulnerability and Adaptation (ETC/CCA)  
c/o Fondazione CMCC - Centro Euro-Mediterraneo sui Cambiamenti Climatici  
V.le Berti Pichat 6/2, 40127 Bologna, Italy  
Web: <http://cca.eionet.europa.eu/>  
Email: [silvia.medri@cmcc.it](mailto:silvia.medri@cmcc.it)

## Contents

|  |           |
|--|-----------|
| <b>Foreword</b> .....  | <b>5</b>  |
| <b>1 Introduction</b> .....  | <b>6</b>  |
| 1.1 About this ETC/CCA Technical Paper .....   | 6         |
| 1.2 How to read this technical paper? .....  | 9         |
| 1.3 Additional information .....   | 11        |
| <b>2 Role of indicators in national monitoring, reporting and evaluation systems of adaptation</b> ..... | <b>14</b> |
| 2.1 The growing demand for indicators .....  | 14        |
| 2.2 Types of indicators .....  | 15        |
| 2.3 Typologies of EEA indicators .....   | 17        |
| 2.4 What is a good indicator? .....  | 18        |
| <b>3 Links between global initiatives and national level activities to track adaptation</b> .....        | <b>20</b> |
| 3.1 Indicators support the implementation of global agreements and initiatives' .....                    | 20        |
| 3.2 Paris Agreement, Sendai Framework and Sustainable Development Goals in a nutshell .....              | 20        |
| 3.3 Relevance of international frameworks for monitoring adaptation on national level .....              | 24        |
| 3.4 Other international work on indicator development with relevance for adaptation .....                | 27        |
| <b>4 European processes for reporting on national level adaptation</b> .....                             | <b>30</b> |
| 4.1 Several reporting processes are relevant for adaptation .....  | 30        |
| 4.2 Monitoring Mechanism Regulation and the Energy Union Governance .....                                | 30        |
| 4.3 EU Adaptation Strategy .....   | 31        |
| 4.4 Sectoral reporting requirements: examples from the water and biodiversity sectors .....              | 34        |
| <b>5 Adaptation indicators used for monitoring national adaptation across Europe</b> .....               | <b>36</b> |
| 5.1 National adaptation indicator sets .....   | 37        |
| 5.2 Observations on key characteristics of national adaptation indicators .....                          | 44        |
| 5.2.1 Sectors covered by indicators .....  | 44        |
| 5.2.2 Main impacts addressed by indicators .....   | 45        |
| 5.2.3 Visual illustration of indicator data .....  | 46        |
| 5.2.4 Data collection and reporting frequencies .....  | 47        |
| 5.2.5 Indicator types and categories .....   | 47        |
| 5.2.6 Links to SDG and SFDRR indicators .....  | 49        |
| 5.2.7 Observed limitations of indicators for adaptation .....  | 51        |
| <b>6 Conclusions and looking ahead</b> .....   | <b>54</b> |
| <b>References</b> .....  | <b>56</b> |
| <b>Annex I: Database guidance document</b> .....   | <b>62</b> |
| <b>Annex II: Excel database of national adaptation indicator sets from five European countries</b> ..... | <b>66</b> |

## List of figures

|   |    |
|---|----|
| Figure 1.1 Visual representation of the stages in the adaptation policy cycle .....             | 7  |
| Figure 1.2: Visual representation of the structure of the present ETC/CCA Technical Paper ..... | 10 |
| Figure 1.3 a-d: Covers of the EEA (2014), EEA (2015), EEA (2017), and ETC/CCA (2017) report...  | 12 |

## List of tables

|   |    |
|---|----|
| Table 3.1 Overview table on Paris Agreement, the Sendai Framework for Disaster Risk Reduction (SFDRR) and the 2030 Agenda for Sustainable Development (SDGs)..... | 23 |
| Table 3.2 Indicators with relevance for climate impacts, initiatives and adaptation included in the European SDG indicators .....                                 | 24 |
| Table 3.3 Indicators with relevance for adaptation included in the SDGs and/or in SFDRR .....   | 26 |
| Table 4.1 EU Adaptation Scoreboard .....  | 32 |
| Table 5.1 Summary tables of national indicator sets for adaptation and their development .....  | 37 |
| Table 5.2 Indicator presentation types found in the country sets.....   | 46 |

## EEA project managers

Wouter Vanneuville and André Jol

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## Foreword

Monitoring, reporting and evaluation (MRE) of national adaptation policies is a continuously evolving field. As countries gain more experience in developing and implementing national adaptation strategies and plans, the need for understanding the progress and effects of the strategies and plans is also increasing. European countries have explicitly expressed their interest in sharing experiences and lessons learnt in this area, especially when it comes to the development of indicators for monitoring and evaluation of adaptation to climate change at the national level.

Building on earlier work on the topic of national level MRE for adaptation in 2015-2016, in 2017 the European Environment Agency (EEA) and the European Topic Centre on Climate Change impacts, vulnerability and Adaptation (ETC/CCA) initiated efforts to collect information on national adaptation indicators across Europe. The first results are presented in this Technical Paper and the accompanying electronic annex that includes an Excel database of national adaptation indicator sets from five European countries collected in 2017 (i.e. Austria, Finland, Germany and the United Kingdom) and 2018 (Scotland). It should be noted that the contents of this Technical Paper were developed in 2017 in conjunction with the first collection of national adaptation indicators. In 2018, updates were made mainly in Chapter 5 following the addition of one national adaptation indicator set in the database.

This Technical Paper and its accompanying database of national adaptation indicators can serve as a source of information and inspiration for countries that are currently developing or revising their adaptation indicators as part of their MRE systems for climate change adaptation. However it is important to underline that neither the Technical Paper nor the database should be considered as a guideline or tool for developing indicator sets for monitoring and / or evaluating national adaptation policies. The collected adaptation indicators are not an ideal or exhaustive set of indicators nor should they be perceived as an attempt to establish a common set of adaptation indicators that countries could be expected to report on in the future. The database should be considered as a 'living library' of adaptation indicators currently in use in different European countries. Several countries are working on adaptation indicators (e.g. Belgium, Sweden, Spain, the Netherlands), and once new information becomes available in the near future it is likely that collections of adaptation indicators can be developed further.

The EEA and ETC/CCA see this Technical Paper and the accompanying database as an opportunity to foster learning and contribute to the evolving knowledge base in the field of MRE. The topic remains one of the key topics of interest within the EEA, and hence EEA activities relevant to it are expected to continue in the future.

October 2018

# 1 Introduction

## 1.1 About this ETC/CCA Technical Paper

Worldwide, climate change adaptation (CCA) is a dynamic, complex and constantly evolving policy field, with relevant activities taking place at multiple governance levels. In Europe, following the Green Paper '*Adapting to Climate Change – Options for EU action*' (EC, 2007) and the White Paper '*Adapting to climate change: Towards a European framework for action*' (EC, 2009), the adoption of the EU Strategy on Adaptation to Climate Change in 2013 (EC, 2013) is considered a key milestone for European adaptation policy development and implementation. The Adaptation Strategy is currently under evaluation. This process started in 2017 and is expected to be completed in 2018 (EC, 2017a).

The EU Adaptation Strategy is designed as a 'framework strategy' (Hildén et al., 2013), which identifies three main priority areas: promoting action by Member States, 'climate-proofing' action at the EU level, and better decision-making; and eight courses of action (EC, 2013). The Strategy aims at supporting Member States (MS) in adapting to climate change by providing guidance and funding, promoting knowledge generation and information-sharing, and enhancing resilience of key vulnerable sectors through mainstreaming. In addition to the communication '*An EU Strategy on adaptation to climate change*' (EC, 2013), the EU Adaptation Strategy Package includes a set of accompanying documents <sup>(1)</sup>, which provide additional guidance and information on key areas of interest (e.g. guidelines on developing adaptation strategies, recommendations for integrating climate change adaptation considerations in rural development programmes, etc.).

In parallel to developments at the European level, progress has been achieved also at the national level. By mid-2017, 28 countries (25 EU Member States and three other EEA member countries <sup>(2)</sup>) had adopted a National Adaptation Strategy (NAS), 17 countries (15 EU Member States and two other EEA member countries) had developed a National Adaptation Plan (NAP) (EEA, 2017c) and 14 countries had a Monitoring, Reporting and Evaluation (MRE) system in place or under development (EEA, 2015, 2017b). In some of these countries, the EU Adaptation Strategy has acted as a springboard for setting up a national strategic framework for adaptation or for starting its implementation, as they developed their NAS and/or NAP either in anticipation of or in response to the adoption of the Strategy (e.g. Greece, Italy, Poland, Slovakia). Some front-runner countries, however, had already started policies and actions in this field much earlier.

Although encouraging steps have been made by European countries to move along the different stages of the adaptation policy cycle (Fig. 1.1), there is still considerable variation among them. Progress also varies among countries that are at the same stage of the adaptation policy cycle. For example, among the 14 countries with a MRE system in place or under development ('Step 6: Monitoring and Evaluation' of the adaptation policy cycle), the majority of them has focused primarily on aspects of monitoring and reporting, and evaluation of adaptation policies has only started recently and still only in a few countries (EEA, 2015).

As experience in MRE activities is still rather limited, fundamental conceptual and methodological challenges remain. For this reason European countries have explicitly expressed their interest in sharing experiences and lessons learnt, especially when it comes to the development of indicators for monitoring and evaluation of adaptation to climate change at national level (henceforth called adaptation indicators) (e.g. 2015 MRE expert workshop, 10<sup>th</sup> and 11<sup>th</sup> EIONET workshop on Climate

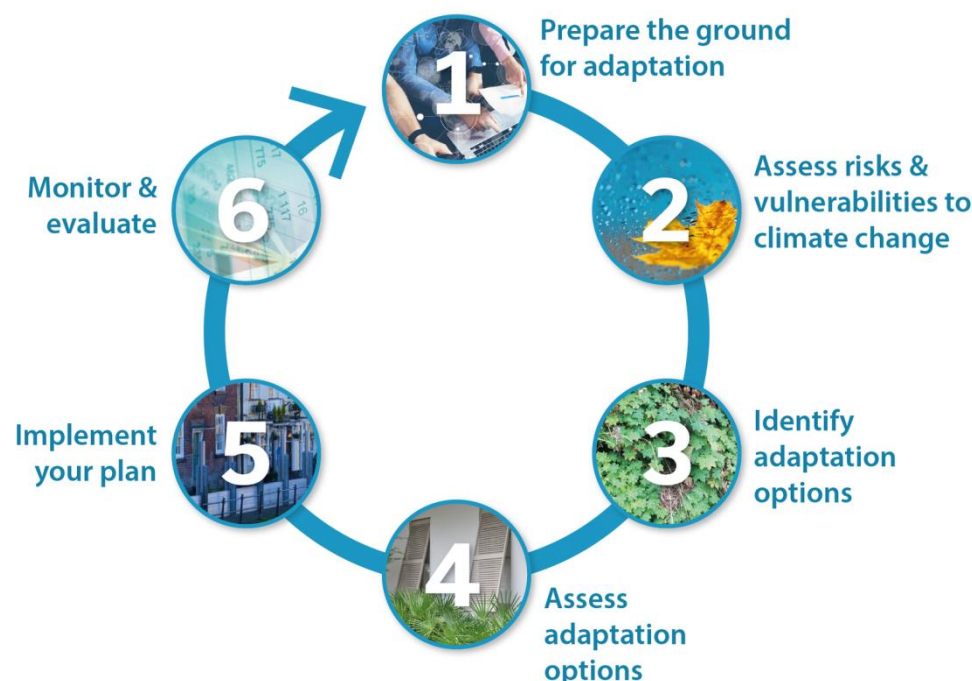
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<sup>(1)</sup> [https://ec.europa.eu/clima/policies/adaptation/what\\_en#tab-0-1](https://ec.europa.eu/clima/policies/adaptation/what_en#tab-0-1)

<sup>(2)</sup> Information on the European environment information and observation network (Eionet), as well as the member and cooperating countries can be found here: <https://www.eea.europa.eu/about-us/countries-and-eionet>



Change Impacts, Vulnerability and Adaptation (CCIVA) 2016, 2017 <sup>(3)</sup>). While several countries are working on adaptation indicators (e.g. Belgium, Sweden, Spain, the Netherlands), and hence new information is expected to become available in the near future, currently only five European countries were found to have an operational set of indicators in place (i.e. Austria, Finland, Germany, Scotland and the United Kingdom).



**Figure 1.1** Visual representation of the stages in the adaptation policy cycle (redrawn from <http://climate-adapt.eea.europa.eu/knowledge/tools/adaptation-support-tool>)

Communicating early insights from the evolving practice of developing and using sets of indicators to monitor and evaluate climate change adaptation at the national level can be valuable both for the more advanced countries with established MRE systems, as well as for those that have recently started being active in this area or that are planning to do so in the near future (EEA, 2015). The former will have the chance to learn about the overall methodological approaches and more specifically about the adaptation indicators used by other countries and reflect on them, while the latter will have the opportunity to learn about what has and has not worked in other countries and use this information to support their own decisions when developing and implementing their MRE systems. Additionally, considering the multiple reporting commitments resulting from different EU and international frameworks, countries are interested in identifying if, where and how synergies, and perhaps complementarities, may emerge in monitoring, reporting and evaluation processes.

This ETC/CCA Technical Paper contributes by offering an overview on the main reporting processes included in EU and global level frameworks. At the global level, the Sendai Framework on Disaster Risk Reduction 2015-2030 (Sendai Framework), the Sustainable Development Goals (SDGs) and the United Nations Framework Convention on Climate Change (UNFCCC) Paris Agreement have been identified as relevant for MRE of climate change adaptation and are presented in this report. Specifically, this technical paper investigates how indicators developed in the context of these frameworks can be

<sup>(3)</sup> All information on Eionet workshops and EEA organised expert workshops can be found here: <https://forum.eionet.europa.eu/nrc-climate-change-adaptation/library/workshops-meetings>

implemented in European countries and if any synergies related to the reporting processes of these international policy frameworks exist. At the European level, the legal reporting requirements under the Greenhouse gas Monitoring Mechanism Regulation (MMR, EU, 2013) are explored. Additionally, experiences in 2014 and 2017 with the non-binding reporting processes resulting from the EU Adaptation Strategy (EC, 2013) (i.e. EU adaptation preparedness scoreboard) are looked at. Furthermore, a key part of the paper provides an overview of recent progress made in the development and implementation of indicators used for monitoring and evaluation of climate change adaptation at national level. Specifically the paper focuses on five European countries that have such adaptation indicators in place: Austria, Finland, Germany, Scotland and the United Kingdom. Finally, lessons learnt and key messages for future work are summarised.

Information presented in this technical paper is complemented by a database, which includes metadata (i.e. title, sector, main impacts addressed, type of indicator, source of data, frequency of data collection, unit of measure, geographical scale, limitations, data visualisation) for national level adaptation indicators from the five countries mentioned above. Indicators for adaptation are generally developed considering the specific circumstances of a country. Thus information as to why a particular indicator has been chosen (as well as the assumptions associated with it) is important for allowing an assessment of whether (or not) an indicator could be suitable to other countries. Nevertheless, such information is rarely mentioned explicitly in policy reports, and it is difficult to collect via interviews. For this reason, although its importance is acknowledged, this information has not been included in the database.

The database is available as an electronic annex to this report. It is important to underline that neither this report nor the database should be considered as a guideline or tool for developing indicator sets for monitoring and / or evaluating national adaptation policies, nor should it be perceived as an attempt to establish a common set of adaptation indicators that countries could be expected to report on in the future. The database should be considered as a 'living library' of adaptation indicators currently in use in different EU Member States, which is likely to be updated in the future as new evidence becomes available. It can serve as a source of information and inspiration for countries that are currently developing or revising their adaptation indicators as part of their MRE systems for climate change adaptation, but not as an ideal or exhaustive set of indicators.

### **Who should read this technical paper?**

This technical paper concentrates on indicators included in national level MRE systems of climate change adaptation and the implementation of MRE processes resulting from global and EU agreements with relevance for adaptation. The information presented here is therefore aimed at policymakers, experts and practitioners who develop, coordinate and implement MRE processes of adaptation policies at the national and EU level.

MRE of adaptation has received less attention at the sub-national and local (city) level, as in many of such cases adaptation policy is still at an early stage. Actors operating at these levels are expected to answer to some extent different types of questions (e.g. how to best adapt to climate change impacts; how to reduce vulnerability of local communities; if actions implemented are still viable and effective in addressing the changing risks) (EEA, 2016c). Nevertheless, as constant progress is made in implementing sub-national and local adaptation strategies and plans, interest in MRE processes is already increasing. For example, the Covenant of Mayors on climate and energy <sup>(4)</sup> started in 2017 to develop a MRE scheme on adaptation for the participating cities, to become operational in 2018. Thus, the information included in this report and database can be of relevance and value also to the actors operating at sub-national and local levels.

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<sup>(4)</sup> <http://www.covenantofmayors.eu/>



## 1.2 How to read this technical paper?

This technical paper is structured in six chapters, which are linked but can also be read independently according to the interest of the reader (Fig. 1.2). Following this introduction (Chapter 1), the technical paper is structured in the following chapters:

- **Chapter 2: Role of indicators in national monitoring, reporting and evaluation systems of adaptation**

Chapter 2 provides a brief introduction to the MRE systems used in European countries and a short discussion on the role of adaptation indicators. It introduces the concepts of ‘monitoring’, ‘reporting’ and ‘evaluation’, and presents different types of indicators, drawing evidence from the existing MRE literature. Finally, it discusses the characteristics that may be considered as indication of a ‘good’ indicator for adaptation.

- **Chapter 3: Links between global initiatives and national level activities to track adaptation**

Chapter 3 concisely describes the Paris Agreement on Climate Change, the Sendai Framework and the Sustainable Development Goals, and their overlaps with climate change adaptation issues. As indicators have been developed in the context of some of these frameworks for measuring the implementation of their targets or are expected to do so in the near future, this chapter identifies possible synergies between them in terms of indicators that might be relevant to climate change adaptation. In addition, it looks at links to indicators developed at the EU level in response to these international frameworks.

- **Chapter 4: European processes for reporting on adaptation at national level**

Zooming into the European level, Chapter 4 brings together information on the legal reporting requirements associated with the Greenhouse gas Monitoring Mechanism Regulation (Regulation (EU) No 525/2013), and other sectoral policies that give rise to reporting processes of interest and relevance for adaptation. The chapter also describes the approach of collecting information using the adaptation preparedness scoreboard developed by the EC for the evaluation of the EU Adaptation Strategy. The chapter further explores the extent to which information collected in the context of such European level reporting processes can inform the development of national level indicators for adaptation.

- **Chapter 5: Adaptation indicators used for monitoring national adaptation across Europe**

Chapter 5 presents an analysis of information on national-level adaptation indicators collected from five European countries. As per October 2018, Austria, Finland, Germany, Scotland and the United Kingdom are the only European countries with an agreed and available set of indicators for adaptation in place. Information on a set of metadata was collected for all adaptation indicators. All metadata is presented in the indicator database, which was compiled in parallel with the development of this report and is available as an electronic annex.

- **Chapter 6: Conclusions and looking ahead**

Key messages emerging from the analysis, lessons learnt and knowledge gaps relevant to future work on adaptation indicators are presented in the final chapter. The challenges of climate change adaptation MRE arise from a rapid evolution of the knowledge base, the different reporting processes and the diversity in countries’ contexts and priorities. Therefore, further efforts for building and sharing knowledge on the best practices of MRE are clearly needed.



Figure 1.2: Visual representation of the structure of the present ETC/CCA Technical Paper

## Methodology

Information from the growing MRE literature, the European Climate Adaptation Platform (Climate-ADAPT <sup>(5)</sup>) and other relevant knowledge platforms, such as PreventionWeb <sup>(6)</sup>, was used as a basis for developing chapters 1-4 of this technical paper. Information presented in chapter 5 and the accompanying adaptation indicators database on which this chapter is based was collected primarily from national MRE reports and/or national adaptation indicator databases.

The information comprising the database was developed separately for each country and then brought together within the database for further adjustment. To minimise bias, guidelines for the authors of this paper were prepared and used to define all included metadata fields. The guidance document is provided in Annex I of this technical paper. Furthermore, when possible, country representatives or actors involved in the development of the national indicators for adaptation were consulted. This improved the consistency and quality of the database, and helped to clarify the differences in interpretations due to national contexts and presentation formats of the indicator sets.

### 1.3 Additional information

This ETC/CCA technical paper supplements other relevant reports and tools already available. Its specific focus on adaptation information draws from the 2015 EEA Technical report on *'National monitoring, reporting and evaluation of climate change adaptation in Europe'* (EEA, 2015), which underlined the strong interest of countries in combining quantitative indicators and qualitative information in the context of national MRE systems of climate change adaptation. The focus of this technical paper is on adaptation indicators alone and not on other types of indicators <sup>(7)</sup> (e.g. climate change impact indicators), unless these have been explicitly considered in the sets of adaptation indicators included in national MRE systems <sup>(8)</sup>. Also information on the overall approaches used in MRE systems in European countries has been presented and discussed in earlier reports (e.g. EEA, 2015) and thus is not in the scope of this technical paper. EEA reports that are complementary to the work described here and thus might be of interest to the readers are presented below:

- **National adaptation policy processes in European countries – 2014** (EEA, 2014b): This report (Fig.3a) presents the findings of a self-assessment questionnaire on national adaptation policy processes in Europe. The questionnaire was sent by the EEA to authorities responsible for coordinating adaptation at national level in 33 EEA countries and 30 of them provided their responses on a voluntary basis. As a result of the high response rate and the wealth of information provided by the countries, this report presents a unique collection of information and a comprehensive overview of national adaptation policy processes in Europe. Monitoring, reporting and evaluation was one of the key topics explored in this report, which acted as the springboard for the EEA-ETC/CCA work that followed later on in this field.
- **National monitoring, reporting and evaluation of climate change adaptation in Europe** (EEA, 2015): This report (Fig.3b) provides insights into adaptation monitoring, reporting and evaluation systems at the national level in Europe. At the time of its publication it constituted the first attempt

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<sup>(5)</sup> <http://climate-adapt.eea.europa.eu/>

<sup>(6)</sup> <https://www.preventionweb.net/english/>

<sup>(7)</sup> Detailed information on other types of climate change indicators can be found in the recently published EEA report: Climate change, impacts and vulnerability in Europe 2016. An indicator-based report (EEA, 2017b).

<sup>(8)</sup> Although climate change impact indicators per se do not fall within the focus of this technical paper, it should be noted that countries often consider climate impact indicators in their MRE systems of climate change adaptation (see database online at [https://cca.eionet.europa.eu/docs/ANNEX\\_TP\\_3-2018](https://cca.eionet.europa.eu/docs/ANNEX_TP_3-2018)).

to consolidate emerging information across European countries, offering reliable and targeted information to support the effective and efficient implementation of climate adaptation policies and actions at the national level in Europe. Among others the report demonstrated the importance and interest of countries in sharing experiences, especially when it comes to the methods that can be used to monitor and evaluate adaptation policies.

- **Climate change, impacts and vulnerability in Europe 2016. An indicator-based report** (EEA, 2017b): This report (Fig.3c) is an indicator-based assessment of past and projected climate change and its impacts on ecosystems and society. It looks at society's vulnerability to these impacts, the development of adaptation policies and the underlying knowledge base. This fourth edition of the 'Climate change, impacts and vulnerability in Europe' report aims to support the implementation and evaluation process of the 2013 EU Adaptation Strategy, which is taking place in 2017-2018, and the development and implementation of national and transnational adaptation strategies and plans.
- A report on 'National climate change vulnerability and risk assessments in Europe 2018', forthcoming in 2018 by EEA, will present an overview of national climate change impact, vulnerability and risks assessments (CCIV assessments), including lessons learned and their contribution to the development of national adaptation policies. This new report intends to facilitate mutual learning between countries and is also meant to be an input to the review of the EU strategy on adaptation to climate change. The report is based on a country survey from the summer of 2017, in which 24 EEA member countries participated.
- **Monitoring, Reporting and Evaluation of national level adaptation in Europe: Lessons and experiences from other policy domains** (ETC/CCA, 2017): This ETC/CCA working paper (Fig.3d) highlights transferable lessons learned from evaluation communities working in the policy fields of biodiversity, adaptation and international development, and sustainability that may inform MRE systems for climate change adaptation. The aim of this working paper is to reveal insightful, inspirational and relevant perspectives for those working on MRE systems for adaptation in Europe, in particular at national level.

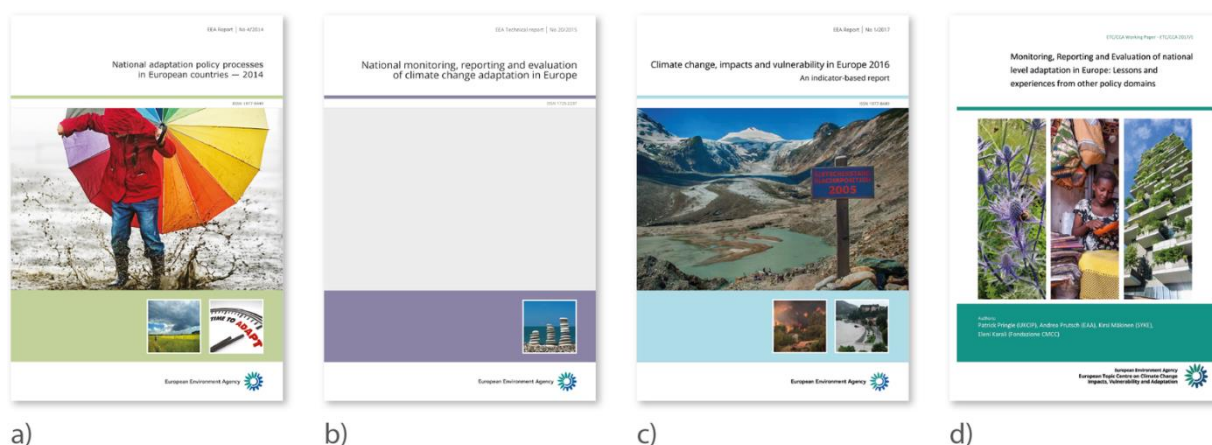


Figure 1.3 a-d: Covers of the EEA (2014), EEA (2015), EEA (2017), and ETC/CCA (2017) report

Additionally, the European Climate Adaptation Platform (Climate-ADAPT), a partnership between the European Commission (DG CLIMA, DG Joint Research Centre and other DGs) and EEA, aims to support Europe in adapting to climate change. Among other information and tools, Climate-ADAPT provides access to the Adaptation Support Tool (AST), which intends to assist users in developing climate change adaptation strategies and plans by providing guidance, links to relevant sources and dedicated tools as a living source of knowledge. Step 6 of the AST is focused on monitoring and evaluation <sup>(9)</sup>. Information presented on this tool is regularly updated as new insights become available, and hence it can be considered as a living source of knowledge for monitoring and evaluation.

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<sup>(9)</sup> <http://climate-adapt.eea.europa.eu/knowledge/tools/adaptation-support-tool/step-6>



## 2 Role of indicators in national monitoring, reporting and evaluation systems of adaptation

### 2.1 The growing demand for indicators

The increasing recognition of the necessity to integrate adaptation in our society's response to climate change has led to an understanding of the need for making targeted, justified, effective and cost-efficient policy decisions on adaptation at national level. In addition, countries are in general interested in evaluating effectiveness and cost-efficiency of national policies, for which monitoring, reporting and evaluation activities are taking place. The recent period of austerity in Europe has become an additional argument for doing so. Numerous countries are facing important budgetary constraints (EEA, 2016a), which not only underline the imperative for making targeted, justified and cost-efficient policy decisions, but also place the achievement of adaptation policy objectives at risk.

In this context, monitoring, reporting and evaluation (Box 2.1) can play an important role in the adaptation policy cycle <sup>(10)</sup>. MRE can (and should be able to) support the evaluation of whether the defined objectives are being achieved (or not), if measures implemented remain effective and if that is being done in a cost-effective and equitable way. When and where this is not the case, MRE systems should trigger a further risk and adaptation assessment. Furthermore, MRE systems may produce data and information, which can help identify when and where further efforts are needed, including the identification of priorities related to those needs, and point to knowledge gaps.

In the case of European countries, tracking and reporting adaptation policy progress and effectiveness, enhance learning and accountability have been identified as the main purposes <sup>(11)</sup> of national MRE systems (EEA, 2015; OECD, 2015). The particular purpose of an MRE system for adaptation often influences the overall approach and specific methods comprising it (EEA, 2015). Countries frequently acknowledge the potential of setting flexible systems that combine both qualitative and quantitative information from multiple sources, for providing a robust, consistent and contextualised description of adaptation progress <sup>(12)</sup>. In terms of methods, as reflected also in other recent reports on adaptation policies (Hammill et al., 2013, 2014; OECD, 2015; EEA, 2015; Vallejo, 2017), countries have expressed a high preference for including indicators in MRE systems of climate change adaptation.

Indicators may serve a range of purposes, including tracking progress in the implementation of an adaptation strategy or plan, monitoring the spending of adaptation funds, mainstreaming adaptation in different sectors and communicating adaptation information to policy-makers, to mention a few (ETC/ACC, 2009). Evidently, this multiplicity of uses is one of the main reasons why countries are keen to use or partly even develop new indicators. Research undertaken in the context of this technical paper, however, revealed that within the confines of Europe, only a limited number of countries have an operational set of indicators for adaptation in place, and in almost all cases these indicators are used primarily for monitoring adaptation policies and reporting on the progress made, rather than for their evaluation. Observations suggest that although countries have a clear interest in indicators, there are still barriers that constrain their full development and use (see e.g. Mitchell et al., 2016). For example,

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<sup>(10)</sup> <http://climate-adapt.eea.europa.eu/knowledge/tools/adaptation-support-tool/step-6>

<sup>(11)</sup> The authors acknowledge that differences exist across different countries in terms of the objectives that they aim to achieve through their MRE systems. Thus the purposes reported here, although already discussed in the literature, might not be always relevant to all countries. In the case of Germany, for example, the aim of the DAS monitoring is to use existing data to describe and to understand the consequences of climate change impacts and if possible, adaptation already begun at national level. In this sense descriptive indicators are used to show impacts and responses in the DPSIR framework. In addition, Germany has a set of vulnerability indicators and still forthcoming a set of evaluation indicators that complement the DAS monitoring indicators covered in this study.

<sup>(12)</sup> <http://climate-adapt.eea.europa.eu/knowledge/tools/adaptation-support-tool/step-6/mixed-methods>

many countries face challenges with addressing uncertainty and long timeframes, establishing suitable baselines and measurable targets and objectives, as well as data and resource constraints (EEA, 2015).

### Box 2.1: What do we mean by ‘Monitoring’, ‘Reporting’ and ‘Evaluation’?

Monitoring, reporting and evaluation have different aims and may involve different actors. Yet they are closely linked processes and are often mentioned together when referring to adaptation policies.

**Monitoring** refers to a continuous and systematic process of tracking the progress made in planning and implementing a climate change adaptation policy, program or other intervention, taking into account its specific objectives and inputs. Monitoring is often based on the use of a specific set of indicators, which consider the context in which adaptation occurs.

**Reporting** refers to the communication of the information collected about the progress or the impact of a climate change adaptation policy, program or other intervention. This process might take place internally within an organisation or country when associated with a specific monitoring or evaluation scheme, or be a requirement related to some international procedures (e.g. National Communications of the UNFCCC, Monitoring Mechanism Regulation (MMR) of the European Union).

**Evaluation** refers to the systematic, transparent and objective process of assessing the effectiveness of a climate change adaptation policy, program or other intervention in terms of its specific objectives, usually in terms of its impact on reducing vulnerability and increasing resilience. Evaluation may use both quantitative and qualitative data from a range of sources, including those gathered through monitoring processes. Although it is often thought that evaluation comes at the end of the policy cycle, before initiating major revisions or taking a decision to continue a particular policy, such processes may take place at different points in time as needed.

**Source:** EEA 2014, 2015

## 2.2 Types of indicators

Climate change and climate change adaptation are rather complex issues, and hence different types of indicators have been developed and used for different purposes. The EEA reports on Climate change, impacts and vulnerability, for example, have focused primarily on risks, impacts and vulnerabilities, and to a lesser extent on adaptation. The EEA report on Climate change, impacts and vulnerability in Europe 2012 (EEA 2012) refers to:

- *climate change indicators*, to understand the causes of climate change impacts;
- *climate change impacts indicators*, to understand the consequences of climate change;
- *social, economic, health and ecological vulnerability indicators*, to monitor and understand vulnerability, identify adaptation needs and evaluate adaptation strategies and action.

More recently the EEA (2017a) report on Climate Change Impacts and Vulnerability (CCIV) made a distinction between ‘*global climate change*’ and ‘*regional climate change*’ for distinguishing indicators used for monitoring the main changes in the global climate system and those for tracing climate hazards to inform regional assessment and management of climate sensitive risks. It also referred to other indicators focused on the ‘*climate change impacts on environmental systems and society*’, which are used for assessing the sensitivity of ecosystems and society to observed climate change, estimating future impacts of climate change and the resulting adaptation needs. The Climate Change Expert Group paper (Vallejo, 2017) looking at national adaptation monitoring and evaluation systems developed in Europe and beyond classified the indicators included in them in three broad categories:

- i. ‘*climate risks*’, which embrace climate hazards, climate impacts, exposure, adaptive capacity;

- ii. *'adaptation processes'*, which look more at the implementation of strategies and plans and the allocation of resources; and
- iii. *'adaptation outcomes'*, which look at the actual results of adaptation policies and plans (Vallejo, 2017, p. 16).

Other typologies have been built on a range of criteria such as the different sectors with which indicators are associated or the perspective that an indicator might have (e.g. 'adaptation perspective' – indicators intend to measure a specific aspect of climate change, 'policy cycle perspective' – indicators designed to measure a process, output or outcome of an adaptation policy (EEA, 2015)).

For the purpose of this technical paper, we developed a list of definitions for the indicators focusing mainly on climate change adaptation (Box 2.2), using as a basis the definitions presented in the Intergovernmental Panel on Climate Change (IPCC) 5<sup>th</sup> Assessment Report (AR5) glossary (IPCC, 2014) and the definitions included in the EEA (2015) report. We grouped the identified types in two categories based on their function related to the adaptation policy process (Type 1) and to climate change adaptation more generally (Type 2). These definitions are also included in the guidance document used while developing the indicator database (Annex I).

#### Box 2.2: Types of adaptation indicators considered in the database

##### Indicator function (Type 1)

- **Input indicator** – an indicator that provides a measure of resources, both human and financial, devoted to a particular adaptation activity, programme or intervention.
- **Process indicator** – an indicator that tracks progress in adaptation policy processes and actions.
- **Output indicator** – an indicator that relates to the direct results of an adaptation policy or action, without assessing if these results actually lead to better adaptation outcomes.
- **Outcome indicator** – an indicator that seeks to define an explicit outcome or result of an adaptation action. Outcome indicators may also assess the level of success of specific adaptation measures, indicating e.g. a reduction in vulnerability or improved adaptive capacity.

##### Indicator content (Type 2)

- **Exposure indicator** – an indicator of the exposure of people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected.
- **Adaptive capacity indicator** – an indicator of the ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities or to respond to consequences.
- **Sensitivity indicator** – an indication of the degree to which a system or species is affected, either adversely or beneficially, by climate variability or change. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range or variability of temperature) or indirect. In the Disaster Risk Reduction (DRR) policy domain and knowledge communities, this is called 'vulnerability' (EEA, 2017a, section 1.4 and Box 1.3).
- **Composite vulnerability indicator** – an indicator that provides a metric characterizing the vulnerability of a system by combining, with or without weighting, several indicators assumed to represent vulnerability. This includes indicators, which combine two or more indicators of exposure, sensitivity and/or adaptive capacity. In some cases in the literature, this has been described as a 'vulnerability index indicator'.

- **Hazard indicator** – an indicator of the potential occurrence of a natural or human-induced physical event or trend or physical impact that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems, and environmental resources.

**Source:** Adapted from EEA (2015) and IPCC AR5 glossaries (IPCC, 2014)

### 2.3 Typologies of EEA indicators

EEA indicators<sup>13</sup> are supported by conceptual frameworks for environmental analysis, such as indicator typologies. To develop reliable, relevant, targeted and timely environmental information, the development of this information can be divided into different phases that link information generation to its final use and distinguishes information to its level of aggregation. The “monitoring – data – indicators – assessments – knowledge” (MDIAK) framework is one of them. In this context, monitoring provides observations of environmental parameters. Data refers to combined measurements, structured in a way that allows further processing and comparison. Indicators are derived by further selection, aggregation and interpretation of single or multiple data to answer specific policy or assessment questions and to communicate them clearly. Also, indicators underpin assessments and result in knowledge, which supports policymaking.

To structure thinking about the interplays of the environment and socio-economic activities, EEA developed the DPSIR-model as an extended version of OECD pressure-state-response framework. In the DPSIR framework, social and economic developments drive (D) changes that exert pressure (P) on the environment. As a consequence, changes occur in the state (S) of the environment, leading to impacts (I) on ecosystem functioning, human health and the economy. Societal and political responses (R) affect earlier parts of the system in a direct or indirect way. From a policy perspective, there is a clear need for indicators on all parts of the DPSIR chain.

An EEA typology of indicators allows the analysis of environment-society interactions in detail. EEA indicators are classified as descriptive (Type A), performance (Type B), efficiency (Type C), policy effectiveness (Type D) or total welfare (Type E), depending on which environmental challenge they address and which stage of the policy cycle they aim to inform. Descriptive indicators (A) can be used for all elements of the DPSIR chain, and reflect the state of affairs (actual situations). Performance indicators (B) may use the same variables as type A indicators, but are connected with targets or reference conditions and link clearly to policy processes. Efficiency indicators (C) express the relationship between drivers and pressures of the DPSIR framework. Policy effectiveness indicators (D) relate the change in environmental variables to policy measures, linking responses to the other elements of the DPSIR framework. Finally, total welfare indicators (E) provide overall measures of sustainability, integrating economic, social and environmental considerations. Nowadays, most EEA indicators are descriptive (Type A) and show pressure, state and impact of the DPSIR framework.

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<sup>(13)</sup> More information on EEA indicators can be found at <https://www.eea.europa.eu/data-and-maps/indicators/about> or EEA (2014a)

## 2.4 What is a good indicator?

The strengths and weaknesses of indicators are a recurring issue (e.g., ETC/ACC, 2009; UNFCCC, 2010; OECD, 2015; EEA, 2015). In this context, finding a common understanding about which indicators are useful and which data best underpin them to measure the progress towards goals and objectives is often seen as a challenging and time-consuming process. This has been shown in several cases including the indicator sets developed for the Sendai Framework on disaster risk reduction at global level and the Sustainable Development Goals at global and European level (see chapter 3).

In general, and so not only for indicators used for monitoring and evaluation of adaptation policies and measures, efforts have been made to propose criteria that define what we mean by 'good indicator'. For good sustainability indicators, the key elements of the "S.M.A.R.T." listing (Doran, 1981; McCarthy et al., 2012; Maxwell et al., 2015) are often considered as such general level criteria, pointing out that useful indicators should be Specific, Measurable, Achievable, Relevant and Timely. Focusing on the criteria for ecological indicators in a more detailed level Dale and Beyeler (2001) suggest that indicators should:

- be easily measured;
- be sensitive to changes in stresses on system;
- respond to changes in stress in a predictable manner;
- signify an impending change in the ecological system in anticipatory manner;
- predict changes that can be averted by management actions;
- provide integrative coverage of the key gradients across the ecological systems;
- have a known response to natural disturbances, anthropogenic stresses, and changes over time;
- have low variability in response.

ETC/ACC (2009) focused specifically on adaptation indicators and identified a set of criteria that are critical for their development. These include:

- availability: existence both of appropriate data and indicators,
- potential availability: availability of reliable data which can support the development of indicators in the future,
- representativeness: availability of indicators that are suitable for measuring progress on the important or determining factors (rather than secondary issues), and
- continuity: regular availability of indicators.

Broad criteria, such as the ones described above can provide useful insights and may serve, up to a certain extent, as valid indication of a good indicator. Furthermore, they can guide the development of indicator sets by helping to clearly define their limitations, background assumptions, uncertainties and associated risks related to their use. These will be particularly important for the continuity of implementation and long-term evolution of a set of indicators.

Finally, in the context of MRE of climate change adaptation, it is important to remember that:

- There is no one size-fits-all indicator;
- The purpose and objective of an adaptation MRE system drives what a good indicator might be;
- A set or portfolio of indicators is usually required to create an accurate picture of adaptation progress;
- Quantitative indicators are more effective when combined with qualitative information;
- There is an inevitable reliance on proxy indicators;



- Outcome indicators often do not show progress over relatively short periods of time;
- It is essential to understand the assumptions and limitations of the indicators, the associated framework, as well as the uncertainties and possible risks in using them (e.g. Gudmundsson, et al., 2009; EEA 2015).

### 3 Links between global initiatives and national level activities to track adaptation

#### 3.1 Indicators support the implementation of global agreements and initiatives'

A number of multilateral frameworks under the United Nations (UN) with relevance for the topic of climate change adaptation have been adopted recently. Besides the Paris Agreement on Climate Change, the Sendai Framework for Disaster Risk Reduction (SFDRR) and the 2030 Sustainable Development Agenda with the Sustainable Development Goals (SDGs) were also adopted in 2015 with strong links to climate change adaptation. With the Paris Agreement, adaptation and mitigation are now considered equally important pillars in climate policy. The Paris Agreement established the global goal on adaptation (GGA) of “enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change, with a view to contributing to sustainable development and ensuring an adequate adaptation response in the context of the global temperature goal” (UNFCCC, 2015b, Art. 7) and thus, linking adaptation and sustainable development. SFDRR and SDGs also consider adaptation as crucial, therefore possible synergies could arise on the national level where these frameworks need to be implemented. For effective use of resources, the three frameworks should ideally be implemented in an integrated manner, ensuring that action taken under any of the frameworks complements the objectives of the others (UNISDR, 2015a). Synergies may arise by allowing more reflection on the progress of adaptation at national level as:

- the Sendai Framework has a monitoring process, including indicators (UNISDR, s.d.);
- the Sustainable Development Goals have indicators and a monitoring framework (Schmidt-Traub et al., 2015; UN, 2017b);
- the Paris Agreement works on further guidance in relation to the adaptation communication and the on the developments of modalities and procedures for the operation and use of a public registry <sup>(14)</sup>, related to Art. 7.

The EU Member States individually implement the required data collection and reporting for each of these three global agreements. In addition, the European Commission contributes to the process towards implementation of these global commitments at EU level, and thus helps to ensure connectivity and coherence between these frameworks within the EU.

This chapter briefly describes these international frameworks while focusing on the process of developing indicators for monitoring. It aims to identify synergies in terms of how to use available indicators best for monitoring climate change adaptation. Furthermore, it provides insights on the role of the European Commission and their support in implementing international frameworks on national level.

#### 3.2 Paris Agreement, Sendai Framework and Sustainable Development Goals in a nutshell

The **Paris Agreement 2015** (UNFCCC, 2015b) sets out a global action plan with the aim to avoid dangerous climate change impacts and to keep global warming well below 2°C. In terms of adaptation, the Agreement recognizes the current need for adaptation, following a country-driven, participatory approach which especially takes into account vulnerable groups and ecosystems (UNFCCC 2015 Art.7 §4-5) (cf. Overview Table 3.1). The EU ratified the Paris Agreement in October 2016 and it entered into force on 4 November 2016.

Adaptation monitoring and evaluation is recognised as an important step in the process of adapting to climate change and requested in the Paris Agreement under Art.7 §9(d). To assess the collective

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<sup>(14)</sup> [http://unfccc.int/paris\\_agreement/items/10528.php#gc\\_3](http://unfccc.int/paris_agreement/items/10528.php#gc_3), accessed 8 March 2018.

progress towards achieving the purpose of the Agreement and its long-term goals, it proposes a global stock-take every 5 years, starting in 2023 (UNFCCC 2015: cf. Art.7 §10 and Art.14 §2). It is at the Parties' discretion to provide information on adaptation with the aim to "enable Parties to increase their understanding of climate risks, improve the effectiveness of adaptation measures, and increase accountability under the UNFCCC" (Vallejo, 2017, p.5). The Working Group on the Paris Agreement is requested to identify and recommend the source of input for the global stocktake, including, but not limited to information on the state of adaptation efforts, support, experiences and priorities from the communications referred to in Article 7 and reports referred to in Article 13 of the Paris Agreement (UNFCCC, 2015a, §100). By end of 2017, no method, uniform set of indicators or framework for monitoring, evaluation and reporting has been proposed by the Convention. In this regard, the Adaptation Committee of the UNFCCC states that 'a common set of indicators for all countries is not useful, owing to the context-specific nature of adaptation' (Adaptation Committee, 2015).

Nevertheless, the absence of a common indicator set does not mean there is no formal reporting (including reporting guidelines). The most recent deadline was 1 January 2018 for the Seventh National Communication for Annex 1 and non-Annex 1 parties <sup>(15, 16)</sup>. Under the Paris Agreement (UNFCCC, 2015b, art. 7 §10), a periodically updated Adaptation Communication is discussed for all parties, and so without a distinction between developed and developing country Parties. In 2018, the scope and content of this Communication will be decided at COP24 in Katowice.

The Governance of the Energy Union Regulation <sup>(17)</sup> aims to ensure that the objectives of the Energy Union, especially the EU's 2030 energy and climate targets, are achieved; and to provide a system accommodating the EU's commitments to the Paris Agreement. It also aims to integrate and streamline most of the current energy and climate planning and reporting requirements of EU Member States as well as the Commission's monitoring obligations. EU countries might be required to develop Integrated National Energy and Climate Plans that cover the five dimensions of the Energy Union for the period 2021 to 2030 based on a common template, and to report on the progress they make in implementing these plans, mostly on a biennial basis.

The **Sendai Framework for Disaster Risk Reduction 2015–2030** (SFDRR) (UNISDR, 2015b) was adopted in 2015 as a voluntary agreement which recognizes that the national level has the primary role to reduce disaster risk but that responsibility should be shared with other stakeholders. It includes seven global targets and four priorities for action reaching from improving the knowledge base, strengthening the governance and increasing the investment in risk reduction measures to enhancing the preparedness and response. Most priorities recognise climate change as important driver for disasters and address the issue at various levels (i.e. better information, more and better methods and tools). Links to climate change adaptation are set at the level of implementation (Art. 47(d)), recognising the need to incorporate disaster risk reduction (DRR) into adaptation policies.

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<sup>(15)</sup> [http://unfccc.int/national\\_reports/annex\\_i\\_natcom/submitted\\_natcom/items/10138.php](http://unfccc.int/national_reports/annex_i_natcom/submitted_natcom/items/10138.php), accessed 8 March 2018.

<sup>(16)</sup> **Annex I** Parties include the industrialized countries that were members of the OECD (Organisation for Economic Co-operation and Development) in 1992, plus countries with economies in transition (the EIT Parties), including the Russian Federation, the Baltic States, and several Central and Eastern European States.

**Non-Annex I** Parties are mostly developing countries. Certain groups of developing countries are recognized by the Convention as being especially vulnerable to the adverse impacts of climate change, including countries with low-lying coastal areas and those prone to desertification and drought. Others (such as countries that rely heavily on income from fossil fuel production and commerce) feel more vulnerable to the potential economic impacts of climate change response measures. The Convention emphasizes activities that promise to answer the special needs and concerns of these vulnerable countries, such as investment, insurance and technology transfer. (UNFCCC, 2014)

<sup>(17)</sup> Adoption Governance of the Energy Union Regulation is foreseen in 2018 in line with the political agreement reached by the co-legislators in June 2018.

The MRE of the SFDRR is based on the work and recommendations of the UN Open-Ended Intergovernmental Expert Working Group on Indicators and Terminology Relating to Disaster Risk Reduction (OIEWG) (UN, 2016). This working group is comprised of more than 250 experts (from e.g. national ministries, NGOs, private sector) nominated by states and supported by UNISDR (2016). It had the duty to develop a set of possible indicators to measure global progress in the implementation of the Sendai Framework, coherent with work of the SDG indicators (SFDRR, Art. 50). On 2 February 2017, the UN General Assembly adopted the resolution on indicators and terminology relating to disaster risk reduction (UN, 2017a). Some of the indicators produced in relation to the Sendai Framework are of direct relevance for climate change adaptation (cf. Table 3.3).

The European Commission's role in implementing the SFDRR was already recognized in 2014 with the adoption of the Communication of the post 2015 Hyogo Framework for Action: Managing risks to achieve resilience (EC, 2014). In June 2016, the European Commission published an Action Plan to guide the implementation of the Sendai Framework in EU policies (EC, 2016b). The action plan is the basis for a more systematic disaster-risk-informed approach for all EU policies towards achieving the Sendai objectives. It considers the following four priorities in line with the Sendai priorities: i) Building risk knowledge in EU policies; ii) An all-of-society approach in disaster risk management; iii) Promoting EU risk informed investments; and iv) Supporting the development of a holistic disaster risk management approach (EC, 2016d). For all these priorities, a series of measures are identified, including a time frame for implementation (cf. Annex 2 of EC (2016b)). Progress will be regularly reviewed based on output indicators developed for all implementation priorities.

In the Sustainable Development Summit 2015, the **2030 Agenda for Sustainable Development** was adopted, containing 17 Sustainable Development Goals (SDGs) and 169 targets (UN, 2015). A direct link to climate change was set with Goal 13 "Take urgent action to combat climate change and its impacts" which highlights that implementation of the Paris Agreement is essential for the achievement of the SDGs. In addition, a number of SDGs are affected by climate change (e.g. SDG 1 on 'No poverty', SDG 2 on 'Zero hunger', and SDG 6 on 'Clean water and sanitation'). Over the next years, with these new (but not legally binding) goals applying to all countries, the aim is to mobilize efforts to end all forms of poverty, fight inequalities and tackle climate change (UN, 2017c).

**Table 3.1 Overview table on Paris Agreement, the Sendai Framework for Disaster Risk Reduction (SFDRR) and the 2030 Agenda for Sustainable Development (SDGs)**

| Key points                            | Paris Agreement   | Sendai Framework for Disaster Risk Reduction 2015–2030 (SFDRR)   | 2030 Agenda for Sustainable Development (SDGs)  |
|---------------------------------------|---|--|---|
| <b>Date of adoption</b>               | 195 nations agreed to Agreement in December 2015; went into force on 4 November 2016  | UN member states adopted in March 2015 at the World Conference on Disaster Risk Reduction held in Sendai, Japan  | 193 member countries agreed to the SDGs in September 2015; went into force in January 2016  |
| <b>Aim</b>                            | <ul style="list-style-type: none"> <li>• Holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels</li> <li>• Increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development</li> <li>• Making finance flows consistent with a pathway towards low GHG emissions and climate-resilient development.</li> <li>• Establishing a global goal on adaptation of enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change, with a to contributing to sustainable development and ensuring an adequate adaptation response in the context of the temperature goal</li> </ul> | <p>Four Priorities for Action:</p> <p>Priority 1. Understanding disaster risk</p> <p>Priority 2. Strengthening disaster risk governance to manage disaster risk</p> <p>Priority 3. Investing in disaster risk reduction for resilience</p> <p>Priority 4. Enhancing disaster preparedness for effective response and to “Build Back Better” in recovery, rehabilitation and reconstruction</p> | 17 goals aiming to end poverty, hunger and inequality, take action on climate change and the environment, improve access to health and education, build strong institutions and partnerships, and more. |
| <b>Mandate</b>                        | voluntary   | voluntary, non-binding   | voluntary, non-binding  |
| <b>Key players for implementation</b> | Governments, EU, private sector and other societal players  | Governments, EU, regional, sub-regional and transboundary cooperation, communities and businesses  | Governments, EU, private sector, civil society  |
| <b>Monitoring/ reporting systems</b>  | Under development   | 38 indicators available (UN, 2016)   | 232 indicators available (UN, 2017b)  |

Sustainable development has long been on the agenda of the European Union. The EU Sustainable Development Strategy (EU SDS) was adopted first by the European Council in June 2001 (EC, 2001) and



reviewed several times (EC 2006, EC 2009). The EU is also committed to play an active role towards the implementation of the SDGs as outlined in the ECs Communication (EC, 2016c). More recently, the emphasis has been on mainstreaming sustainable development into the Europe 2020 Strategy and on implementing the UN Sustainable Development Goals. Since 2005, Eurostat has regularly produced biennial monitoring reports reflecting on the implementation of the EU SDS (EC, 2017). In support of the SDGs, Eurostat is aiming to bring the monitoring reports of the EU SDS in line with future regular monitoring of the SDGs in an EU context. Therefore, a first indicator-based report was published by Eurostat in November 2016 (Eurostat, 2016) to provide statistics on how the EU and its Member States perform regarding the implementation of the SDGs. This report presents information on 51 indicators presenting the broad objectives and ambitions of the SDGs, for which each SDG is represented by up to four indicators. Overall, the indicators are based on official statistics available in Eurostat's online database, but also data and indicators from some other sources - including EEA – are used <sup>(18)</sup>. In 2017 a report entitled “Sustainable development in the European Union – Monitoring report on progress towards the SDGs in an EU context” built on the EU SDG indicator set and developed it further. The indicator set comprises 100 indicators that are structured along the 17 SDGs (see Table 3.2). They will be open to regular reviews in line with informing future policy developments and will take into account new indicators as they become available (Eurostat, 2017). The most recent update was published by Eurostat in September 2018 (Eurostat, 2018).

**Table 3.2 Indicators with relevance for climate impacts, initiatives and adaptation included in the European SDG indicators**

| Nr. | European Indicators relevant for climate impacts, initiatives and adaptation   | SDG    |
|-----|--|--------|
| 1.  | Severely materially deprived people  | 1      |
| 2.  | Self-reported unmet need for medical care  | 1, 3   |
| 3.  | Population unable to keep home adequately warm   | 1, 7   |
| 4.  | Population living in a dwelling with a leaking roof, damp walls, floors or foundation or rot in window frames or floor | 1, 11  |
| 5.  | Area under organic farming   | 2      |
| 6.  | Mean near surface temperature deviation  | 13     |
| 7.  | Climate-related economic losses  | 13     |
| 8.  | Mean ocean acidity   | 13, 14 |
| 9.  | Contribution to the 100 billion <sup>(a)</sup> international commitment on climate-related expending                   | 13     |
| 10. | Population covered by the Covenant of Mayors for Climate and Energy signatories  | 13     |
| 11. | Share of forest area   | 15     |
| 12. | Change in artificial land cover  | 15     |

<sup>(a)</sup> 1 billion = 1000 million

### 3.3 Relevance of international frameworks for monitoring adaptation on national level

Indicators from SFDRR as well as from the SDG process can be linked to and are partly relevant for monitoring climate change adaptation. This might offer opportunities through shared indicators, joint implementation, capacity building and mutual support in policy implementation (UNEP, 2017, p.17).

<sup>(18)</sup> <http://ec.europa.eu/eurostat/data/database>, accessed 22/11/2017.

Table 3.3 presents a selection of 20 indicators with reference to or relevance for climate change adaptation included in SDG and SFDRR. These demonstrate the potential for clear synergies with adaptation as these available indicators also provide some information relevant to monitoring adaptation. Interestingly, some of the indicators are used to measure various goals of the frameworks and/or are included in both, the SDG and Sendai Framework (cf. Indicator 1 and 8 in Table 3.3). In other cases, indicators proposed in SDG and SFDRR are similar, although the wording and the level of detail may vary (cf. Indicators 3, 4, 5 and 6). While indicator 10, included in the SDG Framework, refers to the number of countries with a NAS/NAP in place, a comparable indicator is not included in the SFDRR. Overall, indicators included in the SDG framework go far beyond issues related to disaster risk reduction (main aim of SFDRR) and additionally focus on aspects such as water security, land use, etc. (cf. Indicators 15-20).

**Table 3.3 Indicators with relevance for adaptation included in the SDGs and/or in SFDRR**

| Nr. | Indicators relevant for adaptation  | Covered in SDG            | Covered in SFDRR |
|-----|---|---------------------------|------------------|
| 1.  | Number of deaths, missing persons and directly affected persons attributed to disasters per 100,000 population  | 1.5.1<br>11.5.1<br>13.1.1 | A-1              |
| 2.  | Number of directly affected people attributed to disasters, per 100,000 population (including population injured or ill, whose dwelling is damaged or destroyed, and whose livelihood is disrupted or destroyed)  |                           | B-1              |
| 3.  | Direct economic loss in relation to global GDP, damage to critical infrastructure and number of disruptions to basic services, attributed to disasters  | 11.5.2                    |                  |
| 4.  | Damage to critical infrastructure attributed to disasters (including health and educational facilities damaged or destroyed and critical infrastructure units and facilities)   |                           | D-1              |
| 5.  | Direct economic loss attributed to disasters in relation to global GDP (including losses from agriculture, housing sector, productive assets, critical infrastructure and cultural heritage damaged or destroyed)   |                           | C-1              |
| 6.  | Direct economic loss attributed to disasters in relation to GDP   | 1.5.2                     |                  |
| 7.  | Number of disruptions to basic services attributed to disasters (including educational, health and other basic services)  |                           | D-5              |
| 8.  | Number of countries that adopt and implement national disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015-2030  | 13.1.2                    | E-1              |
| 9.  | Proportion of local governments that adopt and implement local disaster risk reduction strategies in line with national disaster risk reduction   | 13.1.3                    |                  |
| 10. | Number of countries that have communicated the establishment or operationalization of an integrated policy/strategy/plan which increases their ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production (including a national adaptation plan, nationally determined contribution, national communication, biennial update report or other) | 13.2.1                    |                  |
| 11. | Total official international support, (official development assistance (ODA) plus other official flows), for national disaster risk reduction actions   |                           | F-1              |
| 12. | Number of countries that have communicated the strengthening of institutional, systemic and individual capacity-building to implement adaptation, mitigation and technology transfer, and development actions   | 13.3.2                    |                  |
| 13. | Number of countries that have integrated mitigation, adaptation, impact reduction and early warning into primary, secondary and tertiary curricula  | 13.3.1                    |                  |
| 14. | Number of countries that have multi-hazard early warning systems  |                           | G-1              |
| 15. | Proportion of agricultural area under productive and sustainable agriculture  | 2.4.1                     |                  |
| 16. | Percentage of agricultural households using irrigation systems compared to all agricultural households  | 2.4.2                     |                  |
| 17. | Change in water-use efficiency over time  | 6.4.1                     |                  |
| 18. | Degree of integrated water resources management implementation (0-100)  | 6.5.1                     |                  |
| 19. | Proportion of transboundary basin area with an operational arrangement for water cooperation  | 6.5.2                     |                  |
| 20. | Progress towards sustainable forest management  | 15.5.1                    |                  |

Due to national differences in vulnerabilities and risks, but also priorities and many other factors, there will be differences in the importance of these indicators for monitoring adaptation at the national level. In assessing their relevance for the national level, it is important to note that the ambition of the SDG

and SFDRR indicator sets is to provide global overviews of progress. In addition, the proposed indicators include metadata description that might not provide sufficient details for monitoring the progress of implementing adaptation measures at national level. Furthermore, the availability and quality of the data for the suggested indicators may vary significantly from country to country and in many cases may be insufficient. However, in addition to the list of indicators at the global level, a European indicator set of 100 indicators (of which 41 are multi-purpose, which means they are relevant for the monitoring of several SDGs) is there to understand the progress at EU level towards the global SDGs (see Table 3.2, Eurostat, 2017). These include trend categories (progress or movement away from the Sustainable Development Objectives) for the long-term (past 15 years period) and short-term (past 5 years period). The indicators have been selected taking into account their policy relevance from an EU perspective, availability, country coverage, data freshness and quality. With a few exceptions, the indicators stem from already existing indicator sets used for monitoring long-term EU policies. Nevertheless, the EU SDG indicator set will be open to regular reviews in line with future policy developments and to consider new indicators as methodologies, technologies and data sources evolve over time (Eurostat, 2017).<sup>(19)</sup>

Overall, the UNFCCC Adaptation Committee stated at the Technical expert meeting on adaptation (TEM-A) in May 2017 that national stakeholders need to integrate all three global frameworks – SFDRR, SDGs and Paris Agreement – as they are centred on the national level (TEM-A, 2017). This further highlights the need to enhance already existing forms of collaboration and coordination between actors responsible for developing MRE of adaptation, with those working on monitoring of SDGs and DRR at national level. Thus, developed indicators shall support the other global agreements and frameworks in terms of monitoring and evaluation of implementation progress. The overlaps at indicator level from SDG and SFDRR have been showcased in Table 3.3 above. Nevertheless, the context-specificity of adaptation makes it impossible to develop a common set of indicators for all countries to comprehensively assess global progress towards the global adaptation goal (Kato and Ellis, 2016).

### 3.4 Other international work on indicator development with relevance for adaptation

Besides the described UN agreements and frameworks, on the international level, different actors like the European Commission’s Joint Research Centre (JRC) or the Global Climate Alliance Plus are currently working on global databases or global indices. Some of these indicators might inform or inspire national monitoring systems, thus, they are briefly described in the following.

Indices showcased in the boxes below can have a supporting role in terms of monitoring current and potential future impacts as well as supporting effective risk and vulnerability assessments leading to successful adaptation. Indices or sets of indicators can support comparison between countries, especially if normative choices related to indicator selection and aggregation methods are communicated in a transparent way (Ford et al., 2015; Ford and Berrang-Ford, 2016).

|                  |   |
|------------------|---|
| <b>Title:</b>    | INFORM – Index for Risk Management  |
| <b>Aim:</b>      | A global, open-source risk assessment for humanitarian crises and disasters. It aims to support decisions about prevention, preparedness and response.  |
| <b>Result:</b>   | Annual reports for the country level and partly for the sub-national level. All the source data and the calculation steps for functional levels, categories and dimension are available as downloads on the webpage. Detailed country information is available and five year coverage makes it easier to analyse risk trends (2013-2017). |
| <b>Partners:</b> | INFORM is a collaboration of the Inter-Agency Standing Committee Reference Group on Risk, Early Warning and Preparedness and the European Commission.   |

<sup>(19)</sup> The most recent update was published by Eurostat in September 2018 (Eurostat, 2018).

**URL:** <http://www.inform-index.org>

**Title:** ND -GAIN – Notre Dame Global Adaptation Index

**Aim:** Building resilience to climate change as a key component to better prepare humans and their environment for the coming century.

**Result:** The flagship asset is the free and open-source Country Index, the world's leading index showing which countries are prepared to handle global changes brought about by overcrowding, resource-constraints and climate disruption, ranking countries based on their vulnerability and, uniquely, how ready they are to adapt. The Country Index summarizes a country's vulnerability to climate change and other global challenges in combination with its readiness to improve resilience. It aims to help businesses and the public sector better prioritize investments for a more efficient response to the immediate global challenges ahead.

**Partners:** ND -GAIN is part of the Climate Change Adaptation program of the University of Notre Dame Environmental Change Initiative

**URL:** <http://gain.org/>

**Title:** GCCA+ Index

**Aim:** Help the most vulnerable countries mitigate and adapt to the worst impacts of climate change.

**Result:** The Indicator is made up of 34 country-specific indicators and covers social, economic and environmental aspects critical in helping Least Developed Countries and Small Island States achieve 'climate-resilient' development. The open source index is accessible via a web platform that serves as an interface between science and policy

**Partners:** European Commission's Joint Research Centre (JRC) to support the Global Climate Change Alliance Plus (GCCA+)

**URL:** <http://www.gcca.eu/about-the-gcca/jrc-gcca-index>

**Title:** DARA Climate Vulnerability Monitor

**Aim:** Help to keep watch on current and expected impacts caused by climate change and to promote understanding and debate around its growing dangers and how to deal with them

**Result:** Tool to assess the vulnerability of our world to the many effects of climate change

**Partners:** DARA and the Climate Vulnerable Forum developed the Climate Vulnerability Monitor with critical input from leading international thinkers

**URL:** <http://daraint.org/climate-vulnerability-monitor/>

**Title:** TAMD – Tracking Adaptation and Measuring Development

**Aim:** A framework to evaluate the management of climate risks and the assessment of the development outcomes and climate resilience.

**Result:** An aggregable and scalable approach for adaptation-specific indicators. So far only used for some pilot countries (as significant resources are needed), with the potential to adapt the framework and combine it with other tools to have a global assessment.



**Partners:** International Institute for Environment and Development (IIED) with the Department for International Development (DFID, UK)  
**URL:** <https://www.iied.org/tracking-adaptation-measuring-development-tamd>

**Title:** PPCR – Pilot Program for Climate Resilience  
**Aim:** A scoring-based framework for adaptation governance and tracking progress towards climate resilient development.  
**Result:** A country-level aggregable framework balancing sensitivity to the national context with transparency and comparative metrics.  
**Partners:** Climate Investment Funds together with all major development banks  
**URL:** <http://www.climateinvestmentfunds.org/sites/default/files/results-2015/ppcr/index.html>

**Title:** TRAC<sup>3</sup> – Tracking Adaptation to Climate Change Consortium  
**Aim:** TRAC<sup>3</sup> facilitates new and innovative research that improves the understanding of adaptation to climate change around the world.  
**Result:** Data collection, research and publications across a number of major work streams that are characterizing adaptation at the national and local levels and examining drivers and facilitators of adaptation policies and programs.  
**Partners:** McGill University (Montreal, Canada) and Wageningen University (Netherlands)  
**URL:** <http://trac3.ca/>

The following chapter 4 zooms in from the international to the European level. It focuses on the European Union's role in monitoring progress in national level adaptation.

## 4 European processes for reporting on national level adaptation

### 4.1 Several reporting processes are relevant for adaptation

At the European level information on adaptation policies and actions at the national level is collected in a few ways and there are only limited formal requirements for Member States to report on adaptation to the EU. This chapter presents the main features of processes in place at the European level to track national level progress on adaptation. It discusses both current and foreseen reporting requirements as well as other key processes in which national level information on adaptation is collected for aggregation at the European level.

### 4.2 Monitoring Mechanism Regulation and the Energy Union Governance

Formal requirements for reporting on climate change adaptation by Member States to the European Commission, arise from the Monitoring Mechanism Regulation (EU, 2013, MMR). This reporting is supported by EEA as all Member States use EEA's Reportnet and support. Art. 15 of the MMR describes the requirements for reporting by Member States on national adaptation actions. The first MMR reporting on adaptation took place in 2015 <sup>(20)</sup>, and is scheduled to repeat every four years aligned with reporting to the UNFCCC with the next reporting deadline in March 2019.

The MMR reporting guidance is descriptive and does not include any requirements for indicators as such. Rather Member States are requested to provide information on the following areas:

1. Policy and legal framework (adaptation strategies and plans);
2. Information on impacts, vulnerability and adaptation (observations and projections, impact and vulnerability assessments, research and monitoring progress);
3. Priority sectors and adaptation action; and
4. Engaging stakeholders: participation and capacity building (governance, and adaptation capacity, dissemination, education, training).

The contributions from Member States submitted in the MMR reporting form a basis for the country information available on the European climate adaptation portal Climate-ADAPT <sup>(21)</sup>. This way the reported information is available and accessible to all interested parties and countries can learn from the experiences and actions of other countries.

Requirements on Member States' reporting on adaptation from 2021 onwards is one of the elements in the foreseen Energy Union Governance Regulation (EC, 2016e). The EC proposal includes in Art. 17 a two-year reporting cycle and that Member States report information on:

- a) the main goals, objectives and institutional framework for adaptation;
- b) climate change projections including weather extremes, climate-change impacts, assessment of climate vulnerability and risks and key climate hazards;
- c) adaptive capacity;
- d) adaptation plans and strategies;
- e) institutional settings including vertical and horizontal governance and coordination, monitoring and evaluation systems;
- f) progress made in implementation, including good practices and governance changes (EC, 2016a, Annex VI).

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<sup>(20)</sup> <http://rod.eionet.europa.eu/obligations/703/deliveries>

<sup>(21)</sup> <http://climate-adapt.eea.europa.eu/countries-regions/countries>

Thus, the overall content of the proposed reporting on adaptation under the Governance of the Energy Union Regulation is rather similar to the current reporting requirements under the MMR. In June 2018 a political agreement on the proposal was reached by the co-legislators, the European Parliament and the Council of the European Union, and adoption of the Regulation is foreseen by end of 2018. While it is currently unclear if and possibly what kind of indicators might be included, it is likely that future reporting will build on work initiated under the current MMR reporting.

### 4.3 EU Adaptation Strategy

Action 1 of the EU Adaptation Strategy is to encourage all Member States to adopt comprehensive adaptation strategies (EC, 2013). The strategy states that the Commission will develop an adaptation preparedness scoreboard, including key indicators for measuring the level of readiness of Member States. While this process does not entail formal reporting requirements for European countries, countries have been consulted in the process of developing the scoreboard and have an important role in the information generation and collection.

A first draft of the scoreboard was prepared by the European Commission in 2014 and the first round of templates was filled for all 28 Member States in 2014-2015. Based on experiences in the first round and input from Member States, the scoreboard has since been revised. In 2017 the revised scoreboard (EC, 2017c) was used by the European Commission to collect information from Member States primarily for the ongoing evaluation of the EU Adaptation Strategy. Overall, the scoreboard facilitates developing an overview of progress on adaptation policy-making and implementation at national level in EU Member States.

The adaptation scoreboard has a process-based approach. Its indicators focus on different steps of the adaptation policy-making process, starting with (1) preparing the ground for adaptation, (2) assessment of risks and vulnerabilities, (3) identification of adaptation options and (4) their implementation through to (5) monitoring and evaluation. For each step, main areas of performance are specified and each is broken down to various key domains of relevance as shown in Table 4.1.

The scoreboard indicators aim for an overview of progress in adaptation policy processes across European countries. It is important to note that the 2017 revised scoreboard was used to evaluate the EU Adaptation Strategy. As such, the questions have been assessed with specific objectives in mind, which may somewhat differ from the objectives of monitoring and evaluation of adaptation at national level. Most countries are likely to benefit from assessing the applicability and usefulness of its indicators for their national level monitoring and evaluation needs.

The scoreboard creates opportunities for systematic analysis of progress of adaptation over time within a particular country and it can provide countries with inspiration and guidance in the assessment of their national adaptation policy processes, by learning from other countries' experiences'. In addition, after the Commission will publish the scoreboards, these will become available for anyone interested in analysing adaptation policies across countries, while taking into account the methodological limitations of the scoreboard. The scoreboard indicators can be particularly helpful for countries developing adaptation indicators, insofar as they wish to include indicators focussed on the adaptation policy process. However, differences across countries are likely in the ways they can benefit from the scoreboard indicators in their national policy review processes. Countries that are in earlier stages of their adaptation planning may find it useful for identifying relevant dimensions of the adaptation policy process. For countries with more established adaptation policies and programmes, the scoreboard indicators can work as a useful tool for benchmarking and reflection.

**Table 4.1 EU Adaptation Scoreboard**

| Main area of performance   | #  | Key domain of relevance   |
|--|----|---|
| <b>Step 1: Preparing the ground for adaptation</b>   |    |   |
| 1. A country-wide governance system is in place for adaptation policy making and vertical and horizontal coordination arrangements are in place between governmental bodies        | 1a | A central administration body officially in charge of adaptation policy making  |
|  | 1b | <b>Horizontal</b> (i.e. sectoral) coordination mechanisms exist within the governance system, with division of responsibilities   |
|  | 1c | <b>Vertical</b> (i.e. across levels of administration) coordination mechanisms exist within the governance system, enabling lower levels of administration to influence policy making.  |
| 2. Stakeholders (e.g. interest groups, scientists and general public) are involved in the preparation of adaptation policies   | 2a | A dedicated process is in place to facilitate stakeholders' involvement in the preparation of adaptation policies   |
|  | 2b | Transboundary cooperation is planned to address common challenges with relevant countries   |
| <b>Step 2: Assessing risks and vulnerabilities to climate change</b>   |    |   |
| 3. Systems are in place to monitor and assess current and projected climate change, impacts and vulnerability  | 3a | Observation systems are in place to monitor climate change, extreme climate events and their impacts  |
|  | 3b | Scenarios and projections are used to assess the economic, social and environmental impacts of climate change, taking into account geographical specificities and best available science (e.g. in response to revised IPCC assessments)   |
|  | 3c | Sound climate risks/vulnerability assessments for priority vulnerable sectors are undertaken to support adaptation decision making. The selection of vulnerable sectors may be based on a lighter pre-screening vulnerability assessment. |
|  | 3d | Climate risks/vulnerability assessments take transboundary risks into account, when relevant  |
| 4. Knowledge gaps on climate change and climate change adaptation are tackled  | 4a | Work is being carried out to identify, prioritise and address the knowledge gaps  |
| 5. Knowledge transfer processes are in place to build adaptive capacity across sectors   | 5a | Adaptation relevant data and information is available to all stakeholders, including policy makers (e.g. through a dedicated website or other comparable means).  |
|  | 5b | Capacity building activities take place; education and training materials on climate change adaptation concepts and practices are available and disseminated  |
| <b>Step 3: Identifying adaptation options</b>  |    |   |
| 6. For priority sectors, a range of adaptation options is considered, consistent with the results of sectoral risk assessments and taking into account good practices and measures | 6a | Adaptation options address the sectoral risks identified in 3c, the geographical specificities identified in 3b and follow best practices in similar contexts   |
|  | 6b | The selection of priority adaptation options is based on robust methods (e.g. multi-criteria analyses, stakeholders' consultation, etc.) and consistent with existing decision-making frameworks  |
|  | 6c | Mechanisms are in place to coordinate disaster risk management and  |

|  |     |  |
|--|-----|--|
|  |     | climate change adaptation and to ensure coherence between the two policies.  |
| 7. Dedicated and adequate funding resources have been identified and made available to implement adaptation action   | 7a  | Funding is available to increase climate resilience in vulnerable sectors and for cross-cutting adaptation action  |
| <b>Step 4: Implementing adaptation action</b>  |     |  |
| 8. Climate change adaptation is mainstreamed into priority and key national planning and sectoral policymaking   | 8a  | Consideration of climate change adaptation has been included in the national frameworks for environmental impact assessments   |
|  | 8b  | Prevention/preparedness strategies in place under national disaster risk management plans take into account climate change impacts and projections   |
|  | 8c  | Key land use, spatial planning, urban planning and maritime spatial planning policies take into account the impacts of climate change  |
|  | 8d  | National policy instruments promote adaptation at sectoral level, in line with national priorities and in areas where adaptation is mainstreamed in EU policies                                      |
|  | 8e  | Adaptation is mainstreamed in insurance or alternative policy instruments, where relevant, to provide incentives for investments in risk prevention  |
| 9. Climate change adaptation policies and measures are implemented   | 9a  | Adaptation policies and measures are implemented, e.g. as defined in action plans or sectoral policy documents   |
|  | 9b  | Cooperation mechanisms in place to foster and support adaptation at relevant scales (e.g. local, subnational)  |
|  | 9c  | Procedures or guidelines are available to assess the potential impact of climate change on major projects or programmes, and facilitate the choice of alternative options, e.g. green infrastructure |
|  | 9d  | There are processes for stakeholders' involvement in the implementation of adaptation policies and measures.   |
| <b>Step 5: Monitoring and evaluation</b>   |     |  |
| 10. Systems are in place to monitor and report on climate change adaptation, including adaptation-related expenditures, via relevant indicators            | 10a | NAS/NAP implementation is monitored and the results of the monitoring are disseminated.  |
|  | 10b | The integration of climate change adaptation in sectoral policies is monitored and the results of the monitoring are disseminated.   |
|  | 10c | Regional, sub-national or local action is monitored and the results of the monitoring are disseminated   |
| 11. An evaluation framework is in place to assess whether adaptation policy objectives are met and a periodic review of the adaptation strategy is planned | 11a | A periodic review of the national adaptation strategy and action plans is planned  |
|  | 11b | Stakeholders are involved in the assessment, evaluation and review of national adaptation policy   |

The scoreboard indicators are supported by country fiches that provide detailed information related to aspects of adaptation policymaking process covered in the scoreboard. The scoreboard and the draft country fiches have been made publicly available by the Commission as part of the public consultation on the evaluation of the EU adaptation strategy <sup>(22)</sup>, which will also enhance opportunities for learning across countries. The assessments in the scoreboard (yes / no / in progress) need to be read in conjunction with the narrative that accompanies them. The scoreboard assesses the state of play within a country and the assessments should not be directly compared across countries although effort has been made by the European Commission and its consultants to ensure coherence.

#### 4.4 Sectoral reporting requirements: examples from the water and biodiversity sectors

Sectoral EU policies include reporting requirements that can be useful for monitoring adaptation. Relevant requirements at EU level arise for instance within the water sector and also to some extent the biodiversity sector <sup>(23)</sup>.

Water and climate change are intrinsically linked and the water sector is one of the main sectors relevant for climate change adaptation (EC, 2012). While climate change adaptation is not explicitly referred to in the Water Framework Directive (EU, 2000) or the Floods Directive (EU, 2007), in practice requirements for the consideration of climate change adaptation have been added in river basin management and flood risk management planning processes. In 2009, EU Member States agreed during the drafting of the *Guidance on river basin management in a changing climate* (CIS WFD, 2009) that climate-related threats and adaptation planning should be incorporated in the river basin management plans (RBMP) from the second planning cycle onwards (2009-2015 and 2015-2021). As a minimum, the plans should demonstrate 1) how climate change projections have informed the assessment of pressures and impacts, 2) how the monitoring programmes are configured to detect climate change impacts, and 3) how selected measures are robust to projected climate conditions. Of 31 countries <sup>(24)</sup>, the RBMPs by 22/12/2015 and reported by 22/03/2016 for 24 countries reported on the use of the CIS guidance (CIS WFD, 2009) on how to include climate change adaptation in the Water Framework Directive and Floods Directive and 21 of them used the guidance at least for one river basin district within their territory. In addition, for 13 countries at least one river basin district has a key type measure (KTM) called “climate change adaptation”. Similarly, for flood risk management plans (FRMP) the likely impacts of climate change on the occurrence of floods have to be taken into account, but strictly considered for the review of FRMPs only, i.e. only for the second round of FRMPs from 2021 and thereafter. The cyclical nature of preparing RBMPs and FRMPs every six years and reporting on their implementation provides a regular supply of adaptation relevant information for national level monitoring and evaluation of adaptation. However, the relative infrequency of such information can limit the relevance, as more frequent data may be of interest for the purposes of monitoring progress in national adaptation policies and their implementation.

Biodiversity is another sector where overlaps with climate change adaptation have been identified and are visible particularly in the field of indicator development (ETC/CCA, 2017). At the European level, climate change adaptation is not included at the level of legislation in the Habitats Directive (EU, 1992) or the Birds Directive (EU, 2010). However, climate change features strongly in the Biodiversity 2020 Strategy (EC, 2011). At the EU level, the Mapping and Assessing of Ecosystem Services (MAES, <sup>(25)</sup>) is an

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<sup>(22)</sup> [https://ec.europa.eu/clima/consultations/evaluation-eus-strategy-adaptation-climate-change\\_en](https://ec.europa.eu/clima/consultations/evaluation-eus-strategy-adaptation-climate-change_en)

<sup>(23)</sup> While this section focuses on European level requirements, sectoral monitoring and reporting requirements at the national level may cover adaptation relevant information. Such sectors are particularly relevant to consider in the process of developing of adaptation indicators at national level. (ETC/CCA, 2017)

<sup>(24)</sup> EU-28 countries plus Iceland, Liechtenstein and Norway, based on a preliminary analysis of the River Basin Management Plans, [https://public.tableau.com/profile/wfd.assesment#!/vizhome/16\\_NoDataTest/16\\_Adaptationtodroughtandclimatechange](https://public.tableau.com/profile/wfd.assesment#!/vizhome/16_NoDataTest/16_Adaptationtodroughtandclimatechange), last accessed at 14/08/2017.

<sup>(25)</sup> <https://biodiversity.europa.eu/maes>



important project in which 5 main pressures on ecosystems and habitat change are identified. Besides climate change, these are habitat change, overexploitation of resources, invasive alien species and pollution or nutrient enrichment (EEA, 2016b). For each of the main ecosystems various sources, including data reported by Member States under Birds and Habitat Directives on conservation status and main pressures are used to assess the condition of Europe's ecosystems.

The large amount of natural hazards and sustainability indicators (and the subset of them having a link to adaptation) at the global and European level, will be difficult to interpret with a risk that the SDGs will provide diluted guidance at best. Therefore, EEA is involved in the DISTINCT project (Distill SusTainability INdiCaTors) that will perform statistically advanced analyses to evaluate the general level of sustainability of the countries of the world, with a special focus on Europe. DISTINCT will have important policy and measuring impacts, highlighting the leading role of the EU in the UN agenda for Sustainable Development.

In addition, many European countries have developed and are using indicators for monitoring their national biodiversity strategies, often following international commitments including the EU Biodiversity Strategy. Identified overlaps offer the potential for synergies in the form of using existing biodiversity indicators to monitor climate change adaptation in the field natural environment and biodiversity conservation. In the case of the UK, several biodiversity indicators (e.g. number of farmland bird species in decline (short-term and long-term), number of farmland bat species in decline, number of pollinator species in decline (long-term and short-term), area of agricultural land under targeted agri-environmental schemes (HLS), combined input of most hazardous substances to marine environment) of Defra are also considered in the monitoring and evaluation scheme of the UK National Adaptation Programme, in the context of the theme 'Natural Environment'. It is important that existing indicators are carefully assessed for their relevance for monitoring adaptation (ETC/CCA, 2017).

The above examples show that European reporting requirements can support national monitoring of adaptation in terms of indicator selection and development. Particularly, the EU adaptation scoreboard provides a broad range of process-related indicators, and sectoral reporting requirements include more quantitative indicators that can inform the consideration of climate change impacts and risks in specific sectors and/or ecosystems. In each case, it is important to assess the relevance of any existing indicators, whether from another sector, ecosystem or administrative level, for their fitness with the objectives and information needs of national monitoring and evaluation of adaptation. Likewise it is important to understand the assumptions, limitations and uncertainties associated with each indicator to better inform its interpretation. The following chapter presents existing national adaptation indicator sets from five European countries and discusses the emerging differences and similarities in the approaches selected by countries.

## 5 Adaptation indicators used for monitoring national adaptation across Europe

This chapter presents an overview of adaptation indicators used by five European countries (Austria, Finland, Germany, Scotland and the United Kingdom) for monitoring climate change adaptation at national level. Based on the first systematic collection of adaptation indicator information, this chapter reflects on key features of the national indicator sets for adaptation, including sectors and climate impacts covered by indicators, types of limitations observed in relation to indicators, and reporting of indicators.

In section 5.1, overview tables summarise the adaptation policy framework focusing on the role of MRE, the process through which national adaptation indicators were developed, and key features of the adaptation indicator sets and their status in mid-2017 for Austria, Finland, Germany and the UK, and mid-2018 for Scotland.

Section 5.2 looks across the adaptation indicators collected from these five countries. Observations are based on the collected indicator information available in detail in the database that was compiled in parallel with this report. The indicator database presents information on nearly 400 adaptation indicators and is available as an electronic annex to this report <sup>(26)</sup>. More information on the collected metadata included in the database is described in

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<sup>(26)</sup> Available at [https://cca.eionet.europa.eu/docs/ANNEX\\_TP\\_3-2018](https://cca.eionet.europa.eu/docs/ANNEX_TP_3-2018)

#### Annex I: Database guidance document.

The choice of the database structure aims to best capture the characteristics of indicators from all the five countries whose indicators were available, recognising that this structure might be less suitable for some countries compared to their individual classification and structure. Nevertheless, such a common structure for all indicators was applied, as the ETC/CCA believes it is the best compromise to understand commonalities and differences, opportunities and limitations, and share learning experiences.

## 5.1 National adaptation indicator sets

**Table 5.1 Summary tables of national indicator sets for adaptation and their development**

| <b>Austria</b>                                     |  |
|--|--|
| <b>Adaptation policy process with focus on MRE</b> | A national adaptation strategy (NAS) was adopted on 23 October 2012 by the Council of Ministers and endorsed by the Provincial Governors' Conference on 16 May 2013. The Austrian NAS consists of two parts: a Strategic Framework (or "Context") and an Action Plan. The strategy intends to create a national framework to ensure coordination and harmonisation of the various climate change adaptation activities in all areas. In August 2017, a revised version of the NAS and the NAP was adopted by the Austrian Council of Ministers and again endorsed by the Provincial Governors' Conference. The NAP presents a catalogue of 136 adaptation measures for 14 areas for action (agriculture, forestry, water resources and water management, tourism, energy, protection from natural hazards, construction and housing, disaster risk management, health, ecosystems and biodiversity, transportation infrastructure and selected aspects of mobility, spatial planning, business/industry/trade, and cities with a focus on urban green and open spaces). A progress report on the state of implementation of the measures described in the NAP was adopted by the Council of Ministers in 2015 and also taken note of by the Provincial Governors. Monitoring and evaluation of the NAS/NAP is based on a twofold and pragmatic approach closely related to the NAP: The 1st module is a stakeholder survey ("self-assessment approach" based on the NAP, sent to the key actors mentioned therein); the 2nd module presents a criteria-approach ("indicator-based approach" with qualitative and quantitative data collections). |
| <b>Indicator development process</b>               | Representatives of the federal level and provincial states as well as further relevant stakeholders (including scientists) have been involved in the establishment of a monitoring and evaluation system in Austria. Adaptation criteria (indicators) have been developed in an iterative process based on a literature review and expert knowledge. First, a stakeholder workshop with national and provincial policymakers was held to gain feedback on possible adaptation indicators identified based on literature review. Second, expert interviews were conducted to inform the final selection of the indicators and to discuss data sources and availabilities.   |
| <b>Description of indicator set</b>                | The final set of 45 indicators covers 13 sectors (except urban green areas) of the NAP with around four indicators assessing each sector (some provide information for more than one sector). The indicators selected describe the adaptation process (e.g. mainstreaming adaptation into funding programmes), the output (e.g. share of biologically cultivated land) or the outcome (e.g. decreased number of exposed infrastructure and buildings in flood risk areas). Nearly all indicators chosen have been used for other policy questions and circumstances before and, thus, data sources are available (ETC/EEA 2015).   |
| <b>Status of indicators in mid-2017</b>            | The first set of indicators was published in 2014. For the next progress report in 2020, this current indicator set will be revised and very likely changed without losing information on the baseline of adaptation (referring to 2015).  |
| <b>Reporting of indicators</b>                     | The set of indicator has been used for reporting on adaptation and the results have been summarised in the First National Progress Report of Adaptation to Climate Change in 2015. Future monitoring, reporting and evaluation is planned on a five-year-cycle. The next Progress report on adaptation can be expected in 2020.  |
| <b>Sources</b>                                     | Climate-ADAPT, National Progress report (BMLFUW, 2015), EEA (2015)   |
| <b>Finland</b>                                     |  |

|  |   |
|--|---|
| <b>Adaptation policy process with focus on MRE</b> | Finland was one of the first countries to adopt a National Adaptation Strategy (NAS) in 2005. Following the principle of mainstreaming, it was primarily implemented through sectoral action but regular efforts to monitor the implementation at each sector were not initiated at that time. Rather progress in the first years was followed through work of the National Adaptation Coordination Group and through two evaluation processes in 2008-2009 (mid-term evaluation) and 2012-2013 (final evaluation), which fed into the NAS revision process. In November 2014 the national adaptation policy framework was updated when the <i>National Climate Change Adaptation Plan 2022 (NAP)</i> was adopted. The NAP includes a measure to ensure continuous monitoring and evaluation of the scale and effectiveness of the Plan. Development of national adaptation indicators started in 2015 against this background.         |
| <b>Indicator development process</b>               | The indicator set was developed in a participatory process involving over 50 experts from various backgrounds. During the process, a broad list of preliminary indicators was identified. In consultation with data providers and other key stakeholders, indicators requiring further development were screened out. Availability of well-established data sources was a key selection criterion because resources for developing new indicators are not foreseen. Transparency and comprehensibility across sectoral borders were other key selection criteria. The indicator development process also included screening of potential connections with the set of national sustainable development indicators that was under development at the same time. Indicator development process is seen as an iterative process. Permanent mechanisms for further development, data collection and reporting have not yet been agreed upon. |
| <b>Description of indicator set</b>                | <p>The Finnish adaptation indicators are organised into seven thematic indicator baskets, each currently including approximately three indicators. In total there are 24 indicators. The indicator baskets are organised in a matrix structure including: <i>three columns of main climate impacts</i> (extreme weather conditions, temperature changes, rising water levels) and <i>three rows of indicator types/categories</i> (impact indicators, risk indicators, and indicators for implementation and decision making).</p> <p>This way of organising the indicator set shows that the indicators are not aligned to the structure/form of the NAP. The indicators focus mainly on key climate impacts and risks relevant for Finland and their implications for activities in a range of sectors, rather than directly describing specific adaptation measures.</p>   |
| <b>Status of indicators in mid-2017</b>            | The first set of national adaptation indicators was agreed in May 2017. A number of additional indicators have been identified for further development to enable a more comprehensive and balanced indicator set.   |
| <b>Reporting of indicators</b>                     | By October 2017, the Finnish adaptation indicators had not yet been formally reported. A rolling release and update of the indicators along with contextual description/interpretation of the data is foreseen. A separate report presenting the suggested indicators has been published. It has been proposed that the indicator set should be published and updated as a part of suitable national online indicator portal such as the national climate change platform Climate Guide. Ensuring wide usability of indicators across different societal sectors is emphasized as a key success factor of future indicator reporting.   |
| <b>Source</b>                                      | Arnkil, et al., 2017  |

| Germany  |  |
|--|--|
| <b>Adaptation policy process with focus on MRE</b> | <p>In Germany, adaptation to climate change is a permanent task established along an agreed and politically adopted institutional and methodological framework. Scientific research programmes, participation and consultation processes as well as the establishment of on-going reporting systems are set up. On the national level nearly all federal ministries are represented in the “Interministerial Working Group on Adaptation to Climate Change” (IWG Adaptation), led by the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety. To coordinate adaptation activities with the federal states the Conference of Environmental Ministers established in June 2009 a standing committee for the adaptation to climate change impacts. Both the Interministerial and national-federal cooperation are crucial to bring together expertise in the manifold tasks of climate change adaptation. In 2015, the Federal Government of Germany adopted the initial progress report on the German Strategy for Adaptation to Climate Change (DAS). This report gives an overview of the federal activities since the adoption of the DAS in 2008 and the Action Plan I (APA I 2011) and outlines future measures and activities to combat the impacts of climate change in an Action Plan II. The Federal Government decided to report periodically: monitoring report every 4 years, vulnerability assessment every 6 years, Adaptation Actions Plans as well as the Progress Reports every 4 years Furthermore, it was decided to evaluate the adaptation process in Germany on a regular basis. The first report is scheduled for 2019. In Germany all mayor resolutions with regard to the adaptation process are enforced by cabinet decision (source BMUB).</p>  |
| <b>Indicator development process</b>               | <p>Work on the DAS monitoring indicator system started in 2008 and was developed through an interdepartmental process with participation of numerous experts from competent agencies at federal and state levels and scientific and private institutions. A consultant was commissioned to design and moderate the indicator system development process by bringing together the competencies and existing knowledge from individual sectors and departments. The consultant cooperated closely with the Environment Agency (Umweltbundesamt - KomPass) and the Ministry of Environment (Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit). Technical experts and political decision-makers from different governmental and non-governmental institutions were involved in this process in various ways, including: expert meetings and workshops; bilateral expert meetings for in-depth discussions; engagement with the political bodies set up for DAS, namely the Federal Inter-ministerial Working Group on Adaptation Strategy (IMA) and the States Standing Committee for Adaptation to the Consequences of Climate Change (AFK). In 2012, a consultation process was initiated at federal and state levels. The revised version of the entire set of DAS monitoring indicators was agreed and adopted by IMA in July 2014.</p> <p>The aim of the DAS monitoring is to use existing data to describe and to understand the consequences of climate change impacts and if possible, adaptation already begun at national level. In that sense descriptive indicators are used to show impacts and responses in the DPSIR framework. Target is not “tracking and reporting adaptation policy progress and effectiveness”. This is due to evaluation and at the early stage of the process only possible to a limited extent. The indicators for adaptation are a living system (and under development), and include the DAS monitoring indicators, the indicators from the vulnerability assessment, and the ongoing evaluation.</p> |
| <b>Description of indicator set</b>                | <p>With reference to the 13 action fields and two cross-sector issues of the DAS strategy, the DAS monitoring indicators provide an overview of areas affected by impacts of climate change and of any adaptation processes already initiated in the</p>   |



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|   | areas. In total, the DAS Indicator System comprises 97 indicators, 55 of which describe the impacts of climate change (Impact Indicators), 42 adaptation measures or activities and conditions affecting the adaptation process (Response Indicators). In addition, five indicators are designed as overarching indicators; they represent overarching activities on behalf of the Federal Government, which are intended to support the process of adapting to climate change (Schönthaler et al., 2015). |
| <b>Status of indicators in mid-2017</b> | In total, the German DAS Monitoring system includes 102 indicators. In addition, 40 indicators been/will be developed as part of a vulnerability study and the evaluation system currently under development.  |
| <b>Reporting of indicators</b>          | The German Monitoring report (Schönthaler et al., 2015) reports on the 102 indicators developed in the indicator system. The next Monitoring report can be expected in 2019 (4-year-cycle) <sup>(27)</sup> .   |
| <b>Sources</b>                          | Schönthaler et al. (2015), DAS 2008 <sup>(28)</sup> , APA 2011 <sup>(29)</sup> , EEA (2015), Climate-ADAPT   |

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<sup>(27)</sup> The evaluation includes both the strategic level and the level of measures outlined by the DAS. Progress in developing the strategy will also be determined based on an impact evaluation. Starting in summer 2017, the developed method will be used to evaluate whether the DAS represents a successful strategic approach that can be used to achieve the established policy objectives of the individual fields of action, including when climatic conditions have changed. The overarching goal of the evaluation of the DAS process is to gain the knowledge needed to further develop and improve the process. Based on the overarching goals, the evaluation explores three main questions, using a process evaluation to consider the DAS process at the strategic level, particularly the development process, the interaction of the participating players, and relationships between documents and projects or activities. A second key question relates to the extent to which adaptation measures have been implemented at federal government level. The focus of this part of the evaluation is on the Adaptation Action Plan (APA II), because it indicates the current progress of measures taken by the German government and contains all of the important information about requirements for action and the climate impacts being addressed. In addition to the question concerning progress in implementing measures, the question of what factors contribute to successful implementation and what challenges face the responsible entities and participating actors involved in implementation will also be explored. A third part will cover the question of the effectiveness of DAS.

<sup>(28)</sup> DAS, 2008, [http://www.bmub.bund.de/fileadmin/bmu-import/files/pdfs/allgemein/application/pdf/das\\_gesamt\\_bf.pdf](http://www.bmub.bund.de/fileadmin/bmu-import/files/pdfs/allgemein/application/pdf/das_gesamt_bf.pdf), accessed 08.12.2017

<sup>(29)</sup> APA, 2011, <https://www.umweltbundesamt.de/themen/klima-energie/klimafolgen-anpassung/anpassung-auf-bundesebene/aktionsplan-anpassung>, accessed 08.12.2017

| The United Kingdom                                 |  |
|--|--|
| <b>Adaptation policy process with focus on MRE</b> | <p>The UK is one of the first countries that adopted a long-term and legally binding framework to address climate change and its impacts. The Climate Change Bill was introduced into Parliament on 14 November 2007 and became law (Climate Change Act 2008) on 26 November 2008. Mitigation is the primary focus of the Act. Nevertheless, Government's responsibility with regards to issues related to adaptation is also specified in it, which, among others, foresees the publication of a UK-wide Climate Change Risk Assessment (CCRA) and National Adaptation Programme (NAP) on a five-year-cycle.</p> <p>Following from the first CCRA in January 2012, the first NAP was published in July 2013. It was structured according to the following main themes: Built Environment, Infrastructure, Healthy &amp; Resilient Communities, Agriculture &amp; Forestry, Natural Environment, and Business, each one forming a chapter of the Programme. A cross-cutting Local Government chapter was also included, reflecting the critical role of local authorities in climate change adaptation processes. The NAP included 31 objectives and more than 370 actions, the majority of which was owned by central Government departments and their agencies. Half of the actions contained in the first NAP are now marked as complete and the majority of the remaining ones are considered 'on track'.</p> <p>The second CCRA (CCRA2) was published and presented to the Parliament in January 2017. It was informed by the ASC's independent Evidence Report, which identified six priority areas. Following from the CCRA2, the revised NAP will be available in summer 2018, providing a description of how the risks identified within the CCRA will be addressed and how progress will be monitored and evaluated.</p> <p>Further to the CCRA and the NAP, the Climate Change Act 2008 involved the establishment of the Committee on Climate Change (CCC); an independent statutory body, which provides advice to the UK Government on issues related to climate change mitigation. In this context, a group dedicated to adaptation, the Adaptation Sub-Committee (ASC), was also established to provide support on issues related to climate change risks, opportunities and adaptation. CCC and the ASC report to the Parliament on the progress made in reducing greenhouse gas emissions and preparing for climate change biennially.</p> <p>The last statutory assessment was published in June 2017 and considered the below-listed areas: the built environment, infrastructure, healthy and resilient communities, agriculture and forestry, the natural environment, and business.</p> |
| <b>Indicator development process</b>               | <p>The development of a set of indicators that supports the assessment of UK's adaptation progress was initiated in the context of the second assessment report that was published in July 2011. Three questions were raised during this process, targeting at three elements outcomes, actions and decisions:</p> <ol style="list-style-type: none"> <li>1. Is the UK becoming more or less vulnerable to risks from current and future climate? (<i>outcomes</i>)</li> <li>2. Is there sufficient uptake of low-regret adaptation actions? (<i>actions</i>), and</li> <li>3. Are long-term decisions systematically accounting for climate risks? (<i>decisions</i>).</li> </ol> <p>ASC used a preparedness framework 'adaptation ladder to assess preparedness' to develop an initial set of indicators to track trends in impacts, components of vulnerability and the uptake of adaptation actions. Main consequences of current</p>  |

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|   | <p>climate variability across a set priority areas were assessed, along with the drivers of vulnerability to these consequences and any relevant adaptation actions.</p> <p>The process of developing indicators was based on the principle that adaptation is context specific and that a certain degree of flexibility is required in adaptation plans. Taking these points into consideration, available indicators and datasets that can be used to track trends were identified, drawing evidence from indicator frameworks used previously in the field of environmental sustainability. The selection of indicators was also determined by whether they can provide a robust assessment of vulnerability or exposure to a climate risk; an action that is taking place; or the resulting impact on risk. Finally, it was acknowledged that a coherent and credible indicator set should be seen as part of an iterative process, and thus needs to be reviewed after the publication of the CCRA.</p> |
| <b>Description of indicator set</b>     | Most of the ASC's indicators focus on vulnerability, exposure and actions rather than impacts. With reference to the four priority areas Natural environment; People and the built environment; Infrastructure and Business, the UK Adaptation Sub-Committee (ASC) has developed 118 indicators: 36, 58, 11 and 13 indicators under the aforementioned priority areas, respectively. Further to the list of indicators included in the latest report published in June 2017, ASC prepared an additional list of indicators (ca. 90 indicators). This list includes indicators, which the ASC considers important, but for which data is not currently available, and others for which available time series are too short to allow for a meaningful use.   |
| <b>Status of indicators in mid-2017</b> | The first set of indicators was published in the 2011 report. The 2017 report considered 118 indicators, which will be revised in preparation of the next progress report.   |
| <b>Reporting of indicators</b>          | The set of indicators are used for reporting on adaptation on a two-year-cycle and the results are summarized in the National Progress Reports of Adaptation to Climate Change and are published every two years. The latest progress report was published in June 2017 and the next one is expected in June 2019.   |
| <b>Sources</b>                          | Climate-ADAPT; ASC, 2011; CCC, 2015, 2017; Ffoulkes et al., 2017; EEA, 2015; ETC/CCA, 2017   |

| <b>Scotland</b>                                    |   |
|--|---|
| <b>Adaptation policy process with focus on MRE</b> | <p>The Climate Change Act 2008 requires the United Kingdom (UK) Government to publish 5-yearly assessments of risk to the UK. The first UK Climate Change Risk Assessment (CCRA) was published in January 2012 and provides an assessment of the current and predicted threats and opportunities to the UK from climate change, including a CCRA for Scotland. The second CCRA was published in 2017, again with a national summary for Scotland. The Climate Change (Scotland) Act 2009 requires Scottish Ministers to lay a programme before the Scottish Parliament, setting out amongst others their objectives in relation to adaptation to climate change and their proposals and policies for meeting those objectives. This is reflected in the Scottish Climate Change Adaptation Programme (SCCAP) which was laid before the Scottish Parliament under Section 53 of the Climate Change (Scotland) Act 2009 in 2014. The SCCAP addresses the impacts identified for Scotland in the CCRA which are not dealt with under the UK Government's National Adaptation Programme.</p> <p>Monitoring and evaluation is a central part of assessing the effectiveness of efforts to tackle climate change. To monitor climate change adaptation in Scotland specific indicators were developed. They provide evidence that a certain condition exists or certain results have (or have not) been achieved. Monitoring helps policy makers to review the progress of Scotland in adapting to climate change and to highlight where policy action and awareness raising may be needed.</p> <p>ClimateXChange (CXC) is Scotland's centre of expertise connecting climate change research and policy. It is funded by the Scottish Government with the mandate to make advice, guidance and evidence for climate change adaptation available for policy making. Besides addressing the challenge of considering the costs, benefits and trade-offs associated with adaptation actions, the CXC is establishing a range of case studies or demonstration sites and supports the measuring adaptation progress by means of indicators.</p> |
| <b>Indicator development process</b>               | CXC has developed indicators to monitor climate change adaptation in Scotland based on an 'indicator framework' that sets out the rationale for the types of indicators. The indicators were developed in liaison with 80 academic researchers and agency staff across 25 organisations and more than 50 policymakers and stakeholders.   |
| <b>Description of indicator set</b>                | The full list of the adaptation indicators was published in mid-2016 and contains 105 indicators, presented in 13 narratives. The indicators were built around policy need. They directly address the risks identified in the CCRA and the objectives of the SCCAP. Of the 105 indicators, 44 provide baseline data but no trend, 23 indicators provide data over time but with no discernible trend and 38 indicate a trend. The indicators provide information about 1) the progress in delivering adaptation actions and outcomes, 2) whether adaptation actions are contributing to desired outcomes and policy objectives (i.e. are they reducing the risks and maximising the opportunities of climate change), 3) important relationships between sectors when delivering adaptation (e.g. areas of conflict or win-win opportunities which could be addressed by policy), 4) priority areas for adaptation and for adaptation policy by identifying areas of most risk or opportunity e.g. where multiple risks converge.   |
| <b>Status of indicators in mid-2018</b>            | The first set of indicators was published in mid-2016 and contains 105 indicators. The CXC indicators are intended to be updated and developed to maintain relevance to the most recent iterations of the CCRA and SCCAP (Moss 2018).   |
| <b>Reporting of indicators</b>                     | The Climate Change (Scotland) Act 2009 requires Scottish Ministers to provide an annual report on progress towards achieving the objectives and implementing the proposals and policies set out in SCCAP. The Act also establishes the requirement to   |

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|                | independently assess the Scottish Government's progress towards achieving the objectives and implementing the proposals and policies set out in the Programme. An independent assessment must be commissioned within two years of the Programme being laid before the Scottish Parliament which was in 2016. |
| <b>Sources</b> | ClimateXChange 2016 <sup>(30)</sup> , The Scottish Government (2014), Moss (2018)  |

The summary tables presented above illustrate that the process of developing and agreeing on a set of national adaptation indicators can require significant resources both in terms of time and efforts to engage a broad range of stakeholders. The experiences show that the involvement of multiple key actors including authorities (often from multiple levels of administration), the research community as well as data providers in the process of defining operational sets of adaptation indicators is key.

Another important feature is the iterative nature of the indicator development evident in the experiences of all five countries. The initial sets of national indicators have been selected in an iterative process through engagement of different actors and discussions around data availability. In the UK and Germany, indicator sets have been further developed and revised based on experience of applying them. Likewise Austria has identified that a revision of current indicators is likely to be needed in the next round of reporting. In Finland, the initial set of adopted indicators is relatively limited but in the process of selecting them, more indicators that are relevant were identified for further development to enable their use as part of the national adaptation indicator set in the future.

The examples also show that countries have followed a range of approaches in structuring their adaptation indicator sets. In this regard, the prevailing adaptation policy framework often provides the framework for organizing indicators. In Austria, Germany, Scotland and the UK, for example, indicators play an important part in efforts to track progress in the implementation of national adaptation policies, and adaptation indicators are also closely linked with the actions, sectors and priorities targeted by policies. The discussion on ensuring wide usability of indicators for a range of societal actors in Finland is likewise an indication of the high importance placed on the relevance of indicator information for both policy and practice. These experiences also show that countries are considering multiple uses for their adaptation indicators, such as communication in addition to tracking progress in adaptation.

## 5.2 Observations on key characteristics of national adaptation indicators

As discussed in previous chapters of this technical paper, national level adaptation MRE and the development of indicators have progressed in recent years. Nevertheless, experience in MRE activities, and especially the development of robust and comprehensive sets of adaptation indicators for this purpose, is still rather rare, confirmed by the limited number of countries in Europe with operational sets of adaptation indicators available.

This section presents emerging observations on some specific features and attributes of the national indicators for adaptation of Austria, Finland, Germany, Scotland and the UK to support knowledge sharing in this emerging field. Examples from the adaptation indicator database ([link](#)) are used to illustrate findings on the following aspects: range of sectors and main climate impacts covered by indicators, indicator data visualisation, data collection and reporting frequencies, indicator typologies and categorisations, observed limitations, as well as links to SDG and SFDRR indicators.

### 5.2.1 Sectors covered by indicators

Coverage of different sectors varied considerably in the indicator sets of the five countries assessed, reflecting different geographical and socio-economic contexts. In the case of Austria, indicators were

<sup>(30)</sup> ClimateXChange, 2016, [https://www.climateexchange.org.uk/media/2400/cxc\\_adaptation\\_indicators\\_full\\_list.pdf](https://www.climateexchange.org.uk/media/2400/cxc_adaptation_indicators_full_list.pdf) and [https://www.climateexchange.org.uk/media/2402/cxc\\_adaptationguide\\_hyperlinks.pdf](https://www.climateexchange.org.uk/media/2402/cxc_adaptationguide_hyperlinks.pdf), accessed 25.10.2018.

developed for all 13 areas of action addressed in the National Adaptation Strategy/Plan (NAS and NAP: agriculture, forestry, water resources and water management, tourism, energy (with a focus on the electricity industry), protection from natural hazards, construction and housing, disaster risk management, health, ecosystems and biodiversity, transportation infrastructure and selected aspects of mobility, spatial planning and business/industry/trade). As in Germany, the 13 action fields of the DAS and two cross-sector issues are covered by the indicator set. In addition to indicators on impacts and adaptation measures, five indicators are designed as overarching ones, representing the activities on behalf of the Federal Government to support the process of adapting to climate change (Schönthaler et al., 2015).

The UK structured their indicator set along the four priority areas: i) Natural environment, ii) People and the built environment, iii) Infrastructure and iv) Business. The Scottish adaptation indicators are structured along three areas: i) Natural Environment, ii) Buildings and Infrastructure Networks and iii) Society. The Scottish indicators were built around policy needs and directly address the risks identified in the CCRA and the objectives of the SCCAP. The 105 indicators are presented in 13 narratives. The Finnish indicator set covers a more limited range of sectors and features for instance several indicators describing forestry and agriculture sectors.

In addition to differences in national contexts, the variation in sectors covered can be attributed to the different approaches to adaptation as reflected by the relative different use of multi-sector indicators (i.e. indicators not clearly focusing on a single sector/area of action). These multi-sector indicators were favoured in particular by Finland whereas the other four countries had a higher share of indicators focusing on adaptation in certain sector/areas of action.

#### 5.2.2 Main impacts addressed by indicators

As expected by the range of sectors covered, the variety of climate impacts addressed by the indicators was high as well. More than half of all indicators used by the five countries address multiple impacts, for example such as river flooding, pluvial flooding and heavy precipitation.

In Germany, a high number of indicators (more than 25) relate to an increasing temperature, identified as relevant in many sectors (such as health, agriculture, forestry, built environment, water, biodiversity, etc.). Similarly, in Finland, approximately one quarter of their indicators address the issue of temperature increase whereas in the UK, Scotland and in Austria, only a few indicators primarily consider this specific climate change impact. However, some of the Austrian indicators that address “multiple impacts” include among others the issue of temperature increase (e.g. ‘Mainstreaming of climate change adaptation into strategies, funding schemes and legislation’ or ‘Selected habitat types and species which are vulnerable to climate change’).

Extreme heat is addressed with indicators in the Austrian as well as German system, but less often in the UK indicator set and only with one indicator in the Scottish indicator set. While the focus in the UK related to heat is on health, the German and Austria also mention heat stress in sectors such as agriculture, forestry, energy, buildings and tourism. Fewer indicators focus on droughts and water scarcity, but where included they mainly relate to the sectors agriculture (AT, DE, UK, Scotland), water (DE, UK, Scotland) and businesses (UK).

Generally, climate impacts related to precipitation are less often considered as indicators than those related to temperature. Nevertheless, the indicator sets of all countries highlight risks related to flooding, comprising pluvial flooding and river flooding events.

Not surprisingly, the Austrian set excluded indicators focusing on impacts on coastal areas, but perhaps more surprisingly, the impacts of ‘sea level rise and storm surges’ are also missing from the Finnish, Scottish and the UK indicator sets. For Finland, this may be explained by the low total number of indicators that can limit the coverage of impacts, as well as the relative importance of different climate



impacts in their national context. In the case of the UK and Scotland, many indicators consider coastal and river floods together. In such cases, a ‘multiple impacts’ label has been assigned to consider several relevant impacts, which usually included surges, river flooding, pluvial river flooding and heavy precipitation. Also for some indicators referring to coastal areas, the identification of a climate change impact was also not clear (e.g. hectares of coastal habitat created) and hence in such cases no specific impact was assigned to such indicators. Forest fires as a climate change impact is only addressed in the UK indicator set by one indicator. Similarly, windstorms are only addressed in the Finnish and the Scottish indicator sets.

### 5.2.3 Visual illustration of indicator data

Visual illustration of indicator data helps to communicate complex issues to different stakeholders. Visualisation supports the explanation and exploration of raw data, and can be useful particularly for comparisons and communicating large amounts of data.

The choice of visual illustration may be defined by the detailed type, quality and amount of data used, but also by the intended use of indicator data in communication. For example where sufficient time series are available, graphical representation may provide useful insights on trends and long-term change. Similarly, for spatially based indicator information, maps may be a suitable form of visualisation.

As part of the metadata collection for indicators in the database, information on the visual illustration types used for different national adaptation indicators was collected where available either in published reports or websites. Examples in the database illustrate a broad range of visualisation types and other presentation formats being applied by all five countries, as summarised in Table 5.2 below. The most common presentation format was visualisation via graphs and charts, followed by numerical tables and maps. In some case indicators were found to use a combination of different visualisation types (e.g. in the case of composite vulnerability indicators) and sometimes only a text description.

**Table 5.2 Indicator presentation types found in the country sets**

| Country  | Text only | Numerical tables | Graphs and charts | Maps | No information available <sup>(*)</sup> |
|--|-----------|------------------|-------------------|------|---|
| Austria  | ✓         | ✓                | ✓                 | ✓    |   |
| Germany  | ✓         | ✓                | ✓                 |      |   |
| Finland  |           | ✓                | ✓                 | ✓    | ✓                                       |
| Scotland   |           | ✓                | ✓                 | ✓    |   |
| UK   |           | ✓                | ✓                 | ✓    | ✓                                       |
| (*) This may be because either information was not publicly available or the indicator visualization is still under development. |           |                  |                   |      |   |

Visualisations can be powerful, but also include risks of misinterpretation. Therefore, care must be taken to accompany data visualisations with adequate contextualisation and written explanation to support interpretation of indicator information, including when used for improving policy or practice. For adaptation indicators, this may be particularly important, as many indicators are proxy indicators i.e. they have been originally developed to serve other purposes. Consequently, these indicators may require additional explanation and interpretation to make explicit their relevance and potential limitations for adaptation policy and practice. In particular, framings created by titles, sub-titles or captions of visualisations are important for creating the intended interpretations among the target audience.

The indicator presentation formats, including visualisations, observed for the database indicators were based on a one-way communication model. The online presentation formats did not include interactive features allowing the user to select, scale, weight and visualise the indicator data according context-specific knowledge needs. An example of such feature can be found from the Finnish Climate Guide that

has an interactive map tool for indicators of adaptive capacity and vulnerability of the elderly as well as cross-country skiing <sup>(31)</sup>. These indicators, however, are not included in the national adaptation indicator set.

#### 5.2.4 Data collection and reporting frequencies

Reporting of indicator data is most often driven by knowledge demands arising from national adaptation policies, which may specify timeframes and frequencies for monitoring and reporting on progress. For example in Austria, the first reporting of indicators was in 2015 and the next reporting is expected in 2020. In Scotland, the indicators were first reported in mid-2016. In the UK, the indicators were first reported in 2011 and then at regular intervals, most recently in 2017. In Finland, indicator reporting cycles are not yet as clearly defined. There, a rolling update of indicators throughout the year is initially foreseen where the timing of publishing updated indicator information is linked to considerations such as timing of data generation (e.g. making data on flood insurance pay-outs available as soon as it is annually aggregated) or relevance of topical issues (e.g. publishing indicator data on pollen season length in the springtime ahead of the pollen season).

The frequency of data collection defines the time intervals at which new indicator data becomes available and can thus limit the frequency of indicator reporting. This may not be an issue if adaptation indicators are reported relatively infrequently (e.g. at five year intervals) or if the indicator sets do not include indicators with long data generation cycles. While for the majority of indicators in the database new data is generated annually or even more frequently, there are some indicators for which data is generated less frequently (e.g. silvicultural data). This may be caused by infrequent data generation processes by default, such as surveys or updates of plans required by specific policies (e.g. flood risk management plans), or the fact that the indicator tracks impacts of certain major (extreme) events in which case data is only collected following the occurrence of such event. Infrequent data collection is also observed in relation to indicators based on one-off collection of data, and indicators for which more frequent data collection efforts would be too time or resource intensive to be practical (e.g. some indicators focusing on biodiversity or changes in natural ecosystems). Furthermore, adaptation indicators can be based on data originally produced to serve the priorities of other policy processes or basic research.

It is typical that there is a considerable time lag from between when the data was last collected and the time of reporting, which should be noted when considering policy relevance and timeliness of indicator information (Lyytimäki, 2012). This may be less of a concern if the indicator for example focuses on demonstrating long-term trends with low risk of sudden non-linear shifts. For indicators focusing on specific policy responses, the timeliness of indicator data and timing of indicator release may be of greater relevance, if the policy response is adaptive and adjustable.

#### 5.2.5 Indicator types and categories

Indicator types and categories were analysed based on the first integrated version of the database. Therefore, the results presented below should be interpreted with caution. Indicator types were screened based on the categories of process-oriented “Type 1” indicators (input, process, output, outcome) and more general climate change adaptation related “Type 2” indicators (exposure, sensitivity, adaptive capacity, composite vulnerability, hazard) (see Box 2.2). It is important to note that the applied indicator type categorisations are not exhaustive and national adaptation indicator sets may also be developed on the basis of alternative typologies. However, examination of national indicator sets from the perspective of common typologies may offer useful insights into how countries are approaching the complexity of tracking adaptation and developing appropriate sets or portfolios of indicators.

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<sup>(31)</sup> <https://ilmasto-opas.fi/en/datat/sopeutumiskyky-ja-haavoittuvuus>, accessed 25.10.2018.

The preliminary results suggested a high variability of indicator types visible among the five indicator sets analysed for this study. Almost one third of indicators was found to be not applicable for the Type 1 categorisation, suggesting that there are several indicators that are not directly describing aspects directly linked to the adaptation policy process. A popular class of the Type 2 categorisation was composite vulnerability indicator (about 40% of all classified indicators). The share of composite vulnerability indicators varied considerably between the five countries.

The analysis of the initial categorisations indicated a need for further development in order to allow reliable and transparent identification of indicator categories. German and Austrian indicator sets were used to test the initial categorisations. The testing showed that there is considerable room for different interpretations, even though the classifications were assumed to be relatively straightforward. Regarding the Type 1 category a complete agreement between three coders was reached after one round of coding for just over a half of the 148 indicators included for testing. The most important reason for disagreement was over the class “not applicable”<sup>(32)</sup>. The German DAS indicator set focuses on impacts and responses which, in part, may explain why this type of categorisation is less relevant for many of the analysed German indicators. Regarding the Type 2 categorisation, complete agreement was reached for nearly two thirds of 148 indicators. The disagreement was most often about the class “composite vulnerability indicator”. The adaptive capacity indicators, from one in the Finnish indicator set to 29 in the full UK indicator data set and around 10 in the German and Austrian indicator sets, can be very useful for policy makers as they are closely linked to the responses to deal with climate change. This type of indicator does not occur in climate change impact and vulnerability indicator sets - as present in many countries - and the presence of adaptive capacity indicators is one of the characteristics of an adaptation indicator set.

The key reasons explaining differences in interpretations of the categorisation include at least the following:

- *Subjectivity of interpretation*: Different background assumptions influence the interpretation despite the attempts to define categories as clearly as possible.
- *Focus of indicators*: Single indicator may describe elements of several classes such as process and outcome of climate adaptation. Indicators may describe issues or processes that are driven mainly by other factors than climate change or climate change adaptation. Often indicators included in national adaptation indicator sets were originally developed for other purposes, which makes the categorisation of such proxy indicators challenging from the adaptation perspective.
- *Indicator presentation formats*: High diversity of presentation formats (quantitative or qualitative, visual or text) makes it in some cases difficult to agree even on the basic issue such as when an indicator should be counted as one or several indicators (e.g. for composite vulnerability indicators, understanding what the different elements comprising it are).
- *Indicator framings*: Framings by titles and visual presentation formats can significantly affect the interpretation even when the quantitative data of the indicator is essentially the same. In many cases it is vital to read the qualitative descriptions for interpreting the quantitative data of the indicators.
- *Problems with classifications*: Existing classifications may not be optimal for the categorisation of climate adaptation indicators typically aimed to have high policy relevance. For example, impact categories focusing on direct physical impacts tend to exclude indicators focusing on economic and socio-cultural aspects.

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<sup>(32)</sup> Category ‘not applicable’ denotes indicators that do not clearly fall under the input, process, output or outcome indicator categories.

These experiences suggest that further elaboration of indicator categories and the categorization process is needed in order to develop methods for producing a coherent and reliable overall picture of different indicator types in a resource-efficient way. Further elaboration taking into account the work done elsewhere is needed also to avoid potential confusion created by use of different types of classifications. For example, Vallejo (OECD, 2017) has presented a framework based on general level distinction between indicators providing information on climate risks, on adaptation processes and on adaptation outcomes. A key question worth reflecting on in relation to indicator classifications and typologies is the usefulness of such efforts. While such categorisations may be informative in developing national indicator sets, they are likely to be less meaningful for the ultimate use and policy relevance of information collected by indicators.

### 5.2.6 Links to SDG and SFDRR indicators

The SDG and SFDRR indicators with a direct link to CCA are described in Table 3.3, Section 3.3. They can roughly be divided into three groups:

- Indicators of impacts of natural hazards (people affected, economic losses and impacted infrastructures);
- Process indicators (NAP, early-warning etc. in place); and
- Thematic indicators (mainly related to integrated water resources management (IWRM) and agriculture).

With some exceptions, the individual indicators from the national adaptation indicator sets for the five case countries do not cover the breadth of the SDG or SFDRR indicators. However, the national adaptation indicators are much more detailed and subsets of them provide a good insight or proxy for many of the SDG and SFDRR indicators. In some cases, like the German indicator on international finance, the Austrian indicator on health impacts from natural hazards (fatalities) or the UK water abstraction indicators, single indicators give the information that is possibly sufficient at the international level in the SDG or SFDRR indicator sets.

While the SDG and SFDRR indicators on impact focus a lot on the measured impact once an event caused by a natural hazard takes place, it is clear that there will be a large variety from one year to another depending on the occurrence of events in a single year. These types of indicators are present in all five national adaptation indicator sets, however, in addition risk-based indicators and long-term averages can also be found in all five. In so doing, indicators are included covering the entire risk management cycle<sup>(33)</sup>, where SDG and SFDRR indicators<sup>(34)</sup> focus more on preparedness and response and less on prevention and the recovery avoiding (new) risk creation. The importance of spatial planning in the national adaptation indicator sets, or aspects like biodiversity are a result of this more integrated view on all stages of the risk management cycle. This approach within the national adaptation indicators sets also results in indicators measuring the progress of the measures to limit the risk or to reach the specified objectives.

The number of fatalities and missing people due to natural hazards is relatively low in Europe compared to the rest of the world. Therefore, and instead of looking at human impacts like fatalities (as is the main

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<sup>(33)</sup> Several variations of a cycle to express disaster risk management are available, including one from the IPCC (2012). Recently, Wilkinson et al. (2017) structure the management of disaster risk management into 1) prevention and mitigation, 2) preparedness and response, 3) recovery and avoiding risk creation, and 4) risk transfer and financing. For the EU Floods Directive, the steps prevention, protection, preparedness, response and recovery are defined (EU, 2007; CIS WFD, 2013). Avoiding and reducing new and existing risks is described in this section as prevention (covering what is described as prevention, protection and mitigation in different frameworks). Preparedness is used to describe pre-event action, while response is during and (immediately) after the event.

<sup>(34)</sup> The SDG and SFDRR indicators as suggested, not the goals and framework as such as these have a wider understanding.

focus in the SDG and SFDRR frameworks), several indicators focusing on health effects were found in the five national indicator sets examined here. For example, countries report on vector species for diseases, but also on climate related accidents (Germany), the number of hospital admissions as a result of extreme weather events (Scotland) or time before people can return home after a natural hazard (UK).

For the sectors involved in the national adaptation indicator sets (see section 5.2.1), specific indicators on losses are mostly available per sector or type of critical infrastructure. This includes the direct losses and damages, but also more difficult to monetarize quantitative indicators like number of people affected by disruptions or indicators focussing on business continuity plans, mainly for the energy sector or the energy intensive industries. Although covered to a more limited extent, this is also relevant for sectors like transport, water management or health. As mentioned above, in addition to the economic sectors where monetary losses occur, there is attention on impacts on the natural environment and biodiversity, an aspect almost completely absent in the SDG and SFDRR indicator frameworks in relation to climate change adaptation, where the primary focus is on anthropogenic concerns.

Information on loss and damage in the national indicator sets contributes to a multi-dimensional matrix with axes on different hazards, different sectors, measured losses versus long-term averages and risks. Still limited in the national adaptation indicator sets are the international aspects, being the effects of climate change impacts outside a country on the economy, human health and ecosystems within a country. An example can be found in the UK indicator set <sup>(35)</sup> and the topic is gradually getting more attention (see e.g. the Swiss workshop on the international impacts on Climate Change, (ETH Zürich, 2017)).

Several of the more process related indicators in the SFDRR and SDG frameworks, at first look are binary at the national level – those starting with “number of countries that have ...” – and they appear relevant mainly at the regional (European) or global level. Nevertheless, some examples of national indicators fit almost directly into the global indicators of the SFDRR and SDG frameworks (like the Austrian indicator on CCA and DRR integration). At a second look, the national adaptation indicator sets of five case countries covered provide additional detail. For example, several Austrian indicators deal with the progress of mainstreaming CCA into other policy domains, both in planning and implementation phase. Indicators on the involvement of regional (sub-national) and local authorities differ in the national indicator sets of the countries included in the database, as their roles and responsibilities differ from one country to another. Examples of indicators on the involvement of regional and local authorities cover both general aspects related to adaptation planning as well as details for sectors for which regional and local authorities are responsible or share the responsibility.

The SFDRR includes an indicator on multi-hazard early warning systems. Several indicators in the national adaptation indicator sets deal with early-warning. However, most national indicators on this topic are detailed and specific for a single type of hazard (e.g. floods) or towards specific receivers (e.g. health workers). Besides indicators on the availability of early-warning systems, the effectiveness (or uptake of the messages sent out) of flood warning is covered by a UK indicator only.

On the water and agriculture related indicators in the SFDRR and SDG frameworks, lots of information is available in the national indicator sets. On agriculture (and forestry), these cover the occurrence of plant diseases and pests (e.g. in the Finnish indicators), soil conditions (e.g. German indicators), land under targeted agri-environment schemes and sustainable and active management of forests (e.g. UK indicators).

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<sup>(35)</sup> The indicator describing the “Proportion of inputs into goods consumed in the UK from countries at high risk from climate change”.

Water indicators are available in high detail in the German, Austrian, Scottish and UK indicator sets. They cover water resource efficiency (e.g. in the UK) or include different indicators that can be combined to create an index on water efficiency (e.g. in Germany). A high level of sectoral detail and related measures to improve the efficiency can be found in the national indicator sets as well. IWRM at national and transboundary level is divided over several individual indicators. Particularly noteworthy is the reference to River Basin Management Plans and Flood Risk Management Plans and the re-use of monitoring and indicators for these specific policies (e.g. reference to the indicators developed by the Working Group on water issues (LAWA) in Germany). The differences in indicators selected on IWRM reflect the differences in contexts of the different countries. Where several indicators on particular water related issues for different sectors are available with a high level of detail, summarized indicators like the degree of IWRM implementation will probably remain of mixed nature including a qualitative/descriptive assessment.

### 5.2.7 Observed limitations of indicators for adaptation

Understanding the limitations of adaptation indicators can help identify gaps and weaknesses of the indicator sets currently in use, indicate where additional efforts are needed and ultimately inform relevant research and policy initiatives in the future. To contribute to this goal, this technical paper identified key limitations of the adaptation indicators developed in the five European countries considered here. Relevant information, when available, was collected along with information on the indicator characteristics (e.g. sector, climate change impact, type of indicator etc.) and was carefully screened in an attempt to group similar limitations together. Although the list presented below might not be exhaustive, it is considered as representative and thus likely to be of relevance also to countries beyond the ones considered here.

- **Data availability**: Limitations and uncertainties related to the data available for a specific indicator are among those more widely discussed in the literature (e.g. Hammill et al., 2014). Typical examples are for indicators monitoring climate change impacts (e.g. changes in annual or mean monthly temperature, annual hot days, annual precipitation, and extreme events). As the establishment of links between trends in climate variables and climate change requires data across many decades, these indicators are restricted by the short time series that are often available (Hammill et al., 2014).

Limitations related to data availability are relevant also to the countries considered in this technical paper. Frequently, these limitations refer to a complete lack of data, unsuitable data due to short time series or partial coverage (referring usually to geographical coverage but not only) and inconsistencies in the available datasets. Although alternative approaches can be implemented to overcome to some extent these limitations (e.g. a 'case-study' approach can overcome the limitation of the partial geographical coverage), countries often have to use more than one source to gather the data they need for calculating some of the indicators included in their MRE systems. Also, the different categorical variables often considered in different datasets makes the use of different sources problematic. Inconsistency restricts the extent to which indicator values can be compared and thereby limit the usefulness of such multiple sourced indicators.

- **Data collection**: Data collection process may influence the suitability, the quality and reliability of a dataset and hence impact on the operationalization of adaptation indicators. Using different methods to collect data or changing the design of the data collection process (e.g. size of survey samples, number of sites considered) may restrict the suitability of the produced datasets for a specific indicator, constrain the comparability of the indicator values or even lead to misleading conclusions <sup>(36)</sup>. In the case of indicators monitoring flood risk areas (and people living in them), for

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<sup>(36)</sup> This issue relates also to the more widely relevant challenge of attributing any changes in the indicator to actions being taken.



example, decreasing numbers may reflect a real change due to the implementation of effective adaptation measures or may be observed in response to methodological and resource changes (i.e. if more resources become available more land area can be covered to identify the risk areas). Although such changes in methodologies are not unexpected, especially during long time periods, a key point is the need to harmonise the data collected, through tried and tested approaches.

Data collection may also influence the frequency and timing when data is available, which can also be serious limitations. Irregular data collection can have many implications. For example, it can be responsible for data not being readily available and thus cause delays in the update of indicators. This limitation relates more to the overall framework in which MRE and/or data collection processes are embedded, the actors responsible for the relevant tasks and the resources available for undertaking them, and underlines the importance of establishing a long-term and holistic MRE system with clear roles and responsibilities, and secured resources.

- **Development, calculation, interpretation and use of indicators**: Limitations related to the way that indicators are developed, calculated, interpreted and used were relevant to the five countries considered in this technical paper. Such limitations are associated primarily with progress made in the development of individual indicators or indicator sets overall (i.e. fully or partially developed), the elements embraced by different indicators (e.g. sensitivity of the indicator to changes in drivers or measures introduced), or the methods and data that have been used to calculate and the potential changes and errors in them.

When it comes to the use of indicators, the difficulty in interpreting them is perhaps one of the most important challenges for those involved in MRE processes. Vallejo (2017, p. 19) citing an evaluation of SIDA's Climate Change Initiative (César et al., 2013) refers to the challenge of "[defining] indicators that are too vague and difficult to measure, too narrow output focused indicators that only provide a piecemeal picture of the whole, or the development of a very high number of indicators which are very resource-intensive". This challenge is relevant also to the countries considered in this paper, specifically, in cases where a clear trend is lacking, or an indicator is used for the first time, or when the links of indicators to adaptation measures and policies are not clear or difficult to establish. Also in this case, the challenge of attribution is evident, and relevant not only to the indicators per se but to the overall practice of adaptation MRE.

- **Institutional framework and resources**: The lack of a robust framework that foresees the operationalization of monitoring and evaluation activities in the long-term and the uncertainty related to the availability of the resources needed to implement them, places the development, regular update and communication of indicators at risk in many countries. In the current period of austerity, it is vital to better understand what resources and skills are necessary for ensuring the continuity of MRE processes, and ensure that these are available and independent of the changes that might take place in the political scene of a country. Ensuring the availability of the necessary human and financial capital will allow establishing a long-term vision for MRE activities. For the case of indicators, this can ensure that long and uninterrupted time-series will be available in the future, allowing for meaningful interpretation and use of indicators to inform or revise policy processes.

Taking a closer look at the limitations presented above, one can observe the links that exist between them. Irregular data collection (*data collection*), for example, may result in data not being timely available (*data availability*), causing in turn delays in the update of indicators and, ultimately, in the provision of information needed to inform or revise policies (*development and use of indicators*). Such links suggest the complex and multiple implications that one constraint may have on the successful implementation of MRE processes and hence the need for such limitations to be considered and addressed holistically rather than separately.



Moreover, further to the identification of the key limitations associated with the indicator sets used in the five European countries considered in this technical paper, some reflections on the limitations of the indicators as a method overall emerged.

First, the importance of employing qualitative narratives in support of the indicators, which are usually quantitative, was highlighted. Although a single indicator with high sensitivity has the potential to show the changes in the variables it monitors or evaluates, it has very limited power to explain why these changes happen. This was also one of the key messages of the EEA report on National monitoring, reporting and evaluation of climate change adaptation in Europe (EEA, 2015), which highlighted the strength of the mixed method (qualitative / quantitative) approaches used in MRE systems of adaptation.

Second, providing the users of indicators with opportunities to give feedback related to the indicators' selection as well as their qualitative interpretation is important for the future development of indicator sets. The experiences from case countries considered in this paper show that considerable attention has already been paid to interaction with experts during the selection process of indicators. Nevertheless, interaction with potential end users has so far received less attention. This leads to a lack of knowledge about the usefulness of indicators from the user's point of view. This links also to how well indicators perform in relation to their different uses and what expectations are set for them. For example, as discussed in section 5.2.3 above, indicators are commonly lacking features of interactivity and user control. This is fine when indicators serve standard performance based thinking needs and for instance strive for comparability across locations. If, however, indicators are meant to serve the interests of learning and insight, interactivity may become a highly desirable feature.

Moreover, as indicators often have multiple uses, and especially in the case of adaptation, indicators are frequently collected for other purposes, it is expected that such information can be relevant to more than one policy field. Demonstrating and clearly articulating the value and the suite of indicators is of utmost importance. This would also require establishing synergies that can withstand the many 'changes' in governments, funding and programmes and their resources, as their volatility will always challenge monitoring programmes.

Finally, addressing the limitations discussed in this section may require the implementation of different approaches, taking into account the specific conditions that characterise each country. Nevertheless, information presented here can already help countries, especially those currently in the process of developing adaptation indicators, consider possible limitations at an early stage and thus, if not to overcome them all, to develop suitable ways of benefiting from the indicators and the MRE process that recognises these limitations.

## 6 Conclusions and looking ahead

In response to reporting requirements resulting from European and global level agreements, the continuous progress made in national level adaptation processes, and the resulting need to better understand if policies and actions are achieving their intended goals, interest in MRE activities has increased significantly in recent years. Among other methods, adaptation indicators have received particular attention in this context. To a large extent, this is due to the multiplicity of their potential uses, along with the perception that they can contribute to different objectives. This has strengthened the popularity of the indicator approach in policy and associated academic communities.

This technical paper has brought together evidence on recent developments of national level adaptation indicators from five European countries: Austria, Finland, Germany, the United Kingdom and Scotland. It has also provided an overview on the main legal reporting requirements as well as other non-binding reporting processes relevant for indicators of climate change adaptation. These include the Paris Agreement on Climate Change, the Sendai Framework on Disaster Risk Reduction and the Sustainable Development Goals, as well as the EU level legal reporting requirements associated with the existing Greenhouse gas Monitoring Mechanism Regulation (Regulation (EU) No 525/2013) and potential requirements arising from the foreseen Governance of the Energy Union Regulation, the non-legal reporting processes related to the EU adaptation preparedness scoreboard developed by the EC, and other sectoral policies at the European level.

The suitability and effectiveness of monitoring and evaluation methods for adaptation, including indicators, depends on the specific purpose for which MRE is undertaken at different levels. Different sets of criteria have been developed to describe what a ‘good’ indicator might mean in different cases, including those for adaptation (see section 2.2). In practice, it is not likely that one could develop a set of indicators that fulfil all criteria in all conceivable situations. What can be considered as a ‘good’ indicator will depend partially on the purpose and how the indicator (or indicator set) will be used. Therefore, it becomes clear that the appropriateness and value of an indicator is largely context-specific. The justification for the choice of a particular indicator set needs to reflect an awareness of context in addition to the practical constraints such as resources and data availability. For example, simple quantitative indicators based on readily available national statistics may satisfy basic accountability needs, but understanding the context-specific factors of vulnerability requires a nuanced set of indicators. This can be achieved both by developing a broader set of indicators taking into account a variety of issues or by more focussed selection of indicators in order to address specific concerns arising from national circumstances and priorities. In both cases, qualitative narratives of indicators and the associated assumptions, uncertainties and limitations can have significant influence on how quantitative data is framed and interpreted.

The different roles of indicators discussed in section 2.2 (instrumental, conceptual and political) and different types of indicators (Box 2.2.) highlight the multiple possibilities for using adaptation indicators. Evidence described in this technical paper also indicates that European countries have developed adaptation indicator sets from different starting points and with different objectives. National context matters in defining whether indicator development is primarily driven by policy, data or concerns that are more theoretical. Experiences from the five countries explored for this report indicate that the balance between different driving forces of MRE, along with available resources, shapes the entire development of indicator sets. Similar challenges and constraints are likely to be valid for other European countries that strive to measure the progress in implementing national adaptation strategies or plans, sector-specific adaptation measures as well as monitoring the impacts of climate change.

Experiences of the five European countries also highlight the iterative nature of adaptation indicator development at the national level, which is to be expected given the emerging nature of this field. Therefore, the current version of the database of adaptation indicators primarily serves as a “living portfolio” that will be refined and expanded as more indicators become available. As countries gain

more experience in developing and using adaptation indicators, new knowledge and good practices can be cumulatively shared for the benefit of all actors working with adaptation indicator development and use at national, but also other levels of administration and governance.

There are still fundamental challenges that limit the development and full operationalization of national adaptation indicators. These challenges include, for instance, improving the sensitivity of indicators to systemic changes in vulnerability and adaptive capacity, better recognition of implementation risks of climate change adaptation measures and identification of dynamic interdependencies within and across different systems. Enhancing the use and influence of adaptation indicators also remains a challenge.

Further development of adaptation indicators must be viewed in the broader framework of linked indicator development processes in the fields of sustainable development and disaster risk reduction as discussed in Chapter 3 and Chapter 5. Actively exploring synergies between these parallel processes can support monitoring of climate change adaptation in countries, for instance through ways in which the same data can serve the needs of different monitoring and reporting efforts. While recognizing the importance of avoiding the use of scarce resources for overlapping indicator systems, complementarities, synergies and coordination can also support implementation of these different commitments at national level. Opportunities to use new types of data and data collection methods, including 'big data', citizen science and new space borne data, may also change the scene for climate change adaptation indicators.

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## Annex I: Database guidance document

| Adaptation indicator database: Input guidance (1/3) |   |  |
|---|---|--|
| Metadata field                                      | Suggested categories  | Notes and guidance   |
| No.   | Free text   | Identifier. Each country should be grouped; order is discretionary, where possible retain in country blocks.   |
| Country   | Free text   | Please state the country where the indicator is being applied.   |
| Title of Indicator                                  | Free text   | As stated in literature/by country in question. Direct translation (any clarification should be in square brackets).   |
| Sector 1  | 1) Multi-sector (indicator relevant to more than two sectors)<br>2) Agriculture<br>3) Biodiversity<br>4) Buildings<br>5) Built Environment<br>6) Business<br>7) Civil protection<br>8) Energy<br>9) Forestry<br>10) Health<br>11) Resilient communities<br>12) Infrastructure<br>13) Natural environment<br>14) Tourism<br>15) Transport<br>16) Water<br>17) Spatial planning<br>18) Coastal Areas / Marine<br>19) Fisheries<br>20) Other<br>21) Other – please state | <b>Origin of categories:</b> Adapted from EEA 2014 Report<br><br><b>Guidance:</b><br>Select sector the indicator applies to from dropdown list. If the indicator applies to two sectors input the first here and the second in the next column. Select 'multi-sector' if the indicator applies to more than two sectors. Select 'Not sector specific' if it does not relate to any sectors (this seems likely to be a rarely used category). |
| Sector 2  | As above  | As above   |
| Main impact addressed                               | 1) river flooding<br>2) pluvial flooding and heavy precipitation<br>3) drought and water scarcity<br>4) extreme temperatures (heat waves)<br>5) temperature increase<br>6) wind storms and medicanes  | <b>Origin of categories:</b> Climate-ADAPT<br><b>Guidance:</b> Select the main climate impact addressed by the indicator. If more than one, please choose multiple impacts. If 'non specified' please choose category 13.  |

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|--|--|--|
|  | 7) ice and snow<br>8) sea level rise and storm surges<br>9) hail<br>10) landslides and avalanches<br>11) fire<br>12) multiple impacts<br>13) non specified<br>14) extreme temperature (cold) |  |
|--|--|--|

| Adaptation indicator database: Input guidance (2/3) |   |   |
|---|---|---|
| Indicator type 1                                    | Input indicator<br>Process indicator<br>Output indicator<br>Outcome indicator<br>Not applicable                                     | <p><b>Origin of categories:</b> Developed for this task</p> <p><b>Guidance:</b> Base the categorisation on the following definitions adapted from the ETC/CCA 2015 MRE report:</p> <ul style="list-style-type: none"> <li>• <b>Input indicator</b> – an indicator that provides a measure of resources, both human and financial, devoted to a particular adaptation activity, programme or intervention.</li> <li>• <b>Process indicator</b> – an indicator that tracks progress in adaptation policy processes and actions (e.g. indicators that illustrate a process is under way, such as the formulation of a coastal adaptation planning committee).</li> <li>• <b>Output indicator</b> – an indicator that relates to the direct results of an adaptation policy or action, without assessing if these results actually lead to better adaptation outcomes (e.g. indicators that an output has been achieved, such as 'X' km of upgraded sea defences).</li> <li>• <b>Outcome indicator</b> – an indicator that seeks to define an explicit outcome or impact of an adaptation action. Outcome indicators may also assess the level of success of specific adaptation measures (e.g. indicating a reduction in vulnerability or improved adaptive capacity).</li> <li>• <b>Not applicable</b> – indicators that do not fit the above categories (and for which Type 2 categories described below may be more appropriate)</li> </ul> |
| Indicator type 2                                    | Exposure indicator<br>Sensitivity indicator<br>Adaptive capacity indicator<br>Composite vulnerability indicator<br>Hazard indicator | <p><b>Origin of categories:</b> Developed for this task based on IPCC AR5 definitions</p> <p><b>Guidance:</b> Please select from the following options based on definitions in IPCC AR5:</p> <ul style="list-style-type: none"> <li>• <b>Exposure indicator</b> – an indicator of the exposure of people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected (e.g. number of household in high risk flood areas).</li> <li>• <b>Adaptive capacity indicator</b> – an indicator of the ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to</li> </ul>  |

|  |  |  |
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|  |  | <p>respond to consequences (e.g. number of local authorities with adaptation plans in place).</p> <ul style="list-style-type: none"> <li>• <b>Sensitivity indicator</b> - an indication of the degree to which a system or species is affected, either adversely or beneficially, by climate variability or change. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range or variability of temperature) or indirect (e.g. damages caused by an increase in the frequency of coastal flooding due to sea level rise).</li> <li>• <b>Composite vulnerability indicator</b> – an indicator that provides a metric characterizing the vulnerability of a system by combining, with or without weighting, several indicators assumed to represent vulnerability. This includes indicators which combine two or more indicators of exposure, sensitivity and/or adaptive capacity. In some cases in the literature, this has been described as a ‘vulnerability index indicator’.</li> <li>• <b>Hazard indicator</b> – a indicator of the potential occurrence of a natural or human-induced physical event or trend or physical impact that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems, and environmental resources (e.g. number of heat wave events).</li> </ul> |
|--|--|--|

| Adaptation indicator database: Input guidance (3/3) |                                      |  |
|---|--------------------------------------|--|
| Indicator type – self categorisation                | Free text                            | <p><b>Origin of categories:</b> Developed for this task</p> <p><b>Guidance:</b> Countries may have chosen to define the type of indicator themselves e.g. referring to a specific indicator as a “vulnerability indicator” or “resilience indicator”. Where this has occurred, please record this self-categorisation in this field.</p> |
| What does it monitor?                               | Free text                            | <p><b>Origin of categories:</b> Developed for this task</p> <p><b>Guidance:</b> This free text field should be used to provide a brief description of what this indicator measures/monitors e.g. “Shows the trend of water use in agriculture as reaction to more drought”</p>   |
| Type of measure                                     | Qualitative<br>Quantitative<br>Mixed | <p><b>Origin of categories:</b> ETC/CCA 2015 MRE report</p> <p><b>Guidance:</b> Please select from the drop-down menu the category that best describes nature of the indicator/type of measure.</p>  |
| Unit of measure                                     | Free text                            | <p><b>Origin of categories:</b> Developed for this task</p> <p><b>Guidance:</b> Depending on the indicator, it could be number of houses, % of area sealed for transport, etc.</p>   |
| Source of data                                      | Free text                            | <p><b>Origin of categories:</b> Developed for this task</p> <p><b>Guidance:</b> State the data provider (institution)</p>  |
| Length of time series                               | Free text (insert range)             | <p><b>Origin of categories:</b> Developed for this task</p>  |

|   |  |  |
|---|--|--|
|   |  | <b>Guidance:</b> Length of time series refers to the period the time series for each indicator is available for. Use free text to input the range (e.g. 1997 – 2010; 1987 – to current”)   |
| Frequency of collection (data generation) | Annual<br>Less frequent than annual<br>More frequent than annual<br>No information   | <b>Origin of categories:</b> Developed for this task<br><b>Guidance:</b> Select one category that describes how often the data underpinning the indicator is collected.<br><br><i>NB. Many adaptation indicators are proxy indicators i.e. they have been originally developed to serve other purposes. Especially for such proxy indicators, the frequency of data collection may differ from the frequency of reporting the adaptation indicators / the indicator set for one country (see “Indicator reporting cycle” below).</i><br><br><i>Furthermore, information on the frequency of data collection for data that has been originally generated to serve other purposes may not be publicly available.</i> |
| Limitation                                | Free text  | <b>Origin of categories:</b> Developed for this task<br><b>Guidance:</b> What limitations have been mentioned in relation to this indicator, what is your expert view on the limitations?  |
| Visual illustration of indicator data     | Numerical table<br>Graphs and charts<br>Maps<br>Combination (of graphs, numerical tables or maps)<br>Text only<br>No information | <b>Origin of categories:</b> Developed for this task<br><b>Guidance:</b> Select one category that describes the visual illustration(s) used for the indicator.   |
| Scale of data                             | European<br>Transnational<br>National<br>Subnational   | <b>Origin of categories:</b> Developed for this task<br><b>Guidance:</b> Select one category   |
| Indicator reporting cycle                 | Free text  | <b>Origin of categories:</b> Developed for this task<br><b>Guidance:</b> Insert any indication on the reporting cycle for this indicator. This will be very likely the same for all indicators in one country. Please note this refers specifically to reporting for the indicator NOT how often the underpinning data is collected.<br><br><i>NB. This information depends mostly on policy decision which may not be publicly available or not adopted.</i>  |
| Reference                                 | Free text  | <b>Guidance:</b> Please insert links to indicators and/or relevant information here.   |

## Annex II: Excel database of national adaptation indicator sets from five European countries

Available online at [https://cca.eionet.europa.eu/docs/ANNEX\\_TP\\_3-2018](https://cca.eionet.europa.eu/docs/ANNEX_TP_3-2018).



European Topic Centre on Climate Change Impacts, Vulnerability and Adaptation  
c/o Fondazione CMCC - Centro Euro-Mediterraneo sui Cambiamenti Climatici  
V.le Berti Pichat 6/2  
Bologna, Italy  
Web: <http://cca.eionet.europa.eu/>  
Email: [silvia.medri@cmcc.it](mailto:silvia.medri@cmcc.it)

The European Topic Centre on Climate Change Impacts, Vulnerability and Adaptation (ETC/CCA) is a consortium of European institutes under contract of the European Environment Agency.