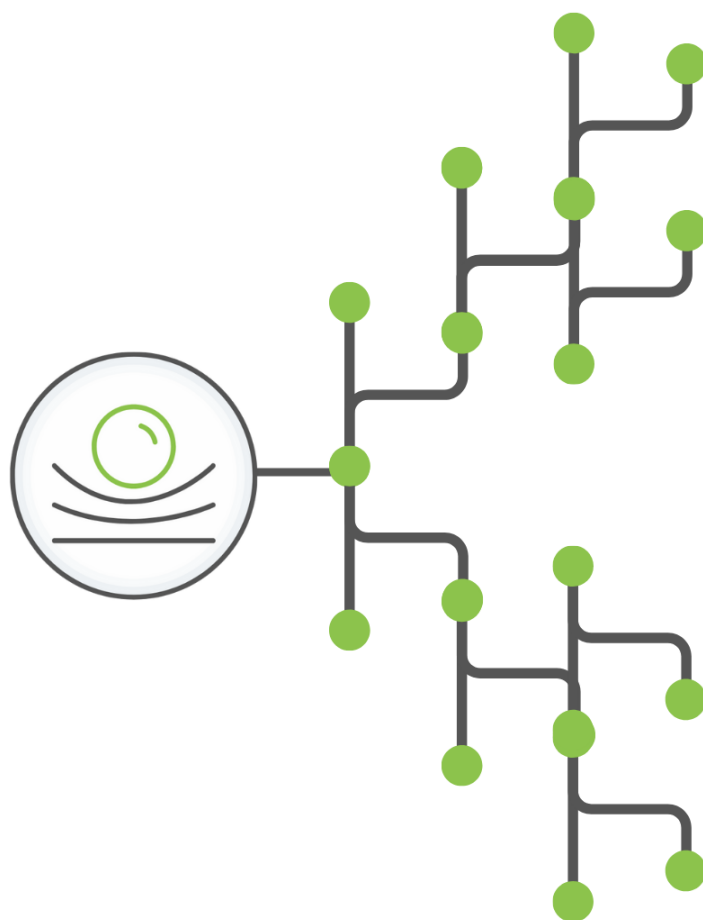# REGILIENCE

## Regional Pathways to Climate Resilience

# Living document for Monitoring and Evaluation of Climate Resilience (1st Version)

## JULY 2023

www.regilience.eu

| Project Acronym: | REGILIENCE |
|---|---|
| Programme | HORIZON2020 |
| Type of Action | Coordination and Support Action |
| Grant Agreement number | 101036560 |
| Start day | 01/11/2021 |
| Duration | 48 months |
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# Document information

| Document Facttable | |
|---|---|
| Full title | Living document for Monitoring and Evaluation of Climate Resilience (1st Version) |
| Work Package | WP3 |
| Task(s) | T3.3 Living document for Monitoring and Evaluation of Climate Resilience |
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| Date | July 2023 |

# Document dissemination Level

| Dissemination Level | |
|---|---|
| X | PU - Public |
| | PP - Restricted to other programme participants (including the EC) |
| | RE - Restricted to a group specified by the consortium (including the EC) |
| | CO - Confidential, only for members of the consortium (including the EC) |

# Document history

| Version | Date | Main modification | Entity |
|---------|------|-------------------|--------|
| V0.1 | 28.06.2023 | Draft version distributed for quality review | adelphi |
| V0.2 | 28.06.2023 | Internal Quality review | FEDARENE |
| V0.3 | 04.07.2023 | Review by the project coordinator | IEECP |
| V0.5 | 05.07.2023 | Review by the project coordinator | IEECP |

# Legal Notice

How to cite this report: REGILIENCE (2022). Concept note for the indicator set.

# About

REGILIENCE aims to foster the adoption and wide dissemination of regional climate resilience pathways, following a demand-driven approach and bearing in mind the expertise and knowledge acquired, as well as the solutions available from Innovation Packages and other sources. The project aims to support the Green Deal targets and communication by implementing Innovation Packages that will address key community systems and comprises the adaptation solutions and pathways deemed essential for climate and social resilience in the specific regional contexts and the set timeline. The REGILIENCE project aims to facilitate the replication of Innovation Packages in 10 vulnerable and low-capacity regions, additional to those targeted by the Innovation Package projects, after a selection process and the signature of a workplan agreement. This ambition is aligned with the Horizon Europe's proposed Mission "Prepare Europe for climate disruptions and accelerate the transformation to a climate-resilient and just Europe by 2030". It will implement the LC-GD-1-3-2020 RIA project results on the Innovation Packages.

# Project partners

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# Abstract

This publication presents the first version of the Living Document for Monitoring and Evaluation of Climate Resilience, serving as a database and guidance tool for existing Monitoring and Evaluation (M&E) practices, frameworks, case studies and data sources in the context of the EU mission on adaptation. Through desk research and synthesis of relevant indicators, frameworks, and case studies, the Living Document was created to support actors and projects in understanding and measuring their contributions to climate resilience, both on a regional and city level. The document provides an overview of key M&E guidance documents, best practice activities, and specific frameworks and indicator sets relevant to EU regions and implementing actors. Additionally, an expansion was made to include an overview of available data sources at the national and regional levels within the EU. The Living Document has been shared with the implementing actors and planned to be updated on a half-yearly basis (next update is planned for December 2023).

# 1 Introduction: Goal and purpose of the Living Document for Monitoring and Evaluation

REGILIENCE is a Coordination and Support Action that is coordinating the work between three Innovation Actions (IAs) – TransformAr, ARSINOE and IMPETUS – on different topics and supporting the transfer of activities from these projects into other regions. All four projects started in autumn of 2021.

In order to facilitate effective Monitoring and Evaluation (M&E) practices within the EU mission on adaptation projects and regions, extensive desk research was conducted. The findings from this research were compiled in the so-called Living Document for M&E of Climate Resilience, designed to serve as a centralized resource for all Mission projects, providing guidance on M&E and fostering knowledge sharing among actors.

The Living Document for M&E provides an overview of key guidance documents on M&E for climate resilience and climate adaptation, accompanied by brief descriptions and assessments of document usability. The heart of the document consists of a compilation of key M&E frameworks and indicator sets that hold particular relevance to the EU regions and implementing actors. These frameworks, including the EU Sustainable Development Goals Framework, Smart Mature Resilience Framework, Green City Tool by the European Commission, OECD Resilient Cities Framework, ISO Indicators, and EU Green City Accord Framework, are displayed within the document. Furthermore, it incorporates a compilation of local and regional best practice M&E activities, featuring cities and regions within Europe that have published information on monitoring their adaptation and climate resilience actions. Lastly, an overview of EU-available, cost-free data sources was integrated into the Living Document, offering information on data type, data origin, spatial and temporal resolution, time frame, and source.

It is set up in a way that it guides and inspires actors and projects in learning about relevant resources in this field. This Living Document, developed and managed by the REGILIENCE project team, a Coordinating and Support Action, is specifically intended to:

(1) help all project teams involved in the Mission to avoid duplicating work-flows regarding monitoring and evaluation,

(2) provide guidance for all projects along not only the objectives but also along the outputs and outcomes formulated by the Mission,

(3) serve as a common database for existing guidelines, best practice examples and indicators for monitoring and evaluation

(4) provide a regularly updated overview of lessons learned by the single projects and thus foster insights on the knowledge acquisition and about the progress of the Mission as a whole.

The Living Document is both presented in an Excel File and as a PDF for easier navigation. The REGILIENCE team will update the sections in the Living Document regularly on a bi-annual basis (next update intended in 12/2023).

# 2 Frameworks for Monitoring and Evaluating Climate Resilience

## 2.1 EU Mission on Adaptation to Climate Change: Objectives, Outcomes and Outputs

"The objective of the Mission is to support at least 150 European regions and communities to become climate resilient by 2030. It contributes to the EU Adaptation Strategy of 2021 with a planned investment sum of ~1 billion EUR of Horizon Europe budget. The Mission's M&E mechanism is built upon impact pathways including indicators to track progress (see the link to the Implementation Plan). Below in Table 1, the indicators that measure the progress of the Mission on Adaptation to Climate Change are presented:

Links:

European Missions – Adaptation to Climate Change

European Missions – Adaptation to Climate Change – Implementation Plan

*Table 1: EU Mission on Adaptation to Climate Change.*

| Objective | Transformative steps | Activities | Outputs | (Expected) Outcomes |
|---|---|---|---|---|
| **Preparing and planning for climate resilience** | (1) Better understanding of climate change related risks | Development of a risk assessment framework<br>Development of a vulnerability assessment framework<br>Development of a knowledge hub for impacts of CC<br>Development of a knowledge hub for already implemented measures to address CC risks<br>Funding of research and innovation actions (RIAs) to support regions in | 1) The Mission will develop a climate risk and vulnerability assessment framework and a knowledge hub which will allow citizens to access information and understand how the places in which they live are or will be affected by climate change and what has been done to address climate risks,<br><br>2) the communities and regions will | 1) Empowered by an easy access to advanced climate risk assessments, local administrations and companies will develop or revise community-based emergency and risk management plans to ensure that critical infrastructure is safe and essential services operable and accessible under critical conditions,<br><br>2) comprehensive climate risk |

| Objective | Transformative steps | Activities | Outputs | (Expected) Outcomes |
|---|---|---|---|---|
| | | using the climate assessment framework | learn about how their key community systems can be affected by climate risks, and how existing risk management capabilities can be further improved to better cope with these risks, | management plans, ensuring that community infrastructure and services are safe and operable and accessible under critical conditions |
| | | Conduction of multi-hazard/risk assessments or upgrading/refining existing ones | | |
| | | Adjustments of existing early warning systems considering changing climate patterns and ensure rapid responses, especially for the most vulnerable communities | (3) In depth review of climate risks affecting the key community systems, | |
| | | Sharing of knowledge, experience and lessons leant by the supported cities | (4) access to climate risk profiles and enhanced EWS | |
| | (2) Mobilizing support and engagement | Foster sustainable citizen and stakeholder engagement establishing new local governance structures steering the transformation | At least 150 regions and communities have well-established governance structures steering the transformation to climate resilience, including mechanisms for a meaningful and continuous citizen and stakeholder engagement and for multilevel governance. | A culture of civic engagement and social learning, and mechanisms ensuring a just transition. |
| | | Establish multi-stakeholder participation in governance processes. | | |
| Accelerating transformations to climate resilience | (3) Formulating a vision and transformative pathways to climate resilience | At least 150 regions and communities have formulated their specific vision of a climate resilient future. | At least 150 regions and communities have formulated their specific vision of a climate resilient future and the transformative pathways to reach it. These strategies should entail clear plans and commitments that should guide and enable the innovation and policy actions that are to be addressed in step 4. | 1) That the vision and pathways to a climate resilient future are reflected in political commitments to prepare the ground for the large-scale diffusion of solutions, including policy actions promoting enabling conditions, addressing barriers and leveraging funds (fundamental for step 5). |
| | | At least 150 regions and communities have formulated their specific transformative pathways reach their formulated climate resilient vision. | | 2) to further mobilize and inspire the engagement of citizens and other stakeholders in the transformative |
| | | At least 150 regions and communities have strategies that entail clear plans and commitments to reach their vision. | | |

| Objective | Transformative steps | Activities | Outputs | (Expected) Outcomes |
|---|---|---|---|---|
| | | At least 150 regions and communities have strategies that guide and enable innovations that are to be addressed in step 4. | | journey to climate resilience, as well as to provide a good understanding of cross-border interdependencies, risks and opportunities (that should be addressed in step 6). |
| | | At least 150 regions and communities have strategies that guide and enable policy actions that are to be addressed in step 4. | | |
| | (4) Orchestrating innovations and testing transformative solutions | At least 150 regions and communities have been involved in development of a whole range of transformative solutions (see implementation plan for suggestions) that have been tested by applied research and have proof of concept. | At least 150 regions and communities have been involved in development and testing of a whole range of transformative solutions that have been developed, tested and/or brought close to the market, ranging from applied research and proof of concept, to demonstrations in operational environments at pre-commercial scale and of first of a kind commercial systems. | That this would accelerate the access to transformative solutions that are ready to be deployed (in steps 5 and 6), and contribute to creating more competitive and smarter regional economies in general. |
| | | At least 150 regions and communities have been involved in testing of a whole range of transformative solutions that have been developed, tested by applied research and got proof of concept, to demonstrations in operational environments at pre-commercial scale and of first of a kind commercial systems. | | |
| **Demonstrating systemic transformations to climate resilience** | (5) Creating impact at scale | Stimulating larger scale deployment of tested solutions | At least 75 demonstrations of systemic transformations contributing to the overall climate resilience of regions. | The large-scale deployment of transformative solutions will eventually lead to high impact and visibility projects contributing to climate resilience in a high number (at least 150) of European regions and communities. |

| Objective | Transformative steps | Activities | Outputs | (Expected) Outcomes |
|---|---|---|---|---|
| | (6) Creating cross-border value | Creation of flagship projects for neighborhood cooperation and valorization of key cross-border community system. | Development and implementation of common strategies for cross-border cooperation | Fostering cross-border-territorial cooperation through an additional set of demonstration projects |

## 2.2  Selection of Guideline Documents on Monitoring and Evaluation for Climate Adaptation and Resilience

Table 2 contains a selection of guideline documents on Monitoring and Evaluation and tools that can be used on a city and regional level. This list will be continued with further available guidelines that can be of help for projects, regions and cities.

*Table 2: Guidance documents and tools of monitoring and evaluating climate resilience in cities and regions*

| Title of Guidance Document | Content regarding M&E | Usability (excellent, good, average) | Prior knowledge needed | Details/Insights | Examples |
|---|---|---|---|---|---|
| Urban Adaptation Support Tool. | ☐ Guiding questions/ checklists<br>☐ Indicator framework<br>☐ Examples of indicators<br>☐ Stakeholder engagement<br>☐ Communication of results<br>☐ Challenges regarding M&E<br>☒ Pool of guidelines and tools | **Excellent** (clear step-by-step guidance with links to useful sources for setting up a M&E system) | No (but additional information is provided: Chapter 6.4. in EEA (2020). Urban adaptation in Europe: how cities and towns respond to climate change: | Setting up a M&E method requires a combination of **robust indicators, knowledge management and active and sustained engagement of stakeholders**, such as the public and private sectors and civil society.<br><br>Other key factors to consider when preparing for monitoring and evaluation are: 1) Acknowledging trade-offs; 2) Defining the baselines as reference for M&E; 3) Considering the unintended and unexpected; 4) Communicating and agreeing on the purpose for monitoring and evaluating.<br><br>**Guidance for defining indicators including five advices** but without a list of exemplary indicators.<br>In the following chapter, the need for observing necessary enhancements within the monitoring | Links to various case studies. |

| Title of Guidance Document | Content regarding M&E | Usability (excellent, good, average) | Prior knowledge needed | Details/Insights | Examples |
|---|---|---|---|---|---|
| | | | | framework is explained. Therefore, four guiding questions are being provided: Are we doing the right thing? Are we doing things right? How is implementation processing? Is the monitoring framework effective? Ultimately, a self-check is provided. | |
| **Planning for Adaptation to Climate Change: Guidelines for Municipalities** | ☒ Guiding questions/ checklists<br>☐ Indicator framework<br>☒ Examples of indicators<br>☒ Stakeholder engagement<br>☐ Communication of results<br>☐ Challenges regarding M&E<br>☒ Pool of guidelines and tools | **Good** - (incl. guiding questions in all subchapters) | No | **Defining key elements:**<br>1) Clearly formulated goals, objectives and output measures - at set of both process-based adaptation and outcome-based indicators (including a table showing differences, advantages and disadvantages of the two);<br>2) clearly defined baseline as reference for M&E;<br>3) the availability of quality data;<br>4) involvement of affected stakeholders;<br>5) continuous feedback-correction cycle (including the emphasis on the actuality of scientific assumptions) | **Examples for outcome-based indicators:** degree and quality of participant involvement in adaptation decisions; number and quality of laws or policies addressing climate change (amongst others);<br><br>**Example process-based indicator:** An example of a process-based indicator is the Performance Indicator for Climate Change Adaptation NI188 in the UK that measured the progress through self-assessment on assessing and managing climate risks and opportunities, and incorporating appropriate action into local authority and partners' strategic planning. The indicator aimed to ensure that local authorities are sufficiently prepared to manage risks to service delivery, the public, local communities, local infrastructure, businesses and the natural environment from a |

| Title of Guidance Document | Content regarding M&E | Usability (excellent, good, average) | Prior knowledge needed | Details/Insights | Examples |
|---|---|---|---|---|---|
| | | | | | changing climate, and to make the most of new opportunities. The indicator had five levels each of which could be either fully or partially completed covering: Level 0 - Getting started, Level 1 – Public commitment and impacts assessment; Level 2 – Comprehensive risk assessment; Level 3 – Comprehensive action plan and Level 4 – Implementation, monitoring and continuous review; |
| **Transition Handbook / Training Package** | ☒ Guiding questions/ checklists<br>☒ Indicator framework<br>☐ Examples of indicators<br>☐ Stakeholder engagement<br>☐ Communication of results<br>☒ Challenges regarding M&E<br>☐ Pool of guidelines and tools | **Good** (clear step-by-step guidance, various clear figures) | No | <u>Theoretical part:</u><br>1) **Establishing the basis for the M&E system**: Definition of the objective of the evaluation; Definition of the object of the evaluation; Definition of the conceptual model of evaluation: limitations, opportunities and assumptions; Definition of the type of evaluation: quantitative, qualitative, or combined?<br>2) **Designing the M&E system:** Take advantage of existing indexes and monitoring schemes; Definition of indicators; Definition of baseline measurement; Definition of periodicity of monitoring and evaluation; Definition of alerts and threshold mechanisms if necessary<br>3) **Communicating results to inform policy and practice**: Translating indicators in a understandable and communicable way for policy-makers and citizens | Pros and cons for different communication methods (Table 47) |

| Title of Guidance Document | Content regarding M&E | Usability (excellent, good, average) | Prior knowledge needed | Details/Insights | Examples |
|---|---|---|---|---|---|
| | | | | Moreover, guiding principles for successful adaptation plans in general are provided as well as reasons for the difficulty of heat-health action plans.<br>**Worksheets**:<br>**Guiding questions for indicators** are included: What should be monitored? How should the monitoring process take place? Why and which would be the most important issues to consider?<br>**Differentiation between process- and outcome-based indicators** incl**.** table over with core dimensions of resilient systems, characteristics and benefits for identifying suitable indicators in the following areas: Grey infrastructure (ICT, water, waste, energy etc.); Green and blue infrastructures; Land use, mobility, urban-rural interface; Architecture, public space, urban regeneration followed by instructions on how to come up with own indicators along the provided information. Worksheet 7 is concerned with the **communication of results** including **guiding principles and examples**. | |
| **AdaptME toolkit. Adaptation Monitoring & Evaluation** | ☒ Guiding questions/ checklists<br>☐ Indicator framework<br>☒ Examples of indicators | **Average** (very comprehensive but a lot of text) | No | **Investigates the possible purposes of investigations:**<br>**Questions to consider:**<br>What is the purpose of your evaluation and what would you like to learn? How do you maximize the synergies between these purposes or manage conflicting purposes? | None |

| Title of Guidance Document | Content regarding M&E | Usability (excellent, good, average) | Prior knowledge needed | Details/Insights | Examples |
|---|---|---|---|---|---|
| | ☒ Stakeholder engagement<br>☐ Communication of results<br>☒ Challenges regarding M&E<br>☐ Pool of guidelines and tools | | | What trade-offs do you have to make and can these be justified? Have you defined the learning objectives of your evaluation? Who should be learning what and how?<br><br>**Aim of the framework the M&E approach is embedded in**: Does the intervention you are evaluating involve building adaptive capacity, adaptation actions or both? Does your evaluation focus on a particular sector or discipline? If so, are there particular data sources or standards which might be applicable to your evaluation?<br><br>**Guidance on building an Adaptation Logic Model**<br>**Guidance on coping mechanisms for uncertainties**<br><br>**Guiding questions for measuring performance against a baseline:**<br>Will your baseline provide a clear picture of the type and nature of both climate and non-climate vulnerabilities and impacts? For medium and long term interventions, does the mix of metrics chosen for your baseline enable you to tease out the differences resulting from your actions and changes in baseline conditions? How often should you revisit your baseline to assess how conditions have changed? How will data availability | |

| Title of Guidance Document | Content regarding M&E | Usability (excellent, good, average) | Prior knowledge needed | Details/Insights | Examples |
|---|---|---|---|---|---|
| | | | | change during the course of the project? Can new data be incorporated into your baseline? Critically, do you think your baseline will help you make better decisions during and after the intervention?<br><br>**Explanation of process and outcome indicators and guiding questions for the identification of potential indicators and metrics** is additionally given as well as tips for evaluating the unintended, stakeholder involvement and the communication of findings. | |
| [Methods and Tools for Adaptation to Climate Change - A Handbook for Provinces, Regions and Cities](#) | ☒ Guiding questions/ checklists<br>☐ Indicator framework<br>☐ Examples of indicators<br>☐ Stakeholder engagement<br>☒ Communication of results<br>☐ Challenges regarding M&E<br>☐ Pool of guidelines and tools | **Average** (clear step-by-step guidance) | Yes | **Goal**:<br>**1.** Identify and formulate the **objectives of monitoring and evaluation** with guiding questions as a first step: What specifically should be monitored and evaluated? What is the general trend with regard to adaptation in various sectors? What is the status of implementation for specific adaptation measures? How are climate change-related challenges developing?<br>**2. Quality criteria** for data and indicators;<br>**3. Relevant questions for the assessment of the M&E system**: What other additional steps and research projects are underway that could contribute to the achievement of the adaptation measure's objective? Why have only a few/no steps been undertaken towards the implementation of the adaptation measure? | **Examples for M&E systems:**<br>MONE (sustainability); Mobility-e (biodiversity); ÖWAD (forests); Austrian Forest Inventory; WEM (wild game impact monitoring); Evaluation programmes for rural development ; Surveys conducted by Statistic Austria; Energy efficiency monitoring; Surveys by e-control; State of the Environment Report (UKB; Federal Environment Agency); Report on the Water Framework Directive; Monitoring obligations from the Water Rights Act<br>Plus various examples for the communication on climate change and adaptation including |

| Title of Guidance Document | Content regarding M&E | Usability (excellent, good, average) | Prior knowledge needed | Details/Insights | Examples |
|---|---|---|---|---|---|
| | | | | What challenges have confronted the actors in the course of planning and implementation? What support will be necessary for planning and implementation to be able to begin? Are there any additional suggestions with regard to the adaptation measure (missing content-related aspects, additional implementation steps, etc.)? **4. Guidance on communication principles** | Additional reading: Federal Environment Agency Germany Brochure: The Climate is Changing – What Can We Do? Examples of Local Adaptation |
| **Adaptation Monitoring and Evaluation Toolkit** | ☒ Guiding questions/ checklists <br> ☐ Indicator framework <br> ☐ Examples of indicators <br> ☒ Stakeholder engagement <br> ☒ Communication of results <br> ☐ Challenges regarding M&E <br> ☒ Pool of guidelines and tools | **Average** (clear step-by-step guidance, however, rather short with links to other resources) | No | **Steps that need to be answered:** <br> **1. Identifying your reasons for conducting an evaluation** will help you craft an appropriate evaluation plan. Communicating program successes? Accountability to funders or other groups? Learning if the program has been implemented as intended? Measuring program impacts and identifying success factors? Making informed changes to a policy? <br> **2. Available resources**: Has the program been evaluated in the past? If so, what can you learn from the results? Do you have the staff capacity and capabilities to conduct an evaluation in-house? Do you have the financial resources to hire an external evaluator? Does some data about the program already exist, such as surveys, reviews, or metrics that you or others have collected? Do you have support from other members of your organization, supervisors, funders, peers, and target audiences? What can these partners and stakeholders offer in terms of technical | **Examples**: <br> NOAA Office for Coastal Managements Guide for Planning for Meaningful Evaluation for guidance on creating an evaluation plan. <br> Additional examples for good evaluation standards AdaptME-Toolkit, Developing Urban Climate Adaptation Indicators by Institute for Sustainable Communities, Urban Sustainability Directors Network, and Government of the District of Columbia; Monitoring & Evaluation in Climate Change Adaptation Projects: Highlights for Conservation Practitioners by The Wildlife Conservation Society Climate Adaptation Fund; Examples or stakeholder |

| Title of Guidance Document | Content regarding M&E | Usability (excellent, good, average) | Prior knowledge needed | Details/Insights | Examples |
|---|---|---|---|---|---|
| | | | | expertise, financial resources, or access to partnerships?<br>Moreover: guidance if additional resources are needed: external evaluator, funding etc.)<br>**3. Guidance on communication:** stakeholder assessment; Some ideas for communicating your results: Share through your organization's website, newsletter, and social media. Disseminate to stakeholders, funders, and similar organizations. Present your findings at the National Adaptation Forum or a regional adaptation conference. Contact the Resilience Metrics team or the Climate Adaptation Knowledge Exchange (CAKE) to explore sharing a case study. | communication (focus on culturally-inclusive backgrounds) |
| **Guidelines for Climate Change. Adaptation at the local level in the Alps** | ☒ Guiding questions/ checklists<br>☐ Indicator framework<br>☒ Examples of indicators<br>☐ Stakeholder engagement<br>☒ Communication of results<br>☐ Challenges regarding M&E<br>☐ Pool of guidelines and tools | **Average** (not as straight forward as other guidelines, but useful information focused on sub-national actors) | No | **Goal of the guideline: ensure success of sub-national adaptation strategies**<br><br>**1. Three key factors to ensure success of sub-national adaptation strategies** (at local level in the Alps): 1) Perception and awareness; 2) Addressing knowledge gaps and uncertainties; 3) Policy integration at sub-national level;<br>**2. Explanation for the use and rationale of indicators** (policy relevance, causal links to CC, data quality and accessibility, robustness and known uncertainty, acceptance and intelligibility), differentiation between process- and outcome-based indicators;<br>**3. Addresses need for coordination of** | **Examples for different types of indicators**:<br>- Climate change drivers (temperature, precipitation)<br>- Understanding the causes of impacts of climate change;<br>- Climate change impacts (floods, droughts)<br>- Understanding consequences of climate change and determining vulnerability to climate change; Social, economic, health and ecological vulnerability - Monitoring and understanding vulnerability;<br><br>**Process-based indicators** |

| Title of Guidance Document | Content regarding M&E | Usability (excellent, good, average) | Prior knowledge needed | Details/Insights | Examples |
|---|---|---|---|---|---|
| | | | | **measures though monitoring** to avoid cross-cutting and maladaptation; **4. Need for participatory adaptation strategies**; List of issues to be considered when communicating (intermediate) results:<br>**5. Communication should be sustained over time**: the same message should not be conveyed overtime, regardless of how the audience evolves in its understanding of climate change. Moreover, provides information about funding resources (again not really clear how this is only linked with M&E instead of the whole adaptation process). Ultimately, three quarters of once one page are dedicated to maladaptation which can be prevented by effective M&E frameworks. | **(selection)**<br>General - use of scenarios to inform adaptation options, production of local adaptation guidance; examples of sectoral indicators<br><br>**Outcome-based indicators**:<br>Examples of sectoral indicators |

# 3 Selection of Indicator Frameworks for Monitoring and Evaluating Climate Resilience

## 3.1 EU SDG Indicators

While the SDGs do not specifically focus on climate resilience, they encompass a range of interconnected issues that contribute to building resilience against climate change impacts. By working towards achieving the set goals of the SDGs, countries can enhance their capacity to adapt to and cope with climate-related risks and promote sustainable development. Below is a selection of the main indicators on the EU level (differ from global indicators and from EUROSTAT indicators). It's important to note that while the SDGs provide a broad framework, more specific and targeted indicators may be needed to comprehensively monitor climate resilience at various scales, including local, regional, and national levels. In addition, the framework does not cover all specific consequences of climate change such as impacts on human health based on heat stress or flooding are not directly considered (UNFCCC, 2022, p.4, https://unfccc.int/sites/default/files/resource/ReportGGATP_final.pdf).

Activities that target climate resilience are mostly contributing to at least one of the following five goals:

- SDG 6: Clean Water and Sanitation
- SDG 11: Sustainable Cities and Communities
- SDG 13: Climate Action
- SDG 14: Life below Water
- SDG 15: Life on Land

The listed indicators in Table 3 are taken from the Sustainable Development Solutions Network and Bertelsmann Stiftung.

Link:

https://eu-dashboards.sdgindex.org/map

*Table 3: EU SDG Indicators*

| Interpretation of Indicators on EU Level | Description |
|---|---|
| **1. Goal: No poverty** | |
| **1.1. People at risk of income poverty after social transfers** | 1.1.1 People at risk-of-poverty are persons with an equivalized disposable income below the risk-of-poverty threshold, which is set at 60 % of the national median equivalized disposable income (after social transfers). |
| **1.2 Severely materially deprived people** | 1.2.1 The share of severely materially deprived persons who have living conditions severely constrained by a lack of resources. They experience at least 4 out of 9 following deprivations items: cannot afford I) to pay rent or utility bills, ii) keep home adequately warm, iii) face unexpected expenses, iv) eat meat, fish or a protein equivalent every second day, v) a week holiday away from home, vi) a car, vii) a washing machine, viii) a color TV, or ix) a telephone. |
| **1.3. Poverty headcount ratio at $5.50/day** | 1.3.1 Estimated percentage of each country's population that in 2019 is living under the poverty threshold of US$5.50 a day in purchasing power parity (PPP) at constant 2011 prices. |
| **2. Goal: Zero hunger** | |
| **2.1. Prevalence of obesity (BMI>30)** | 2.1.1 The percentage of the adult population that has a body mass index (BMI) of 30kg/m2 or higher, based on self-reported height and weight. |
| **2.2 Human Trophic Level (best 2-3 worst)** | 2.2.1 Trophic levels are a measure of the energy intensity of diet composition and reflect the relative amounts of plants as opposed to animals eaten in a given country. A higher trophic level represents a greater level of consumption of energy-intensive animals |
| **2.3 Yield Gap Closure (%)** | 2.3.1 The ratio of the actual yield to the country's potential yield in the three annual crops using the most land area, weighted for the relative importance of each crop in terms of surface area |
| **2.4 Cross nitrogen balance on agricultural land (kg/hectare)** | 2.4.1 The potential surplus or deficit of nitrogen in agricultural soils. A lack of nitrogen or phosphorus may lead to degradation in soil fertility, while an excess may cause surface and groundwater (including drinking water) pollution and eutrophication. Ideally, the input/output of nutrition to the soil should be balanced. The land types included in utilized agricultural area (UAA) are arable land, permanent crops and permanent grassland. |
| **2.5 Ammonia emissions from agriculture (kg/hectare)** | 2.5.1 The amount of ammonia (NH3) emissions as a result of the agricultural production. Ammonia emissions per hectare are calculated using the total utilized agricultural area (UAA) of the relevant year as denominator. |
| **2.6 Exports of pesticides banned in the EU (kg/1,000 population)** | 2.6.1 The amount of pesticide mixture, containing a pesticide ingredient banned in the EU, per 1,000 population. Data are reported in either liters or kilograms, a conversion factor of (1kg = 1L) was assumed to aggregate data. Data come from export notifications at the European Chemicals Agency (ECHA), paperwork that companies must complete under European law to export banned pesticides beyond the European Union. |

| Interpretation of Indicators on EU Level | Description |
|---|---|
| **3. Goal: Good health and well-being** | |
| **3.1 Life expectancy at birth (years)** | 3.1 Life expectancy at birth is defined as the mean number of years that a newborn child can expect to live if subjected throughout his life to the current mortality conditions (age-specific probabilities of dying) |
| **3.2 Gap in life expectancy at birth among regions (years)** | 3.1 Differences in life expectancy among regions. Calculated by taking the largest gap in life expectancy among NUTS2 regions within each country |
| **3.3 Population with good or very good perceived health (% of population aged 16 or older)** | 3.1 The indicator is a subjective measure on how people judge their health in general on a scale from "very good" to "very bad". It is expressed as the share of the population aged 16 or over perceiving itself to be in "good" or "very good" health. |
| **3.4 Gap in self-reported health, by income (p.p.)** | 3.4 Gap in percentage of people who perceive their health status as good or very good between the poorest 20% and the richest 20% of the population. |
| **3.5 Gap in self-reported unmet need for medical examination and care, by income (p.p.)** | 3.5 Gap in percentage of people reporting unmet needs for medical care between the poorest 20% and the richest 20% of the population. A positive value means that people with low income report more unmet needs than people with high income. |
| **3.6 New reported casas of tuberculosis (per 100,000 population)** | 3.6 New cases of tuberculosis infection per 100,000 population. |
| **3.7 Standardized preventable and treatable mortality (per 100,000 persons aged less than 75)** | 3.7 Avoidable mortality covers both preventable and treatable causes of mortality. Preventable mortality refers to mortality that can mainly be avoided through effective public health and primary prevention interventions (i.e. before the onset of diseases/injuries, to reduce incidence). Treatable mortality can mainly be avoided through timely and effective health care interventions, including secondary prevention and treatment (after the onset of diseases to reduce case-fatality). The data are presented as standardized death rates, meaning they are adjusted to a standard age distribution in order to measure death rates independently of different age structures of populations. |
| **3.8 Suicide rate (per 100,000 population)** | 3.8 Rate of mortality due to self-harm per 100,000 population |
| **3.9 Age-standardized death rate attributable to household air pollution and ambient air pollution (per 100,000 population)** | 3.9 Mortality rate that is attributable to the joint effects of fuels used for cooking indoors and ambient outdoor air pollution. |
| **3.10 Mortality rate, under -5 (per 1,000 live births)** | 3.10 The probability that a newborn baby will die before reaching age five, if subject to age-specific mortality rates of the specified year, per 1,000 live births. |

| Interpretation of Indicators on EU Level | Description |
|---|---|
| 3.11 People killed in road accidents (per 100,000 population) | 3.11 The number of fatalities caused by road accidents, including drivers and passengers of motorized vehicles and pedal cycles as well as pedestrians. Persons dying on road accidents up to 30 days after the occurrence of the accident are counted as road accident fatalities. After these 30 days, a different cause of death might be declared by reporting institutions. For Member States not using this definition, corrective factors are applied |
| 3.12 Surviving infants who received 2 WHO-recommended vaccines (%) | 3.12 Estimated national routine immunization coverage of infants, expressed as the percentage of surviving infants children under the age of 12 months who received two WHO-recommended vaccines (3rd dose of DTP and 1st dose of measles). |
| 3.13 People engaging in heavy, episodic drinking at least once a week (%) | 3.13 Proportion of population that engages in heavy episodic drinking, which is defined as ingesting more than 60g of pure ethanol on a single occasion. |
| 3.14 Smoking prevalence (%) | 3.14 The share of the population aged 15 years and over who report that they currently smoke boxed cigarettes, cigars, cigarillos or a pipe. The data does not include use of other tobacco products such as electronic cigarettes and snuff. The data are collected through a Eurobarometer survey and are based on self-reports during face-to-face interviews in people's homes. |
| 3.15 People covered by health insurance for a core set of services (%) | 3.15 Percentage of people covered by health insurance for a core set of services under public programs and through private insurance. |
| 3.16 Share of total health spending financed by out-of-pocket payments (%) | 3.16 Share of total health spending financed by out-of-pocket payments. Out-of-pocket payments are expenditures borne directly by a patient where neither public nor private insurance cover the full cost of the health good or service. They include cost-sharing and other expenditures paid directly by private households and should also in principle include estimations of informal payments to health care providers. |
| 3.17 Subjective Wellbeing (average ladder score, worst 0-10 best) | 3.17 Subjective self-evaluation of life, where respondents are asked to evaluate where they feel they stand on a ladder where 0 represents the worst possible life and 10 the best possible life. |
| 3.18 Individuals that use the internet to make appointments with a practitioner (%) | 3.18 The proportion of the population that reported using the internet to make appointments with a practitioner.. |
| 4. Goal: Quality education | |
| 4.1 Participation in early childhood education (% of children between age of 3 and starting age of compulsory primary education) | 4.1 The share of the children between the age of three and the starting age of compulsory primary education who participated in early childhood education. |

| Interpretation of Indicators on EU Level | Description |
|---|---|
| **4.2 Early leavers from education and training (% of population aged 18 to 24)** | 4.2 Share of the population aged 18 to 24 with at most lower secondary education who were not involved in any education or training during the four weeks preceding the survey. Lower secondary education refers to ISCED (International Standard Classification of Education) 2011 level 0-2 for data from 2014 onwards and to ISCED 1997 level 0-3C short for data up to 2013. Data stem from the EU Labor Force Survey (EU-LFS). |
| **4.3 PISA score** | 4.3 National scores in the Programmed for International Student Assessment (PISA), an internationally standardized assessment that is administered to 15-year-olds in schools. PISA scores for reading, mathematics and science were averaged to obtain an overall PISA score. |
| **4.4 Underachievers in science (% of population aged 15)** | 4.4 Share of 15-year-old students failing to reach level 2 ("basic skills level") on the PISA scale for science. The data stem from the Programme for International Student Assessment (PISA), an internationally standardized assessment that is administered to 15-year-olds in schools. |
| **4.5 Variation in science performance explained by students socio-economic status (%)** | 4.5 Percentage of variation in science performance on the PISA explained by students' socio-economic status. The data stem from the Programme for International Student Assessment (PISA), an internationally standardized assessment that is administered to 15-year-olds in schools. |
| **4.6 Tertiary educational attainment** | 4.6 Share of the population aged 25-34 who have successfully completed tertiary studies (e.g. university, higher technical institution, etc.). This educational attainment refers to ISCED (International Standard Classification of Education) 2011 level 5-8 for data from 2014 onwards and to ISCED 1997 level 5-6 for data up to 2013. The indicator is based on the EU Labor Force Survey (EU-LFS). |
| **4.7 Adult participation in learning (%)** | 4.7 Share of people aged 25 to 64 who stated that they received formal or non-formal education and training in the four weeks preceding the survey (numerator). The denominator consists of the total population of the same age group, excluding those who did not answer to the question 'participation in education and training'. Adult learning covers formal and non-formal learning activities — both general and vocational — undertaken by adults after leaving initial education and training. Data stem from the EU Labor Force Survey (EU-LFS). |
| **5. Goal: Gender equality** | |
| **5.1 Unadjusted gender pay gap (% of gross male earnings)** | 5.1 The difference between average gross hourly earnings of male paid employees and of female paid employees as a percentage of average gross hourly earnings of male paid employees. The indicator has been defined as unadjusted, because it gives an overall picture of gender inequalities in terms of pay and measures a concept which is broader than the concept of equal pay for equal work. All employees working in firms with ten or more employees, without restrictions for age and hours worked, are included. |
| **5.2 Gender employment gap (p. p.)** | 5.2 Difference between the employment rates of men and women aged 20 to 64. The employment rate is calculated by dividing the number of persons aged 20 to 64 in employment by the total population of the same age group. |

| Interpretation of Indicators on EU Level | Description |
|---|---|
| **5.3 Population inactive due to caring responsibilities (% of population aged 20 to 64)** | 5.3 The indicator measures the share of individuals that are not actively seeking work, so they are neither employed nor unemployed and considered to be outside the labor force, because of caring responsibilities. While several reasons may exist why somebody is not seeking employment, only the main one is considered. "Inactivity due to caring responsibilities" refers to the reasons 'looking after children or incapacitated adults' and 'other family or personal responsibilities'. |
| **5.4 Seats held by women in national parliaments (%)** | 5.4 The proportion of women in national parliaments. The national parliament is the national legislative assembly and the indicator refers to both chambers (lower house and an upper house, where relevant). The count of members of a parliament includes the president/speaker/leader of the parliament. |
| **5.5 Positions led by women in senior management positions (%)** | 5.5 The share of female board members in the largest publicly listed companies. Only companies which are registered in the country concerned are counted. Board members cover all members of the highest decision-making body in each company (i.e. chairperson, non-executive directors, senior executives and employee representatives, where present). |
| **5.6 Proportion of ICT specialists that are women (%)** | 5.6 The share of ICT employment that was accounted for by women. |
| **6. Goal: Clean water and sanitation** | |
| **6.1 Population having neither a bath, nor a shower, now indoor flushing toilet in their household (%)** | 6.1 The share of total population having neither a bath, nor a shower, nor an indoor flushing toilet in their household. |
| **6.2 Population connected to at least secondary wastewater treatment (%)** | 6.2 The percentage of population connected to wastewater treatment systems with at least secondary treatment. Thereby, wastewater from urban sources or elsewhere is treated by a process generally involving biological treatment with a secondary settlement or other process, resulting in a removal of organic material that reduces the biochemical oxygen demand (BOD) by at least 70 % and the chemical oxygen demand (COD) by at least 75 %. |
| **6.3 Freshwater abstraction (% of long-term average available water)** | 6.3 Annual total fresh water abstraction in a country as a percentage of its long-term annual average available water (LTAA) from renewable fresh water resources (groundwater and surface water). Total fresh water abstraction includes water removed from any fresh water source, either permanently or temporarily. Mine water and drainage water as well as water abstractions from precipitation are included, whereas water used for hydroelectricity generation (in situ use) is excluded. |

| Interpretation of Indicators on EU Level | Description |
|---|---|
| **6.4 Scarce water consumption embodied in imports (m³/capita)** | 6.4 Water scarcity is measured as water consumption weighted by scarcity indices. In order to incorporate water scarcity into the virtual water flow calculus, a new satellite account was constructed where water use entries are weighted so that they reflect the scarcity of the water being used. The weight used is a measure of water withdrawals as a percentage of the existing local renewable freshwater resources. The Water Scarcity Index was used for converting total water use into scarce water use. |
| **6.5 Population using safely managed water services (%)** | 6.5 Percentage of the population using a safely managed drinking water service. A safely managed drinking water service is one where people use an "improved" source meeting three criteria: it is accessible on premises, water is available when needed, and the water supplied is free from contamination. Improved sources are those that have the potential to deliver safe water by nature of their design and construction. |
| **6.6 Population using safely managed sanitation services (%)** | 6.6 Percentage of the population using safely managed sanitation services. Safely managed sanitation services are "improved" sanitation facilities that are not shared with other households, and where the excreta produced should either be treated and disposed of in situ, stored temporarily and then emptied, transported and treated off-site, or transported through a sewer with wastewater and then treated off-site. Improved sanitation facilities are those designed to hygienically separate excreta from human contact. |
| **7. Goal: Affordable and clean energy** | |
| **7.1 Population unable to keep home adequately warm (%)** | 7.1 Share of population who are in the state of enforced inability to keep home adequately warm. |
| **7.2 Share of renewable energy in gross final energy consumption (%)** | 7.2 The indicator measures the share of renewable energy consumption in gross final energy consumption according to the Renewable Energy Directive. The gross final energy consumption is the energy used by end-consumers (final energy consumption) plus grid losses and self-consumption of power plants. |
| **7.3 CO2 emissions from fuel combustion per electricity output (MtCO2/TWh)** | 7.3 A measure of the carbon intensity of energy production, calculated by dividing CO2 emissions from the combustion of fuel by electricity output. This indicator was calculated by dividing national data on Total CO2 emissions from fuel combustion for electricity and heat (MtCO2) over Electricity output (TWh). |
| **8. Goal: Decent work and economic growth** | |
| **8.1 Protection of fundamental labour rights (worst 0-1 best)** | 8.1 Measures the effective enforcement of fundamental labor rights, including freedom of association and the right to collective bargaining , the absence of discrimination with respect to employment, and freedom from forced labor and child labor. |

| Interpretation of Indicators on EU Level | Description |
|---|---|
| **8.2 Gross disposable income (€/capita)** | 8.2 The indicator reflects the purchasing power of households and their ability to invest in goods and services or save for the future, by accounting for taxes and social contributions and monetary in-kind social benefits. It is calculated as the adjusted gross disposable income of households and Non-Profit Institutions Serving Households (NPISH) divided by the purchasing power parities (PPP) of the actual individual consumption of households and by the total resident population. |
| **8.3 Youth not in employment, education or training (NEET) (% of population aged 15 to 29)** | 8.3 The share of the population aged 15 to 29 who is not employed and not involved in education or training. |
| **8.4 Unemployment rate** | 8.4 The percentage of the active population (labor force) that is unemployed. The labor force is the total number of people employed and unemployed. |
| **8.5 People killed in accidents at work (per 100,000 population)** | 8.5 Number of fatal accidents that occur during the course of work and lead to the death of the victim within one year of the accident. The incidence rate refers to the number of fatal accidents per 100 000 persons in employment. |
| **8.6 In work at risk-of-poverty rate (%)** | 8.6 The share of persons who are employed and have an equivalized disposable income below the risk-of-poverty threshold, which is set at 60 % of the national median equivalized disposable income (after social transfers). For the purpose of this indicator, an individual is considered as being employed if he/she was employed for more than half of the reference year. |
| **8.7 Fatal work-related accidents embodied in imports** | 8.7 Number of fatal work-related accidents associated with imported goods. Calculated using extensions to a multiregional input-output table. |
| **9. Goal: Industry, innovation and infrastructure** | |
| **9.1 Gross domestic expenditure on R&D (% of GDP)** | 9.1 The indicator measures gross domestic expenditure on R&D (GERD) as a percentage of the gross domestic product (GDP). |
| **9.2 R&D personnel (% of active population)** | 9.2 Share of R&D personnel broken down by the following institutional sectors: business enterprise (BES), government (GOV), higher education (HES), private non-profit (PNP). Data are presented in full-time equivalents as a share of the economically active population (the 'labor force').. |
| **9.3 Patent applications to the European Patent Office (per 100,000 population)** | 9.3 Requests for protection of an invention directed either directly to the European Patent Office (EPO) or filed under the Patent Cooperation Treaty and designating the EPO (Euro-PCT), regardless of whether they are granted or not. If one application to the EPO has more than one inventor, the application is divided equally among all of them and subsequently among their countries of residence, thus avoiding double counting. Euro-PCT applications are allocated according to the nationality of the first listed applicant. The data shows the total number of applications per country and per million inhabitants. |

| Interpretation of Indicators on EU Level | Description |
|---|---|
| **9.4 Household with broadband access (%)** | 9.4 Percentage of households with broadband internet service. Data given in this domain are collected annually by the National Statistical Institutes and are based on Eurostat's annual model questionnaires on ICT (Information and Communication Technologies) usage in households and by individuals. |
| **9.5 Gap in internet access, urban vs rural areas** | 9.5 Difference in the percentage of households with internet access between those in urban areas as opposed to rural areas. |
| **9.6 Individuals aged 55 to 74 years old who have basic or above basic digital skills (%)** | 9.6 Percentage of people aged 55-74 years old who have basic or above basic digital skills. Data given in this domain are collected annually by the National Statistical Institutes and are based on Eurostat's annual model questionnaires on ICT (Information and Communication Technologies) usage in households and by individuals. |
| **9.7 Logistic performance index: Quality of trade and transport-related infrastructure (worst 1-5 best)** | 9.7 Survey-based assessment of the quality of trade and transport-related infrastructure, e.g. ports, roads, railroads and information technology, on a scale from 1 (worst) to 5 (best). |
| **9.8 The Times Higher Education Universities Ranking: Average Score of top 3 universities (worst 0-100 best)** | 9.8 The average score of the top three universities in each country that are listed in the global top 1,000 universities in the world, expressed as 0–100. For countries with at least one university on the list, only the score of the ranked university was taken into account. Whenever a university score was missing in the Times Higher Education World University Ranking , an indicator from the Global Innovation Index on the top 3 universities in Quacquarelli Symonds (QS) University Ranking 2018, was used as a source when available. |
| **9.9 Scientific and technical journal articles (per 1,000 population)** | 9.9 The number of scientific and technical journal articles published, that are covered by the Science Citation Index (SCI) or the Social Sciences Citation Index (SSCI). Articles are counted and assigned to a country based on the institutional address(es) listed in the article. |
| **10 Goal: Reduced inequalities** | |
| **10.1 Gini Coefficient** | 10.1 The Gini coefficient is defined as the relationship of cumulative shares of the population arranged according to the level of equivalized disposable income, to the cumulative share of the equivalized total disposable income received by them. |
| **10.2 Palma ratio** | 10.2 Share of all income received by the 10% of people with highest disposable income divided by the share of all income received by the 40% of people with the lowest disposable income. |
| **11. Goal: Sustainable cities and communities** | |
| **11.1 Urban population without access to green urban area in their neighborhood (%)** | 11.1 The average share of urban green spaces and forests as a percentage of land area. |

| Interpretation of Indicators on EU Level | Description |
|---|---|
| **11.2 Overcrowding rate among people living with below 60% of median equivalized income (%)** | 11.2 Share of people living in overcrowded conditions in the EU. A person is considered to be living in an overcrowded household if the house does not have at least one room for the entire household as well as a room for a couple, for each single person above 18, for a pair of teenagers (12 to 17 years of age) of the same sex, for each teenager of different sex and for a pair of children (under 12 years of age). |
| **11.3 Recycling rate of municipal waste (%)** | 11.3 Tonnage recycled from municipal waste divided by the total municipal waste arising. Recycling includes material recycling , composting and anaerobic digestion. Municipal waste consists mostly of waste generated by households, but may also include similar wastes generated by small businesses and public institutions and collected by the municipality. |
| **11.4 People living in a dwelling with a leaking roof, damp walls, floors or foundation or rot in window frames or floor** | 11.4 Share of the population experiencing at least one of the following basic deficits in their housing condition: a leaking roof, damp walls, floors or foundation, or rot in window frames or floor. |
| **11.5 Exposure to air pollution: PM2.5 in urban areas  (µg/m3)** | 11.5 Air pollution measured as the population weighted annual mean concentration of particulate matter at urban background stations in agglomerations. |
| **12. Goal: Responsible consumption and production** | |
| **12.1 Circular material use rate (%)** | 12.1 The circular material use (CMU) rate measures the share of material recovered and fed back into the economy in overall material use. The CMU rate is defined as the ratio of the circular use of materials to the overall material use. |
| **12.2 Gross value added in environmental goods and services sector (% of GDP)** | 12.2 The environmental goods and services sector (EGSS) is defined as that part of a country's economy that is engaged in producing goods and services that are used in environmental protection and resource management activities either domestically or abroad. Gross value added in EGSS represents the contribution of the environmental goods and services sector to GDP. Products for environmental protection prevent, reduce and eliminate pollution or any other degradation of the environment and include measures undertaken to restore degraded habitats and ecosystems. Examples are electric vehicles, catalysts and filters to decrease pollutant emissions, wastewater and waste treatment services, or noise insulation works. Products for resource management safeguard the stock of natural resources against depletion. Examples are renewable energy production, energy efficient and passive buildings, seawater desalinization or rainwater recovery. |
| **12.3 Production-based SO2 emissions (kg/capita)** | 12.3 $SO_2$ emissions associated with the production of goods and services, which are then either exported or consumed domestically. |
| **12.4 Imported SO$_2$ emissions (kg/capita)** | 12.4 Emissions of $SO_2$ embodied in imported goods and services. $SO_2$ emissions have severe health impacts and are a significant cause of premature mortality worldwide. |

| Interpretation of Indicators on EU Level | Description |
|---|---|
| **12.5 Production-based emissions of reactive nitrogen (kg/capita)** | 12.5 Reactive nitrogen emitted during the production of commodities, which are then either exported or consumed domestically. Reactive nitrogen corresponds to emissions of ammonia, nitrogen oxides and nitrous oxide to the atmosphere, and of reactive nitrogen potentially exportable to water bodies, all of which can be harmful to human health and the environment. |
| **12.6 Imported emissions of reactive nitrogen (kg/capita)** | 12.6 Imports of reactive nitrogen emitted during the production of commodities. Reactive nitrogen corresponds here to emissions of ammonia, nitrogen oxides and nitrous oxide to the atmosphere, and of reactive nitrogen potentially exportable to water bodies, all of which can be harmful to human health and the environment. |
| **13. Goal: Climate action** | |
| **13.1 $CO_2$ emissions from fossil fuel combustion and cement production (t$CO_2$/capita)** | 13.1 The estimates of global and national fossil $CO_2$ emissions (EFOS) include the combustion of fossil fuels through a wide range of activities (e.g. transport, heating and cooling, industry, fossil industry own use, and natural gas flaring), the production of cement, and other process emissions (e.g. the production of chemicals and fertilizers) as well as $CO_2$ uptake during the cement carbonation process. |
| **13.2 $CO_2$ emissions embodied in imports (t$CO_2$/capita)** | 13.2 $CO_2$ emissions embodied in imported goods and services. |
| **13.2 $CO_2$ emissions embodied in fossil fuel exports (kg/capita)** | 13.3 $CO_2$ emissions embodied in the exports of coal, gas, and oil. Calculated using a 5-year average of fossil fuel exports and converting exports into their equivalent $CO_2$ emissions. Exports for each fossil fuel are capped at the country's level of production. |
| **14. Goal: Life below water** | |
| **14.1 Bathing sites of excellent quality (%)** | 14.1 Assesses quality of surface waters that can be used for bathing except for swimming pools and spa pools, confined waters subject to treatment or used for therapeutic purposes and confined waters artificially separated from surface water and groundwater. Bathing water quality was evaluated upon two microbiological parameters: Intestinal enterococci and Escherichia coli. |
| **14.2 Fish caught from overexploited or collapsed stocks (% of total catch)** | 14.2 The percentage of a country's total catch, within its exclusive economic zone (EEZ), that is comprised of species that are overexploited or collapsed, weighted by the quality of fish catch data. |
| **14.3 Fish caught by bottom trawling or dredging (%)** | 14.3 The percentage of fish caught either by bottom trawling or dredging. Bottom trawling is a fishing method in which industrial fishing vessels drag large nets (trawls) along the seabed. Dredging is a method of fishing in which a dredge or metal toothed bar is dragged along the ocean floor, digging into the seabed to collect mollusks into a steel net. |
| **14.4 Fish caught that are then discharged (%)** | 14.4 The percentage of fish that are caught only to be later discarded. |

| Interpretation of Indicators on EU Level | Description |
|---|---|
| **14.5 Marine biodiversity threats embodied in imports (per million population)** | 14.5 Threats to marine species embodied in imports of goods and services. |
| **14.6 Mean area that is protected in marine sites important to biodiversity (%)** | 14.6 The mean percentage area of marine Key Biodiversity Areas (sites that are important for the global persistence of marine biodiversity) that is covered by protected areas. |
| **15. Goal: Life on land** | |
| **15.1 Mean area that is protected in terrestrial sites important to biodiversity (%)** | 15.1 The mean percentage area of terrestrial Key Biodiversity Areas (sites that are important for the global persistence of biodiversity) that is covered by protected areas. |
| **15.2 Mean area that is protected in freshwater sites important to biodiversity (%)** | 15.2 The mean percentage area of freshwater Key Biodiversity Areas (sites that are important for the global persistence of biodiversity) that is covered by protected areas. |
| **15.3 Biochemical oxygen demand in rivers (mg $O_2$/liter)** | 15.3 Biochemical oxygen demand (BOD) is used to measure water quality. It refers to the amount of oxygen required by aerobic microorganisms to decompose organic substances in a water sample over a period of five days in the dark at 20°C ($BOD_5$), measured as milligrams per liter (mg $O_2$/L) and weighted by the number of measuring stations. High values of $BOD_5$ are usually a sign of organic pollution, which affects the water quality. |
| **15.4 Nitrate in groundwater (mg $NO_3$/liter)** | 15.4 Indicator refers to concentrations of nitrate (NO3) in groundwater, measured as milligrams per liter (mg NO3/L). Data are taken from well samples and aggregated to annual average values. Nitrate can persist in groundwater for a long time and accumulate at a high level through inputs from anthropogenic sources (mainly agriculture). The EU drinking water standard is limited to 50 mg NO3/L to avoid threats to human health. |
| **15.5 Red List Index of species survival (worst 0-1 best)** | 15.5 Change in aggregate extinction risk across groups of species. The index is based on genuine changes in the number of species in each category of extinction risk on The IUCN Red List of Threatened Species. |
| **15.6 Terrestrial and freshwater biodiversity threats embodied in imports (per million population)** | 15.6 Threats to terrestrial and freshwater species embodied in imports of goods and services. |
| **16. Goal: Peace, justice and strong institutions** | |
| **16.1 Death rate due to homicide (per 100,000 population)** | 16.1 Standardized death rate of homicide and injuries inflicted by another person with the intent to injure or kill by any means, including 'late effects' from assault (International Classification of Diseases (ICD) codes X85 to Y09 and Y87.1). |

| Interpretation of Indicators on EU Level | Description |
|---|---|
| **16.2 Population reporting crime in their area (%)** | 16.2 Share of the population who reported that they face the problem of crime, violence or vandalism in their local area. This describes the situation where the respondent feels crime, violence or vandalism in the area to be a problem for the household, although this perception is not necessarily based on personal experience. |
| **16.3 Gap in population reporting crime in their area, by income (p. p.)** | 16.3 Gap in percentage of people reporting crime, violence or vandalism in their area between those below 60% of median equivalized income and those above 60% of median equivalized income. |
| **16.4 Access to justice (worst 0-1 best)** | 16.4 Composite measure of the affordability and accessibility of the civil justice system. |
| **16.5 Timeliness of administrative processing's (worst 0-1best)** | 16.5 Composite measure of the effectiveness and timeliness of the enforcement of civil justice decisions and judgments in practice. |
| **16.6 Constraints on government power (worst 0-1 best)** | 16.6 Composite measure of the extent to which those who govern are bound by law. It comprises the means, both constitutional and institutional, by which the powers of the government and its officials and agents are limited and held accountable under the law. |
| **16.7 Corruption Perceptions Index (worst 0-100 best)** | 16.7 Perceived levels of public sector corruption, on a scale from 0 (highest level of perceived corruption) to 100 (lowest level of perceived corruption). The CPI aggregates data from a number of different sources that provide perceptions of business people and country experts. |
| **16.8 Unsentenced detainees (% of prison population)** | 16.8 Unsentenced prisoners, as a percentage of overall prison population. Persons held unsentenced or pre-trial refers to persons held in prisons, penal institutions or correctional institutions who are untried, pre-trial or awaiting a first instance decision on their case from a competent authority regarding their conviction or acquittal. |
| **16.9 Exports of major conventional weapons (TIV constant 1990 million USD per 100,000 population)** | 16.8 Volume of major conventional weapons exported, expressed in constant 1990 US$ millions per 100 000 people. It is calculated based on the trend-indicator value (TIV), which is based on the known unit production cost of a core set of weapons, and does not reflect the financial value of the exports. Small arms, light weapons, ammunition and other support material are not included. |
| **16.10 Press Freedom Index (best 0-100 worst)** | 16.10 Degree of freedom available to journalists in 180 countries and regions, determined by pooling the responses of experts to a questionnaire devised by Reporters sans frontiers. |
| **17. Goal: Partnerships for the goals** | |
| **17.1 Official development assistance (% of GNI)** | 17.1 Official development assistance (ODA) consists of grants or loans that are undertaken by the official sector with the objective of promoting economic development and welfare in recipient countries. Disbursements record the actual international transfer of financial resources, or of goods or services valued at the cost of the donor. ODA is here presented as a share of Gross National Income (GNI). GNI at market prices equals Gross Domestic Product (GDP) minus primary income payable by resident units to non-resident units, plus primary income receivable by resident units from the rest of the world. The list of countries and territories eligible to receive ODA is determined by the OECD's Development Assistance Committee. |

| Interpretation of Indicators on EU Level | Description |
| --- | --- |
| **17.2 Shifted profits of multinationals (billion USD)** | 17.2 Estimation of how much profit is shifted into tax havens and how much non-haven countries lose in profits from such shifting. Based on macroeconomic data known as foreign affiliates statistics. Negative values indicate profit shifting. |
| **17.3 Corporate Tax Haven Score (best 0-100 worst)** | 17.3 The Corporate Tax Haven Score measures a jurisdiction's potential to poach the tax base of others, as enshrined in its laws, regulations and documented administrative practices. |
| **17.4 Statistical Performance Index (worst 0-100 best)** | 17.4 The Statistical Performance Index is a weighted average of the statistical performance indicators that evaluate the performance of national statistical systems. It aggregates five pillars of statistical performance: data use, data services, data products, data sources, and data infrastructure. |

# 3.2 Resilience Maturity Model

Designed as a strategic tool, the Resilience Maturity Model equips cities with a roadmap to enhance their resilience (not limited to climate resilience), providing a holistic perspective on the process while helping end users grasp resilience as a multidimensional objective. By utilizing this model, cities can assess their current stage of maturity and identify the specific policies required to propel resilience towards the next level. The accompanying handbook serves as a guide, leading users through the practical application of the model. Table 4 contains the dimensions, subdimensions and maturity stages including relevant policies for each section.

Dimensions:

- Leadership and Governance
- Preparedness
- Infrastructure and Resources
- Cooperation

Maturity stages:

- Starting: Starting with local (departmental) resilience plans
- Moderate: Integration of local (departmental) resilience plans
- Advanced: Implementation of the integrated (holistic) resilience plan
- Robust: Internationalizing resilience
- Vertebrate: Leading resilient city

Link:

https://smr-project.eu/tools/maturity-model-guide/resilience-maturity-model/

*Table 4: Resilience Maturity Model*

| Dimension | Sub-dimension | Policies | Description | Indicators | Maturity Stage | Results |
|---|---|---|---|---|---|---|
| **Leadership and Governance** | Municipality, cross-sectorial and multi-governance collaboration | Establish a working team responsible for resilience issues in the city | This policy identifies responsible people from different departments and establishes a structure for their collaboration on resilience issues. | Resources dedicated to the development of the resilience action plan. | Starting | |
| | | Integrate resilience into visions, policies and strategies for city development plans | Resilience is part of the city's broader and related plans and strategies, for example as a sub-section or as discrete goals and aims related to sectors like climate change education, security, education, social policy or infrastructure planning. | Resources dedicated to the development of the resilience action plan. | Starting | |
| | | Establish a resilience department or committee and a cross-departmental coordination board and procedures | The city is aware of climate change and its remaining challenges and therefore, it is committed to adopting preventive actions to tackle the consequences of climate change. The actions cover topics such as: mobility, emission reduction, recycling, energy efficiency, adaptation among others. | Resources dedicated to the development of the resilience action plan. | Moderate | Number of stakeholder groups involved in resilience-building activities about resilience. |
| | | Align, integrate and connect the resilience action plan with regional plans | Policies are compared with input at a regional, national and international input and possible similarities and complementarities sought. On the basis of this, steps are taken to align, integrate and connect local policies with those in the region, country and abroad | Number of cooperation agreements with CITY stakeholders.<br><br>Number of cooperation agreements with external governmental bodies and cities. | Moderate | Number of policies aligned with regional, national and international input |
| | | Adopt climate change preventive actions | Measures are adopted to contribute to the mitigation of climate change. These can include low carbon and energy saving measures such as the replacement of street | Resources dedicated to the development of the resilience action plan. | Moderate | |

| Dimension | Sub-dimension | Policies | Description | Indicators | Maturity Stage | Results |
|---|---|---|---|---|---|---|
| | | | lighting with LED lighting, deep renovation of housing, investment in car-independent transport modes in order to reduce emissions, introduction of sustainable procurement processes, improvement of recycling and circular economy processes, or similar. | | | |
| | | Promote equality of access to services and basic infrastructure to vulnerable sectors of society | At this stage, a resilience team has been established and resilience is integrated into visions, policies and strategies for city development plans. This policy addresses the need for equality of access to services and basic infrastructure to vulnerable sectors of society. | Number of problem areas covered in the resilience action plan<br><br>Level of politicians' commitment on resilience | Moderate | |
| | | Align, integrate and connect the resilience action plan with national plans | At this point, the resilience action plan has already been aligned, integrated and connected with regional plans. This policy further extends this work to plans at the national level. | Number of policies aligned with regional, national and international input | Advanced | |
| | | Develop a plan for a multi-level governance approach involving the municipal, regional and national levels of governance | At this stage, resilience has been integrated into city development plans and aligned with regional plans. This policy links these plans strategically and extends to the national level. | Number of cooperation agreements with external governmental bodies and cities | Advanced | Number of stakeholder groups involved in resilience-building activities about resilience |
| | | Align, integrate and connect the city resilience plan with regional, national and international resilience management guidelines | At this stage, the resilience action plan has been aligned, integrated and connected with national plans. At this point, this is extended to include regional, national and international resilience management guidelines. | Number of cooperation agreements with external governmental bodies and cities | Robust | Number of policies aligned with regional, national and international input |

| Dimension | Sub-dimension | Policies | Description | Indicators | Maturity Stage | Results |
|---|---|---|---|---|---|---|
| | | Support the development of other city resilience plans aligned, integrated and connected with regional, national and international resilience management guidelines | | Number of cooperation agreements with external governmental bodies and cities | Vertebrate | |
| | Legislation development and refinement | Develop a white paper about multi-level governance approach | | Number of cooperation agreements with external governmental bodies and cities | Moderate | |
| | | Conduct certification processes to achieve conformity with national standards | The city processes are analyzed and relevant national level standards identified. Measures are taken to improve processes to conform to standards at the national level. This can support future exchange and cooperation with other cities in the same country. | Number of policies aligned with regional, national and international input | Advanced | |
| | | Conduct certification processes to achieve conformity with international standards | At this stage, the city is in accordance with national standards in terms of resilience. This process is expanded to include international standards. | Number of certifications | Robust | |
| | | Contribute in the development of standards on resilience guidelines and policies | The city has been conducting certification processes to ensuring conformity with national and international standards. At this stage, the city is active in informing and guiding standardization processes. | Number of certifications | Vertebrate | |
| | Learning culture (learning and dissemination) | Develop a strategy to create a resilience culture | At this stage, resilience is a new concept to some citizens. This policy lays a framework for creating a resilience culture. | Percentage of local government budget spent on resilience building activities | Starting | |

| Dimension | Sub-dimension | Policies | Description | Indicators | Maturity Stage | Results |
|---|---|---|---|---|---|---|
| | | Promote a culture of resilience | At this point, a resilience strategy has been established. This is now implemented through the allocation of resources to incentivize CITY stakeholders to invest in promoting a culture of resilience. | Percentage of local government budget spent on resilience building activities | Moderate | |
| | | Review of best practices to deal with shocks and stresses used in different sectors and other cities | This policy recommends a review of best practices in place in other cities. | Effort taken to learn from what other stakeholders do to increase resilience | Moderate | Learning activities executed among stakeholders and with other cities |
| | | Formalize the learning process and institutionalize regular debriefing meetings | At this stage, a resilience culture strategy is in place, a desk-based review has been undertaken of best practices and communication and promotion work has been going on to share the concept of resilience. At this point, this process is made official with regular information sessions. | Effort taken to learn from what other stakeholders do to increase resilience | Advanced | Percentage of lessons learned implemented per lessons learned identified |
| | | Create a learning city | The city has already worked on promoting a culture of resilience and the learning process has been formalized with regular briefing meetings.  A learning city takes lessons learned identified and makes them into lessons learned implemented. | Effort taken to learn from what other stakeholders do to increase resilience | Robust | Percentage of lessons learned implemented per lessons learned identified

Number of best practices shared among stakeholders |

| Dimension | Sub-dimension | Policies | Description | Indicators | Maturity Stage | Results |
|---|---|---|---|---|---|---|
| | | Develop formal procedures to assess the effectiveness of the learning process | At this stage, the learning process has been formalized and institutionalized through regular debriefing meetings. This policy assesses their effectiveness. | Effort taken to learn from what other stakeholders do to increase resilience<br><br>Number of debriefing meetings carried out | Vertebrate | Percentage of lessons learned implemented per lessons learned identified<br><br>Number of best practices shared among stakeholders |
| | | Promote leadership for knowledge transferring and sharing among global cities, regions and nations | A policy has been long implemented to promote a culture of resilience. At this point leadership is promoted to extend this to global cities. | Effort taken to learn from what other stakeholders do to increase resilience | Vertebrate | Learning activities executed among stakeholders and with other cities |
| | Resilience action plan development | Identify the city requirements regarding resilience process | At this stage, resilience is a new concept to some citizens. This policy lays a framework for creating a resilience culture. | Resources dedicated to the development of the resilience action plan | Starting | Percentage of lessons learned implemented per lessons learned identified |
| | | Develop a resilience action plan to respond to shocks and long term stresses | At this stage, city resilience requirements have been identified as they relate to the resilience building process. This policy builds on this basis with the establishment of a resilience action plan. | Resources dedicated to the development of the resilience action plan | Moderate | Number of best practices shared among stakeholders |
| | | Develop leading indicators for assessing the | A resilience action plan is in place. This policy provides a basis for indicators that can track its performance. | Resources dedicated to the development of | Advanced | Number of updates of the |

| Dimension | Sub-dimension | Policies | Description | Indicators | Maturity Stage | Results |
|---|---|---|---|---|---|---|
| | | performance of the resilience action plan | | the resilience action plan | | resilience action plan |
| | | Assess and monitor the resilience action plan's efficiency periodically in order to continuously improve it | Indicators have been identified related to resilience action plan performance. This policy uses these indicators to assess and monitor the plan's performance. | Resources dedicated to the development of the resilience action plan | Robust | Number of updates of the resilience action plan |
| | | Share the CITY's expertise in resilience action plan development with other cities about to start the process | The city has an established and quality-controlled resilience action plan. At this point, it is ready to be shared with other cities. | Number of cooperation agreements with external governmental bodies and cities | Vertebrate | |
| **Preparedness** | Diagnosis and Assessment | Assess and manage a wide range of risks | Assessment and management is established to cover a full range of risks. | Number of assessments to identify weaknesses | Starting | |
| | | List and prioritize critical services and assets | Critical services are listed and prioritized as preparation for subsequent steps. | Number of revision of CI risk assessment | Starting | |
| | | List existing plans and response mechanisms and guidelines for shocks and stresses | A desk review is conducted of plans and response regarding preparedness. | | Starting | Percentage of businesses/CIs with contingency plans |
| | | Take account of interdependencies when assessing and managing risk | The interdependencies and cascading effects of risk are analyzed, assessed and recorded. The Risk Systemicity Questionnaire can be a helpful tool as part of this process. | Number of analysis of Cis interdependencies | Moderate | |
| | | Assess and prioritize risk scenarios and their implications through consideration of risk systemicity  (e.g. using | Shock scenarios and their cascading effects are assessed and analyzed. | | Robust | |

| Dimension | Sub-dimension | Policies | Description | Indicators | Maturity Stage | Results |
|---|---|---|---|---|---|---|
| | | Risk Systemicity Questionnaire) | | | | |
| | | Undertake regular and long-term risk assessment with a focus on risk systemicity | At this stage, initial assessment and prioritization of risk scenarios and their implications have been undertaken, including the consideration of risk systemicity. This is repeated in a cycle of implementation and evaluation, for example through periodic Risk Systemicity Questionnaire sessions. | Number of revision of CI risk assessment | Robust | |
| | | Assess the value added by CITY contributions to the resilience of other CITIES | The extensive work and investment into resilience activities is likely to result in the city generation positive effects and benefits for other cities as a result of the city's advanced resilience stage. This policy assess and quantifies the degree to which this is the case. | | Vertebrate | Number of policies aligned with regional, national and international input |
| | Education and Training | Conduct training and arrange emergency drills with the emergency teams and critical infrastructure providers | Training exercises and emergency drills are organized to prepare emergency teams and CI providers for crises. This may involve establishing cooperation | Resources deployed for training exercisesNumber of cooperation agreements with CITY stakeholdersFrequency of training exercises | Starting | Effectiveness of training exercises |
| | | Inform citizens about volunteering opportunities in the local community | The local government provides information about different initiatives and activities where they can be involved through the arrangement of workshops, conferences or the city council website. The role volunteering plays in strengthening citizen engagement, social inclusion and building resilient communities is of high importance. It is widely recognized that volunteering | Number of awareness raising events targeting CITY stakeholders | Starting | Number of trained volunteers |

| Dimension | Sub-dimension | Policies | Description | Indicators | Maturity Stage | Results |
|---|---|---|---|---|---|---|
| | | | opportunities have a positive impact on individuals, organizations and the wider community.<br>Volunteering seeks to build community well-being, sustainability and respects the dignity of all people; helps tackle social, cultural, economic and environmental issues; and builds a more humane and just society. These initiatives of volunteering refer to activities undertaken independently as an individual to help others (e.g. checking on the wellbeing of an elderly neighbor), or as part of wider community activity in response to an identified issue or need (e.g. care and maintenance of the local environment). | | | |
| | | Develop a common understanding of the resilience approach among stakeholders | Resilience building starts with an understanding of the concept and value of resilience. This can be promoted through communication and publicity campaigns. | Number of awareness raising events targeting CITY stakeholders | Starting | Effectiveness of training exercises |
| | | Conduct training and arrange emergency drills including volunteers | Training and emergency drills are already in place for emergency and first response professionals and Critical Infrastructure providers. This policy involves an additional group crucial to response: volunteers. | Effectiveness of training exercises | Moderate | |
| | | Provide training for citizens and public and private companies | Emergency teams, critical infrastructure providers and volunteers are well prepared through training and emergency drills. At this stage, exercises are organized | Resources deployed for training exercises<br><br>Frequency of training exercises | Advanced | Effectiveness of training exercises |
| | | Conduct emergency drills at national level | Emergency teams, critical infrastructure providers and volunteers are well prepared through training and emergency drills. At this | Resources deployed for training exercises | Advanced | Effectiveness of training exercises |

| Dimension | Sub-dimension | Policies | Description | Indicators | Maturity Stage | Results |
|---|---|---|---|---|---|---|
| | | | stage, exercises are coordinated at the national level. | Number of cooperation agreements with external governmental bodies and cities<br><br>Frequency of training exercises | | |
| | | Develop education programs in schools about the resilience action plan | At this stage, resilience has not formally been introduced to educational programmes yet. This policy supports public understanding and acceptance of the concept of resilience through education. | Number of cooperation agreements with CITY stakeholders<br><br>Number of awareness raising events targeting CITY stakeholders | Advanced | |
| | | Assess and refine the training programs | Training exercises and emergency drills have been carried out. An assessment and evaluation process now improves the effectiveness of the training programs | Resources deployed for training exercises | Advanced | Effectiveness of training exercises |
| | | Establish a strong network of volunteers | At this stage, training exercises have been carried out with volunteers, establishing initial contact and relationships. This policy strengthens these networks into an established network. | Number of cooperation agreements with CITY stakeholders | Robust | Number of trained volunteers |
| | | Conduct frequent joint training exercises between European cities | At this stage, emergency drills have been carried out with volunteers and at a national level. This policy sees regular joint training exercises being carried out between European cities. | Resources deployed for training exercises<br><br>Number of cooperation agreements with | Robust | Number of trained volunteers<br><br>Effectiveness of |

| Dimension | Sub-dimension | Policies | Description | Indicators | Maturity Stage | Results |
|---|---|---|---|---|---|---|
| | | | | external governmental bodies and cities<br><br>Frequency of training exercises | | training exercises |
| | | Develop training plans in cooperation with other CITIES | Training exercises are in place including citizens, critical infrastructure providers, volunteers and emergency services. Exercises are organized at a national level. | Resources deployed for training exercises<br><br>Number of cooperation agreements with external governmental bodies and cities<br><br>Frequency of training exercises | Vertebrate | |
| | | Develop training activities for other CITIES | Training exercises are in place including citizens, critical infrastructure providers, volunteers and emergency services. Exercises are organized at a national level. The city now shares this experience with other cities and supports their resilience development by developing training activities for other cities. | Resources deployed for training exercisesFrequency of training exercises | Vertebrate | Effectiveness of training exercises |
| | | Support self-organization of the involved agents to improve the Resilience of the CITY | A strong network of volunteers has been established and training and emergency drills have included them. They and other involved stakeholders are now supported in self-organization. | | Vertebrate | Level of training |
| **Infrastructure and resources** | Reliability of Cis and their | Develop cooperation/collaboration | Resilience requires effective cooperation and collaboration between the city and | Number of cooperation | Starting | |

| Dimension | Sub-dimension | Policies | Description | Indicators | Maturity Stage | Results |
|---|---|---|---|---|---|---|
| | interdependences | agreements with critical infrastructure providers | critical infrastructure providers. This is based on agreements. | agreements with CITY stakeholders | | |
| | | Develop plans to monitor critical infrastructure functionality | At this stage, critical infrastructure protection measures are being implemented newly. This policy plans for information to be gathered on critical infrastructures' functionality. | | Starting | |
| | | Develop contingency plans for critical infrastructures | At this stage, critical infrastructure protection measures are being implemented newly. This policy introduces contingency plans for critical infrastructures. | Resources allocated to adopt extraordinary infrastructures to face shocks | Starting | |
| | | Identify interdependencies of critical services at local level | At this stage, cooperation collaboration agreements have been developed with critical infrastructure providers, plans have been developed to monitor critical infrastructures' functionality and contingency plans are in place for critical infrastructure. This policy sees the interdependencies of critical infrastructures identified. | Number of analysis of CIs interdependencies | Moderate | |
| | | Develop periodical maintenance procedures for critical infrastructures | Plans are in place to monitor critical infrastructures' functionality. Now, procedures strengthen their functionality with systematic preventative maintenance. | Resources invested in preventive maintenance activities | Moderate | Number of maintenance procedures in each CI sector |
| | | Develop measures to increase critical infrastructure redundancy and reliability | At this stage, plans are in place to monitor critical infrastructures' functionality as well as contingency plans for critical infrastructures. This step requires further action and measures to critical infrastructure reliability and redundancy. | Resources allocated to improve the reliability of the CI | Moderate | Level of reliability and flexibility of each specific CI sector<br><br>Number of redundant systems- |

| Dimension | Sub-dimension | Policies | Description | Indicators | Maturity Stage | Results |
|---|---|---|---|---|---|---|
| | | | | | | infrastructures per CI sector |
| | | Implement monitoring systems for identifying risk, shocks and long term stresses | At this stage, plans are in place to monitor CI functionality. This policy allows for risk, shocks and long-term stresses to be monitored in a structured way. | Number of revision of CI risk assessment | Moderate | |
| | | Carry out audits for critical infrastructure providers | Cooperation and collaboration agreements are in place with critical infrastructure providers. At this stage, audits are carried out. | Number of stress tests/audits

Number of redundant systems-infrastructures per CI sector | Moderate | Percentage of CIs that fulfill legal requirements |
| | | Develop flexibility measures | Measures are in place to increase critical infrastructure redundancy and reliability. Now, flexibility measures supplement these. | Resources to adopt extraordinary infrastructures to face shocks | Advanced | |
| | | Identify interdependencies of critical services at international level | At this stage, interdependencies of critical services have been identified at a local level. This is now expanded to the national level. | Number of analysis of CIs interdependencies | Robust | |
| | | Encourage the continuous improvement of policies, to take advantage of any shock and stress to bounce forward and improve or re-design | Continuous evaluation and improvement of policies ensures effectiveness. | Resources allocated to adopt extraordinary infrastructures to face shocks | Vertebrate | |
| | | Apply big data approaches to analyze the information obtained | Information on critical infrastructures and interdependencies at international level has been collected. Information is analyzed through big data approaches. | | Vertebrate | |
| | Resources to build up | Assess current initiatives and funding opportunities | | | Starting | Funding received from |

| Dimension | Sub-dimension | Policies | Description | Indicators | Maturity Stage | Results |
|---|---|---|---|---|---|---|
| | resilience and to response | for the development of resilience | | | | EU projects and similar initiatives |
| | | Develop a list of the currently available physical resources for response | The resources for response are researched and compiled in a list. | Resources allocated to improve the reliability of the CI | Starting | |
| | | Deploy a disaster relief fund for emergencies | | Percentage of local government budget spent on resilience building activities | Starting | |
| | | Allow for the resilience action plan in the local government budget | A resilience action plan is developed as part of policy L4M1 to respond to shocks and long-term stresses. This policy accommodates for funding this plan through the local government budget. | Resources dedicated to the development of the resilience action plan | Moderate | |
| | | Promote resources /tool sharing among critical infrastructure providers within a region during crises | | Resources allocated to incentivize CITY stakeholders to invest in resilience | Moderate | |
| | | Promote and provide incentives for initiatives that contribute to build resilience | At this stage, existing initiatives and funding opportunities have been assessed and identified as they relate to resilience development. This stage sees active creation of incentives to promote investment in initiatives feeding into resilience-building. | Resources allocated to incentivize CITY stakeholders to invest in resilience | Advanced | Percentage of infrastructures and population with insurances |
| | | Implement centralized control of coordination of critical resources and activities during shocks and stresses. | | Percentage of local government budget spent on resilience building activities | Advanced | |

| Dimension | Sub-dimension | Policies | Description | Indicators | Maturity Stage | Results |
|---|---|---|---|---|---|---|
| | | Encourage stakeholders to have appropriate insurance coverage | | Resources allocated to incentivize CITY stakeholders to invest in resilience | Advanced | Percentage of infrastructures and population with insurances |
| | | Promote and provide incentives for the development of sustainable urban infrastructures | Resources are allocated to provide incentives for sustainable infrastructure to be developed in the city. | Resources allocated to incentivize CITY stakeholders to invest in resilience | Advanced | Percentage of infrastructures and population with insurances |
| | | Promote and provide incentives to stakeholders for investment in R&D&I projects regarding resilience | Promoting research and development and innovation is important. This policy fosters investment in research and development and innovation by stakeholders by providing and communicating incentives and facilitating the process for investing in these areas. | Resources allocated to incentivize CITY stakeholders to invest in resilience | Robust | Percentage of infrastructures and population with insurances |
| | | Monitor an effective use of resources to ensure the resilience building process performance | At this stage, incentives and investment are in place to foster resilience building. At this stage, the use of resources should be monitored. | Percentage of local government budget spent on resilience building activities | Robust | |
| | | Assess the impact of innovation in the resilience building process. | | Percentage of resources dedicated to lead EU projects or other join initiatives | Vertebrate | |
| | | Apply big data approaches to analyze the information obtained | | Resources allocated to incentivize CITY stakeholders to invest in resilience | Vertebrate | Percentage of infrastructures and population with insurances |
| **Cooperation** | Development of partnerships with city stakeholders | Map relevant stakeholders to develop the resilience action plan | At this stage, stakeholder mapping exercises should be carried out, where the relevant municipal and wider CITY stakeholders are identified and channels of communication and cooperation with them considered as | Number of cooperation agreements with CITY stakeholders | Starting | Existence of emergency plans that integrate stakeholders |

| Dimension | Sub-dimension | Policies | Description | Indicators | Maturity Stage | Results |
|---|---|---|---|---|---|---|
| | | | well as the possible existing relationships between them. | | | |
| | | Develop a public website with emergency information | | Number of mechanisms (platforms, websites) to share lessons learned with CITY stakeholders | Starting | |
| | | Develop a stakeholder engagement plan defining its roles and responsibilities | At this stage, stakeholders have been identified and mapped. This policy sees a plan being established to define stakeholders' roles and responsibilities. | Number of cooperation agreements with CITY stakeholders | Moderate | Existence of emergency plans that integrate stakeholders |
| | | Develop an internal communication platform for sharing information with different municipal departments and emergency services | | Number of mechanisms (platforms, websites) to share lessons learned with CITY stakeholders | Moderate | Number of best practices shared among stakeholders |
| | | Align the objectives of the different stakeholders and set up a common understanding of resilience | Foster cross-departmental and intersectoral relationships and introduce exchange and collaboration activities between stakeholders. | Number of cooperation agreements with CITY stakeholders | Advanced | |
| | | Develop formal partnerships between academic and scientific entities to improve the resilience building process | At this stage, stakeholders in general have been mapped and a plan for their engagement established. The city here establishes formal relationships with local researchers or scientific institutions. | Number of cooperation agreements with CITY stakeholders | Advanced | Number of stakeholder groups involved in resilience-building activities about resilience |
| | | Undertake public consultations to receive | At this stage, stakeholders have been mapped and a stakeholder engagement plan | Number of awareness raising events | Advanced | Number of best practices |

| Dimension | Sub-dimension | Policies | Description | Indicators | Maturity Stage | Results |
|---|---|---|---|---|---|---|
| | | feedback on the resilience action plan | is in place. This is carried out by planning public consultations to invite input and feedback from citizens and other stakeholders on the resilience action plan. | targeting CITY stakeholders | | shared among stakeholders |
| | | Develop a public communication platform to interact with stakeholders | At this stage, a public website has been developed with emergency information to inform the public in crisis situation. An internal communication platform for sharing information with different municipal departments and emergency services has also been developed. Now, these are extended to facilitate two-way communication with stakeholders. | Number of mechanisms (platforms, websites) to share lessons learned with CITY stakeholders | Advanced | |
| | | Widen collaborative networks with stakeholders to reflect on and make decisions about the progress of the city resilience | This policy builds on the work begun as part of C1A1and expands the initial networks of stakeholders to include additional actors. These stakeholders are actively involved in the decision-making process and contribute input and guide policymaking regarding resilience. | | Robust | Number of stakeholder groups involved in resilience-building activities |
| | | Arrange multi-stakeholder debriefing meetings | Cross-sectoral meetings are held with different stakeholders, to inform, invite feedback and exchange knowledge. | Number of awareness raising events targeting CITY stakeholders | Robust | |
| | | Develop a public platform to enhance learning among city stakeholders | At this stage, a public communication platform has been developed to interact with stakeholder. Now, this is augmented to facilitate and encourage sharing and interaction between stakeholders. | | Robust | |
| | | Engage self-organization of cooperation among all | Self-organization among stakeholders is encouraged and fostered, promoting active engagement. | Number of cooperation | Vertebrate | |

| Dimension | Sub-dimension | Policies | Description | Indicators | Maturity Stage | Results |
|---|---|---|---|---|---|---|
| | | stakeholders involved in resilience development | | agreements with CITY stakeholders | | |
| | | Involve all stakeholders in the learning process | Cross-sectoral meetings have been held with different stakeholders to inform, invite feedback and exchange knowledge. This engagement process is expanded to involve all stakeholders in the learning process. | Number of debriefing meetings carried out | Vertebrate | Number of best practices shared among stakeholdersNumber of stakeholder group involved in resilience-building activities about resilience |
| | Involvement in resilience networks of cities | Establish alliances with cities facing similar risks | At this stage, the city reaches out to other cities with shared vulnerabilities and risks to exchange knowledge. | Number of cooperation agreements with external governmental bodies and cities | Moderate | |
| | | Join a major network of European cities | The city joins a major network of European cities, for example ICLEI - Local Governments for Sustainability. This may be formalized through cooperation | Number of cooperation agreements with external governmental bodies and cities | Advanced | |
| | | Develop formal partnerships with regional stakeholders | At this stage, partnerships and alliances with other cities are formalized. | Number of cooperation agreements with external governmental bodies and cities | Advanced | |
| | | Participate proactively in regional, national and international networks to promote initiatives, | At this stage, the city is already a member of a network of European cities. Now, the city becomes an active contributor to regional, national and international networks to | Number of cooperation agreements with | Robust | |

| Dimension | Sub-dimension | Policies | Description | Indicators | Maturity Stage | Results |
|---|---|---|---|---|---|---|
| | | exchange experiences and learning | promote initiatives, exchange experiences and learn. | external governmental bodies and cities | | |
| | | Active involvement of local authority and stakeholders in networks (local, national, European and global) | At this stage, the city is an active contributor to regional, national and international networks to promote initiatives, exchange experiences and learn. At this stage, the city actively involves local authority and stakeholders in networks. | Number of cooperation agreements with external governmental bodies and cities | Vertebrate | Number of policies aligned with regional, national and international input |
| | | Encourage stakeholders to present their experience concerning the resilience building process as reference for other CITIES | | Number of mechanisms (platforms, websites) to share lessons learned from CITY stakeholders | Vertebrate | |

## 3.3 OECD Resilient Cities Indicators

The indicator framework below is an exemplary compilation of suitable indicators for monitoring climate resilience on a city level. The overall guideline document analyses different types of indicators and discusses the appropriate contexts for their use. It also provides recommendations on how local authorities can select indicators tailored to their specific policy priorities and offers guidelines for utilizing indicators effectively within a broader governance framework. It points out that cities should adopt the proposed indicators to their local needs to compose an individual set of indicators, incl. public participation.  Table 5 outlines the main quantitative and qualitative outcome and output indicators for social, economic, environment (natural and built) and institutional aspects of resilience.

Link:

https://www.oecd-ilibrary.org/development/indicators-for-resilient-cities_6f1f6065-en

*Table 5: OECD Resilient Cities Indicators*

| Dimension | Indicator | Type | Justification | Capacities |
|---|---|---|---|---|
| **Income and inequality "Social inclusion"** | Equalized disposable household income (OECD stat) | Outcome Quantitative | Poorer households are more vulnerable to risks. Extensive research over the past 30 years shows that the poor suffer worst from disasters. | Resourceful Inclusive |
| | Poverty rate (OECD stat) | Outcome Quantitative | Poorer households are more vulnerable to risks. Extensive research over the past 30 years shows that the poor suffer worst from disasters. | Resourceful Inclusive |
| | GINI Index (OECD stat) | Outcome Quantitative | Social inequality translates into unequal access to services and opportunities. Furthermore, it may contribute to socially segregated urban development, which in turn generates new patterns of risk. | Resourceful Inclusive |
| | Spatial segregation (Dissimilarity Index, or Spatial Ordinal Entropy Index at a 1 000-metre scale) (OECD stat) | Outcome Quantitative | Spatial segregation has pervasive effects on the income, education and employment perspectives of poor, segregated groups – as found by the neighborhood effects literature. It further engenders social divides and lack of trust. | Resourceful Inclusive |

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| Dimension | Indicator | Type | Justification | Capacities |
|---|---|---|---|---|
| | Number of homeless people per 100 000 population (ISO 37120) | Outcome Quantitative | Homelessness is a risk, in terms of health, education, employment, family structure, safety. | Resourceful Inclusive |
| | Percentage of jobs paying the city/national living wage (adapted from Arup, 2015) | Outcome Quantitative | Living wages ensure the welfare of workers. The indicator shows whether employment provides a path out of poverty. | Resourceful Inclusive |
| **Social capital and social cohesion** **"Citizens' networks in communities are active"** | Number of civic, social advocacy or faith-based organizations per 10 000 people (adapted from Cutter, Ash and Emrich, 2014) | Output Quantitative | Organizational ties promote a sense of belonging, social mobilization and engagement, and also enhance interpersonal ties (Tran et al., 2013). | Robust Resourceful Inclusive |
| | Percentage of neighborhoods with regular Inclusive neighborhood association meetings | Output Quantitative | Neighborhood groups increase sense of place and mobilization levels at the very local scale, as well as local interpersonal ties (Tran et al., 2013). | Robust Resourceful Inclusive |
| | Perceived social network support (percentage people that replied "yes" to the question: If you were in trouble, do you have family and friends you can count on to help in case of need? (OECD stat) | Outcome Quantitative | Social ties matter for higher quality of life, place attachment and higher likelihood to obtain help and support. | Robust Resourceful Inclusive |
| | Perceived interpersonal local network support: % of people that replied "yes" to the question: If you were in trouble, do you have neighbors you can count on to help you whenever you need them? (adapted from OECD stat) | Outcome Quantitative | Local interpersonal ties increase sense of belonging, social cohesion and support at the neighborhood or community level (Klinenberg, 1999). Estimates show that 90% of people are rescued by neighbors (GFDRR, 2017). | Robust Resourceful Inclusive |
| **Health and well-being** **"Citizens enjoy healthy lives"** | Percentage of population that has health insurance coverage, including both public and private or have access to "free" (at the point of delivery) healthcare (adapted from the University of Buffalo) | Output Quantitative | Access to healthcare. | Robust |
| | Self-perception of health % population > 15 years who report "good" or better | Outcome Quantitative | Overall health state of population. People in worse health are more susceptible to all kinds of shocks and stresses. | Robust |

| Dimension | Indicator | Type | Justification | Capacities |
|---|---|---|---|---|
| | health to the question "How is your health in general?" with response scale "It is very good/good/fair/bad/very bad" (WHO) | | | |
| | Average quality of life (satisfaction) (OECD stat) | Outcome Quantitative | Quality of life promotes well-being and is likely to foster aspects such as community cohesion. | Robust |
| **Medical capacity "People have access to services"** | Number of physicians per 100 000 people (ISO 37120) | Output Quantitative | Emergency health needs and overall health service quality. | Robust |
| | Number of hospital beds per 100 000 people (ISO 37120) | Output Quantitative | Emergency health needs and overall health service quality. | Resourceful Flexible |
| | Percentage of hospitals that have carried out disaster preparedness drills in the last year (adapted from UNISDR, 2008) | Process Quantitative | Emergency health needs and overall health service quality. | Resourceful Flexible |
| | Average response time of fire response from initial call (ISO 37120) | Outcome Quantitative | Emergency response. | Resourceful Flexible |
| **Emergency response services** "People have access to services" | Average response time of fire response from initial call (ISO 37120) | Outcome Quantitative | Emergency response. | Resourceful Flexible |
| | Average emergency (police) callout response time last year (Arup, 2015) | Outcome Quantitative | | |
| | Perceptions of local government emergency support (Oxfam) | Outcome Qualitative | Perceived level of response to disaster. | |
| **Communication "People have access to services"** | Number of telephone connections (landlines and cell phones) per 100 000 population (ISO 37120) | Output Quantitative | While some disasters may disrupt telephone and Internet networks (e.g. tropical storms and earthquakes), for many other disasters these systems are not affected and in fact prove to be extremely useful (e.g. heat waves, terror attacks, health epidemics). Broadband networks can also be indicative of economic resilience: notably, highspeed broadband networks are associated with greater levels of economic development in cities (Mölleryd, 2015). | Robust Redundant Inclusive |

| Dimension | Indicator | Type | Justification | Capacities |
|---|---|---|---|---|
| | Percentage of households with access to broadband Internet service (Cutter, Ash and Emrich, 2014) | Output Quantitative | While some disasters may disrupt telephone and Internet networks (e.g. tropical storms and earthquakes), for many other disasters these systems are not affected and in fact prove to be extremely useful (e.g. heat waves, terror attacks, health epidemics). Broadband networks can also be indicative of economic resilience: notably, highspeed broadband networks are associated with greater levels of economic development in cities (Mölleryd, 2015). | Robust Redundant Inclusive |
| | Percentage of population with language competency (or proficiency) (Cutter, Ash and Emrich, 2014) | Outcome Quantitative | Communication capacity, relevant in context of recent and significant migratory flux. | Robust Redundant Inclusive |
| **Economic diversity "Industries are diverse to generate growth"** | Single-sector economic dependence (%, especially primary sector) (Herfindahl Index adapted to sectoral concentration) | Outcome Quantitative | Single sector-dependence increases risk of economic shocks; the primary sector is particularly prone to cyclical fluctuations. | Resourceful |
| | Reliance on individual firms (Herfindahl Index of firm concentration) | Outcome Quantitative | Firm dependence increases risk of economic shocks. | Resourceful |
| **Economic innovation "Innovation takes place to the lead economy"** | Number of new businesses registered within the city in the past year, per 100 000 population (Case Western Reserve University) | Outcome Quantitative | An environment which supports local business development and innovation provides greater livelihood opportunities for its population and is less reliant on external economic influence. | Resourceful, Inclusive, Flexible |
| | Patent applications per million inhabitants (patent intensity, OECD stat) | Outcome Quantitative | An environment which supports local business development and innovation provides greater livelihood opportunities for its population and is less reliant on external economic influence. | Resourceful, Inclusive, Flexible |
| | Share of tertiary education across the labor force (OECD stat) | Outcome Quantitative | The proportion of the labor force with a tertiary education is a common proxy for measuring a region's capacity to generate innovation (OECD, 2013a), and hence is associated with higher levels of economic stability in the long term. | |
| **Skills and employment "The workforce has diverse skills"** | City's unemployment rate (percentage of working age population) (OECD stat – Better Life Index) | Outcome Quantitative | Unemployment. | Resourceful |

| Dimension | Indicator | Type | Justification | Capacities |
|---|---|---|---|---|
| | Percentage of secondary education completion rate (adapted from ISO) or educational attainment (OECD stat) | Outcome Quantitative | Skills help citizens adapt to changes and cope in shock situations. Education positively impacts: communication, alert and awareness, health, labor and employment. Education fosters a greater range and quality of livelihood opportunities. | Resourceful |
| | Percentage of people unemployed for more than six months who have access to a programme that is intended to improve their employment chances (European Union, 2015, as quoted in CRI, 2016) | Outcome Quantitative | "Helping city residents develop relevant skills and employability through matching skills with employment needs promotes placement, retention and promotion. It supports the city's economic stability by building a competitive and quality workforce" (City Resilience Index, 2016). | Resourceful |
| Housing "Infrastructure is adequate and reliable" | Housing deprivation: percentage of population living in dwelling considered overcrowded, while: 1) leaking roof or damp walls, floors, foundations or rot in window frames and floor; 2) no bath or shower; or 3) too dark (Eurostat) | Outcome Quantitative | Housing quality. Poor and overcrowded housing is more susceptible to natural disasters, creates social exclusion, and creates mental and physical health risks. | Inclusive Robust |
| | Percentage of household income spent on housing by the poorest 20% of the population (University of Buffalo) (City Resilience Index, 2016) | Outcome Quantitative | Housing affordability. Adequacy includes access dimension. A higher value implies that the poorest are more at risk of losing access to housing in case of negative income shocks. | Inclusive Robust |
| | Percentage of houses which have passed local building code inspections | Outcome Quantitative | Compliance with housing safety standards designed and enforced at the local level indicates higher resilience to disasters and risks faced at the local context. | Inclusive Robust |
| | Percentage of housing units exposed to a high level of hazard that have been designed or retrofitted to withstand the force of the hazard | Outcome Quantitative | Retrofitting or designing houses that can properly withstand the expected level of hazard exposure is a prevention measure that makes infrastructure more robust. | Robust |
| Temporary accommodation needs "Infrastructure is adequate and reliable" | Percentage of population that could be served by city's access to stock of emergency shelter for 72 hours (Arup, 2015) | Outcome Quantitative | Emergency sheltering capacity, comprising safe schools and hospitals, vacant housing units for rent and hotel/motel rooms. | Inclusive Flexible Robust |

| Dimension | Indicator | Type | Justification | Capacities |
|---|---|---|---|---|
| | Safe hazard shelter vs. expected public demand (Arup, 2015) | Output Quantitative | Expected sheltering needs. | Inclusive Flexible Robust |
| | Percentage per capita of food reserves within a city (including supermarket agreements) for 72 hours (percentage of the population which could be served) (UNISDR, 2014, as quoted in CRI, 2016) | Output Quantitative | Emergency food capacity. | Inclusive Flexible Robust |
| Energy "Infrastructure is adequate and reliable" | Average number of electrical interruptions per customer per year (ISO 37120) | Outcome Quantitative | Reliability of energy supply to daily needs, without frequent outages. | Robust Flexible |
| | Number of different supply sources providing at least 5% of electricity generation capacity (World Bank) | Output Quantitative | If a city receives its energy from a diverse range of sources, disruption to overall city supply will be less severe (City Resilience Index, 2016). | Robust Flexible |
| | Number of days that city fuel supplies could maintain essential household functions (UNISDR, 2014, as quoted in CRI, 2016) | Outcome Quantitative | Spare energy capacity for emergencies, even if through alternative sources. | Robust Flexible |
| Water "Infrastructure is adequate and reliable" | Proportion of population using safely managed drinking water services (SDG Indicator 6.1.1) (UN, 2017b) | Outcome Quantitative | Health and contamination risks, environmental quality. | Inclusive Robust Flexible |
| | Number of different supply sources providing at least 5% of water supply capacity (World Bank adapted from electricity) | Output Quantitative | Diversity of supply sources reduces impact of disruption in services and diminishes drought risk (Buurman, 2016). | Inclusive Robust Flexible |
| | Percentage of population with access to improved sanitation coverage (ISO 37120) | Output Quantitative | Health and contamination risks. Environmental quality. | Inclusive Robust Flexible |
| | Proportion of urban solid waste regularly collected and with adequate final discharge out of total urban solid | Output Quantitative | Health and contamination risks. Environmental quality. | |

| Dimension | Indicator | Type | Justification | Capacities |
|-----------|-----------|------|---------------|------------|
| | waste generated (SDG Indicator 11.6.1) (UN, 2017b) | | | |
| **Ecology Sustainable urban development "Adequate natural resources are available"** | Estimated average exposure to air pollution (OECD stat) or PM10 concentration (ug/m3 ) (ISO 37120) | Outcome Quantitative | Air pollution creates health risks. Environmental quality. | Robust |
| | Percentage of wetland loss | Output Quantitative | Wetlands function as flood buffers. Flooding is the most frequent among all natural disasters, and its impacts in cities are especially harsh (Jha, Bloch and Lamond, 2012). | Robust |
| | Green area (hectares) per 100 000 population (ISO 37120) or average percentage of pervious surfaces | Outcome Quantitative | Permeable surfaces reduce the risk of floods, which destroy buildings and infrastructure. Green areas increase quality of life and well-being (sports, leisure and stress relief). | Robust |
| **Access and transport "Infrastructure is adequate and reliable"** | Proportion of population that has convenient access to public transport, by sex, age and persons with disabilities (SDG Indicator 11.2.1) (UN, 2017b) | Outcome Quantitative | Mobility facilitates access to health, employment, education. It also facilitates access to leisure and engagement in civic activities, which may foster social capital. | Redundant Flexible Inclusive Integrated |
| | Percentage of households with at least one vehicle (Cutter, Ash and Emrich, 2014) | Outcome Quantitative | Evacuation capacity and increased individual mobility. | Redundant Flexible Inclusive Integrated |
| | Number of arterial roads (km/km²) (Cutter, Ash and Emrich, 2014) | Output Quantitative | Evacuation potential. | Redundant Flexible Inclusive Integrated |
| | Death rated due to traffic road injuries (SDG Indicator 3.6.1) (UN, 2017b) | Outcome Quantitative | Road safety. | Redundant Flexible Inclusive Integrated |
| **Risk-based planning "Government ensures citizens' participation and has a clear long-term vision"** | Risk assessment report | Process Qualitative | Evaluation needs (disaster risk calculation), prior to any resilience specific policy design. A risk assessment report is a technical document of disaster risk calculation that identifies the different disaster risks the city is subjected to and the levels of vulnerability of the population (Jha, Miner and Stanton-Geddes, 2013). | Reflective Robust Integrated |

| Dimension | Indicator | Type | Justification | Capacities |
|---|---|---|---|---|
| **City leadership that has sufficient capacity and flexibility to effectively manage emergencies.** | Land-use plans that have been developed with reference to local hazard risk assessment and that have been subjected to a formal consultation process (Arup, 2015) | Process Qualitative | Risk-based, inclusive and participatory urban planning is central to an effective resilience-building strategy. - Land-use plans include: master plan, hazard mitigation plan and emergency response plan. - Formal consultation process involves high-risk minority population groups and technical experts. | Reflective Robust Resourceful |
| **City leadership that has sufficient capacity and flexibility to effectively manage emergencies.** | Hazard-mapping efforts, including energy facilities and industrial uses | Process Qualitative | Evaluation needs (territorial dimension). Maps inform which territories are more affected by which type of risk, combined with demographic data. City leaders can thus better understand which the most vulnerable population groups are and what territories are particularly fragile, and plan accordingly (World Bank, 2013). | Reflective Robust Resourceful |
| **Awareness and alert "Citizens' networks in communities are active"** | Multi-hazard early-warning system | Process Qualitative | Cost-effective measure to improve efficiency and consistency of warnings, thus improving emergency response to disasters (Jha, Miner and Stanton-Geddes, 2013). | Reflective Robust Resourceful |
| | Percentage of population that has received training on first-aid and emergency response skills in past two years | Process Quantitative | Training increases awareness and preparedness. It can be extensively carried out in schools, hospitals and the workplace. | Reflective Robust Resourceful |
| | Percentage of school children educated in disaster risk reduction (UNISDR, 2008) | Process Qualitative | Training increases awareness and preparedness. It can be extensively carried out in schools, hospitals and the workplace. | Reflective Robust Resourceful |
| | Capacity-development platforms (online portal, brochures, guides, toolkits) | Process Qualitative | Information increases awareness. | Reflective Robust Resourceful |
| | Percentage of neighborhoods with emergency groups (e.g. local Red Cross groups, voluntary firefighting associations, etc.) (adapted from USAID) | Process Quantitative | Local emergency groups organize residents and volunteers to prepare for and react to shocks and disasters. They contribute to higher local mobilization and civic engagement. They have greater communication capacity among residents, which further contributes to raising awareness and preparedness levels. | Reflective Robust Resourceful |
| | Level of trust in government | Outcome Qualitative | Legitimacy and effectiveness of public decisions/messages. | Reflective Robust Resourceful |

| Dimension | Indicator | Type | Justification | Capacities |
|---|---|---|---|---|
| **Transparency and accountability "Government is open"** | City open data portal, including budget, organizational structure, plans and projects of different policy sectors | Process Qualitative | Data access is a measure of the openness of government and increases accountability. Open data portals facilitate the development of community-based solutions to challenges. | Inclusive Reflective |
| | Percentage of access to Information requests processed within 90 days | Process Quantitative | Information access is a measure of the openness of the government and can foster civic engagement, trust and participation. | Inclusive Reflective |
| **"Collaboration with other levels of government takes place"** | The country has mechanisms to ensure co-ordination across levels of government (OECD, 2017b) | Process Quantitative | "Effective collaboration with actors at all levels of government is critical to develop integrated, coordinated strategies that make best use of the resources available" (City Resilience Index, 2016). | Integrated Resourceful |
| | The country has formal horizontal mechanisms/incentives between subnational governments (OECD, 2017b) | Process Quantitative | "Effective collaboration with actors at all levels of government is critical to develop integrated, coordinated strategies that make best use of the resources available" (City Resilience Index, 2016). | Integrated Resourceful |
| **Funding availability "The public sector has proper resources"** | Percentage of buildings with insurance cover for high-risk hazards relevant to the city (UN-Habitat) | Outcome Quantitative | Insurance against disasters. | Resourceful |
| | Ten-year average per capita budget for mitigation projects (Cutter, Ash and Emrich, 2014) | Input Quantitative | Investment in mitigation. | Resourceful |
| | Percentage of municipal budget spent in fire, police and emergency services (Cutter, Ash and Emrich, 2014) | Input Quantitative | Level of investment in emergency response. | Resourceful |
| | Proportion of total government spending on essential services (education, health and social protection) (SDG Indicator 1.2.1) (UN, 2017b) | Input Quantitative | Level of investment in essential services that can provide education, health and social protection to residents, to fight the risks of poor health, homelessness, inadequate housing, unemployment, poverty and social isolation. | Resourceful |

## 3.4 ISO 37123: Sustainable cities and communities – Indicators for resilient cities

ISO 37123:2019 introduces a set of indicators that can be used to assess the progress of cities in building resilience. It applies to cities, municipalities, and local governments seeking to measure their performance in a consistent and verifiable manner and covers a wide range of areas crucial to resilience, including economy, education, energy, environment and climate change, finance, governance, health, population, urban planning, transportation, and more. Table 6 depicts the dimensions and indicators of the ISO 311123.

Link:

https://cdn.standards.iteh.ai/samples/70428/96397f7027b5419f8f1b740536e72afe/ISO-37123-2019.pdf

*Table 6: ISO 37123: Sustainable cities and communities - Indicators for resilient cities*

| Dimension | Indicator |
|---|---|
| Economy | Historical disaster losses as a percentage of city product. |
| | Average annual disaster loss as a percentage of city product |
| | Percentage of properties with insurance coverage for high-risk hazards |
| | Percentage of total insured value to total value at risk within the city |
| | Employment concentration |
| | Percentage of the workforce in informal employment |
| | Average household disposable income |
| Education | Percentage of schools that teach emergency preparedness and disaster risk reduction |
| | Percentage of population trained in emergency preparedness and disaster risk reduction |
| | Percentage of emergency preparedness publications provided in alternative languages. |
| | Educational disruption |
| Energy | Number of different electricity sources providing at least 5 % of total energy supply capacity |
| | Electricity supply capacity as a percentage of peak electricity demand |
| | Percentage of critical facilities served by off-grid energy services |
| | Magnitude of urban heat island effects (atmospheric). |

| Dimension | Indicator |
|---|---|
| Environment and climate change | Percentage of natural areas within the city that have undergone ecological evaluation for their protective services |
| | Territory undergoing ecosystem restoration as a percentage of total city area |
| | Annual frequency of extreme rainfall events |
| | Annual frequency of extreme heat events |
| | Annual frequency of extreme cold events |
| | Annual frequency of flood events |
| | Percentage of city land area covered by tree canopy |
| | Percentage of city surface area covered with high-albedo materials contributing to the mitigation of urban heat islands |
| Finance | Annual expenditure on upgrades and maintenance of city service assets as a percentage of total city budget |
| | Annual expenditure on upgrades and maintenance of storm water infrastructure as a percentage of total city budget |
| | Annual expenditure allocated to ecosystem restoration in the city's territory as a percentage of total city budget |
| | Annual expenditure on green and blue infrastructure as a percentage of total city budget |
| | Annual expenditure on emergency management planning as a percentage of total city budget |
| | Annual expenditure on social and community services as a percentage of total city budget |
| | Total allocation of disaster reserve funds as a percentage of total city budget |
| Governance | Frequency with which disaster-management plans are updated |
| | Percentage of essential city services covered by a documented continuity plan |
| | Percentage of city electronic data with secure and remote back-up storage |
| | Percentage of public meetings dedicated to resilience in the city |
| | Number of intergovernmental agreements dedicated to planning for shocks as percentage of total intergovernmental agreements |
| | Percentage of essential service providers that have a documented business continuity plan |
| Health | Percentage of hospitals equipped with back-up electricity supply |
| | Percentage of population with basic health insurance |
| | Percentage of population that is fully immunized |
| | Number of infectious disease outbreaks per year |
| Housing | Capacity of designated emergency shelters per 100 000 population |
| | Percentage of buildings structurally vulnerable to high-risk hazards |

| Dimension | Indicator |
| --- | --- |
| | Percentage of residential buildings not in conformity with building codes and standards |
| | Percentage of damaged infrastructure that was "built back better" after a disaster |
| | Annual number of residential properties flooded as a percentage of total residential properties in the city |
| | Percentage of residential properties located in high-risk zones |
| Population and social conditions | Vulnerable population as a percentage of city population |
| | Percentage of population enrolled in social assistance programmes |
| | Percentage of population at high risk from natural hazards |
| | Percentage of neighborhoods with regular and open neighborhood association meetings |
| | Annual percentage of the city population directly affected by natural hazards |
| Safety | Percentage of city population covered by multi-hazard early warning system |
| | Percentage of emergency responders who have received disaster response training |
| | Percentage of local hazard warnings issued by national agencies annually that are received in a timely fashion by the city |
| | Number of hospital beds in the city destroyed or damaged by natural hazards per 100 000 population |
| Solid waste | Number of active and temporary waste management sites available for debris and rubble per square kilometer |
| Telecommunication | Percentage of emergency responders in the city equipped with specialized communication technologies able to operate reliably during a disaster event |
| Transportation | Number of evacuation routes available per 100 000 population |
| Urban/local agriculture and food security | Percentage of city population that can be served by city food reserves for 72 hours in an emergency |
| | Percentage of the city's population living within one kilometer of a grocery store |
| Urban planning | Percentage of city area covered by publicly available hazard maps |
| | Pervious land areas and public space and pavement built with porous, draining materials as a percentage of city land area |
| | Percentage of city land area in high-risk zones where risk-reduction measures have been implemented |
| | Percentage of city departments and utility services that conduct risk assessment in their planning and investment |
| | Annual number of critical infrastructures flooded as a percentage of critical infrastructure in the city |
| | Annual expenditure on water retention measures as a percentage of city prevention measures budget |
| Water | Number of different sources providing at least 5 % of total water supply capacity |
| | Percentage of city population that can be supplied with drinking water by alternative methods for 72 hours |

# 3.5 EU Green City Accord

This monitoring framework was developed for signatory cities of the Green City Accord, which is a movement of European mayors committed to making cities cleaner and healthier. It includes the five priority areas listed below, within which the cities have to take action and achieve goals. Although the framework was developed for a specific initiative, it is still a very valuable source for monitoring resilience within five environmental management areas. Table 7 presents the priority areas and relevant indicators for the Green City Accord Framework.

Link:

https://ec.europa.eu/environment/green-city-accord/monitoring-framework_en

*Table 7: EU Green City Accord*

| Priority area | Indicator |
|---|---|
| Air | PM 2.5 concentration levels [highest annual mean observed at (sub) urban background station] |
| | PM10 daily concentration levels [highest number of days per year exceeding the WHO recommendation of 45 µg/m³ observed at any (sub) urban background or traffic station] |
| | NO3 concentration levels (highest annual mean observed at traffic stations) |
| Water | Household water consumption (liters/capita/day) |
| | Infrastructure Leakage Index (ILI) |
| | Percentage of urban wastewater meeting the requirements of the UWWTD (regarding collection and secondary treatment) |
| Nature and biodiversity | Percentage of protected natural areas, restored and naturalized areas on public land in municipality |
| | Percentage of tree canopy cover within city |
| | Change in number of species of birds in urban area/built-up areas in the city |
| Waste & Circular Economy | Municipal waste generated per capita (tons) |
| | Recycling rate of municipal waste (%) |
| | Percentage of municipal waste landfilled |
| Noise | Percentage of the population exposed to average day-evening-night noise levels (Lden) >= 55 dB |
| | Percentage of the population exposed to night-time noise (Lnight) >= 50 dB |
| | Percentage of (adult) population with High Sleep Disturbance |

# 4 Regional and local examples

Within Table 8, examples are provided to offer a glimpse into the diverse approaches and methodologies employed by various cities and regions in conducting M&E activities. These examples serve as valuable sources of inspiration, allowing cities and regions to explore different frameworks or approaches and adapt them to suit their specific contexts and goals.

*Table 8: Examples of regional and local M&E of climate resilience*

| City / Region with published info on M&E | Content | Important aspects and activities | URL I | URL II |
|---|---|---|---|---|
| **Sydney** | ☒ Strategy <br> ☐ Indicator examples <br> ☒ Full Indicator framework | The City of Sydney has presented a plan called Adapting to Climate Change (URL I). It states that sea level rise should be monitored. In addition, monitoring reports are to be published in different intervals. "These reports provide details of our operational performance, and progress towards the Sustainable Sydney 2030 goals". In order to standardize monitoring within the administration, a performance planning system was developed. The strategy outlines goals and actions including responsibilities. <br> Within the second link, an assessment of the set out goals is included in the annual report incl. the progress and deviations from objectives. | City of Sydney Link 1 | City of Sydney Link 2 |
| **New York City** | ☒ Strategy <br> ☐ Indicator examples <br> ☒ Full Indicator framework | The Climate Change report published by the NYC Housing Authority describes monitoring activities regarding properties close to coastlines potentially affected by sea level rise and storm surges. <br> Within the second document (URL2), an indicator framework is given for climate resilience and adaptation measures (p.146f and p.166). | New York City Link 1 | New York City Link 2 |

| City / Region with published info on M&E | Content | Important aspects and activities | URL I | URL II |
|---|---|---|---|---|
| **London** | ☒ Strategy<br>☒ Indicator examples<br>☐ Full Indicator framework | The current Annual Monitoring Report (URL I) contains a large number of indicators, of which only a few monitor adaptation (in the form of green spaces, adaptation of the transport sector). The following monitoring reports will use a new framework (URL II). This contains six "Good Growth Objectives" and 12 KPIs. One of these Good Growth Objectives is "Increasing efficiency and resilience" and includes the following item:<br>"Those involved in planning and development must ensure buildings and infrastructure are designed to adapt to a changing climate, making efficient use of water, reducing impacts from natural hazards like flooding and heatwaves, while mitigating and avoiding contributing to the urban heat island effect" However, special indicators are probably not intended for this purpose.<br>In addition, the London Environment Strategy contains a specific section dedicated to Climate Adaptation (Chapter 8). Within the chapter, objectives and policy proposals are given - one dedicated to M&E with an exemplary dataset based on the IPCC AR5 methodology including hazards, exposure and vulnerability. Within Appendix 2, which give baseline values on aspects identified as important within the London Environment Strategy. | City of London Link 1 | City of London Link 2<br><br>City of London Link 3: Full Report |
| **Vienna (German Only)** | ☒ Strategy<br>☐ Indicator examples<br>☒ Full Indicator framework | Within the Vienna Smart Climate City Strategy, one chapter is dedicated to climate adaptation. It formulates goals, in parts quantitatively, such as the maximum no. of meters to access to green space.   Preliminary indicators for monitoring the objectives that  were set out in the strategy are displayed in URL2 (German only; p. 11 f). | City of Vienna Link 1 | City of Vienna Link 2 |
| **Metropolitan Region Bremen/ Oldenburg (German only)** | ☒ Strategy<br>☒ Indicator examples<br>☐ Full Indicator framework | The Roadmap of change was concerned with the development of approaches for monitoring and evaluation aim to systematically collect and provide information. They allow for long-term monitoring of climate impacts and adaptation beyond success monitoring. The monitoring and evaluation approach contains the following recommendations for action:<br>- Regular updating and improvement of the data situation | Metropolitan Region Bremen/ Oldenburg Link 1 | |

| City / Region with published info on M&E | Content | Important aspects and activities | URL I | URL II |
|---|---|---|---|---|
| | | - Analysis of existing monitoring systems<br>- Development of sectoral monitoring<br>- Identification of risk areas and development of reporting systems<br>- Development and establishment of integrated monitoring and warning systems | | |
| **Adaptation to Climate Change Model Regions in Austria (KLAR!)** | ☒ Strategy<br>☐ Indicator examples<br>☒ Full Indicator framework | In addition to literature research, experiences from monitoring systems at national and regional level as well as practical inputs from project participants have been used. The indicators are spread over 6 thematic blocks and are:<br>1. awareness raising and information of the general population<br>2. networking with stakeholders from different areas - involved stakeholders from the project team, politics, administration and science<br>3. involved stakeholders from the region with a multiplier function (e.g. associations, federations, interest groups, businesses)<br>4. bilateral consultations and/or specially produced materials depending on the sector/area and the target group<br>5. theme-specific events (e.g. building in climate change) for selected target groups according to sector, type and number of events and number of participants<br>6. target group schools and kindergartens<br>The indicators are mostly purely quantitative and mainly ask for numbers of different actors. The main aim is to find out how many actors with certain interests exist, but no information is collected about the quality of existing structures and their improvement. In addition, qualitative data is collected via interviews and surveys . | [Regions in Austria Link 1](#) | |

| City / Region with published info on M&E | Content | Important aspects and activities | URL I | URL II |
|---|---|---|---|---|
| **Austrian Climate and Energy Fonds (German only)** | ☒ Strategy<br>☐ Indicator examples<br>☐ Full Indicator framework | The handbook "Methods and Tools for Adaptation to Climate Change" for federal states, regions and cities presents 12 fields of action starting on p. 155, for which individual monitoring measures are suggested (e.g. "optimization and expansion of existing warning systems and monitoring systems for the control of new diseases and pests" in the field of agriculture or "adaptation of the monitoring strategy for lakes (regular recording of depth profiles with temperature and oxygen measurement)" in the field of water). In addition, the following three indicators are mentioned as examples of monitoring adaptation measures: Integration of adaptation into spatial planning instruments, Proportion of sealed area in hectares, Development of retention areas in hectares. | Austrian Federal States, Regions and Cities Link 1 | |
| **Region Brandenburg (German only)** | ☐ Strategy<br>☐ Indicator examples<br>☒ Full Indicator framework | Climate Change Monitoring:<br>Includes consideration of four "overarching indicators": climate change and vegetation development, greenhouse gas emissions, final energy consumption and renewable energies. Subsequently, a variety of indicators for the categories water, soil, forestry, agriculture, nature and biodiversity, health and infrastructure some of which are considered with adaptation. | Brandenburg Region Link 1 | |
| **North Rhine Westphalia (German only)** | ☐ Strategy<br>☐ Indicator examples<br>☒ Full Indicator framework | Compilation of indicators (on state level) for monitoring climate impacts and adaptation covering the following thematic areas: climate development, environment, humans, planning and building, economy | North Rhine Westphalia Region Link 1 | |
| **Karlsruhe (German only)** | ☒ Strategy<br>☐ Indicator examples<br>☒ Full Indicator framework | The document summarizes the monitoring endeavors of the climate adaptation strategy of Karlsruhe. It depicts the developed impact indicators and response indicators. | City of Karlsruhe Link 1 | |
| **Planning Region East (PGO), Austria** | ☐ Strategy<br>☒ Indicator examples | In this report, concrete response indicators for monitoring, including definitions, possible data bases and spatial resolution, are presented (potential threshold values for climatic phenomena, from which impact indicators can be derived, are also mentioned). The indicators are: | Region East Austria Link 1 | |

| City / Region with published info on M&E | Content | Important aspects and activities | URL I | URL II |
|---|---|---|---|---|
| | ☐ Full Indicator framework | o Proportion of green spaces in settlement areas<br>o Exposed buildings in natural hazard risk zones<br>o Land use | | |
| **Thuringia** | ☐ Strategy<br>☒ Indicator examples<br>☐ Full Indicator framework | Several state and impact indicators that are in line with DAS from 2015. Some of which could be attributed to adaptation measures even though no response indicators are mentioned | Thuringa Region Link 1 | |
| **Paris** | ☒ Strategy<br>☐ Indicator examples<br>☐ Full Indicator framework | Climate and Energy Report, but it seems that it is only published in French. This information is derived from the Paris Climate Action Plan (URL I) | City of Paris Link 1 | |
| **Barcelona** | ☒ Strategy<br>☐ Indicator examples<br>☐ Full Indicator framework | Development of urban green space is being monitored (URL I), Special Climate Emergency Report contains information on monitoring, but is written in Catalan (can be found at URL I); URL II reports on pilot projects in which the greening and shading of schoolyards and their effects on health and temperature-related indicators are being monitored. | City of Barcelona Link 1 | City of Barcelona Link 2 |
| **Amsterdam** | ☒ Strategy<br>☐ Indicator examples<br>☐ Full Indicator framework | Overall, however, it is unfortunately once again a strategic paper - little or nothing is reported about the concrete interventions and the monitoring systems planned for them. Just to the point: „Making Amsterdam more drought resistant" it is mentioned that it must be focused on "a monitoring programme to keep track of soil subsidence" | City of Amsterdam Link 1 | |
| **Bottrop (German only)** | ☐ Strategy<br>☒ Indicator examples<br>☐ Full Indicator framework | Clear description of the goal and the method of setting up the monitoring system for the city. Analysis of 37 frameworks with indicators in the field of urban, sustainable and resilient economic structures. Building on an additional workshop, a planning instrument for monitoring activities has been drafted. It puts resilience of economic activities in the center. | City of Bottrop Link 1 | |

# 5 EU Data Sources

Within Table 9, REGILIENCE has compiled a tabular overview of various sources (websites) of databases for climate mitigation and adaptation data, along with relevant details for selecting the most suitable database. The included websites offer different kind of data, from meteorological, to satellite to socio-economic census data.

*Table 9: EU Data Sources for Climate Resilience Monitoring*

| Title / Institution | Copernicus Climate Data Storage/ European Climate Data Explorer | Extreme precipitation indicators for Europe from 1950 to 2019 | EEA | Data Risk Hub | ESPON Database: Project package Climate data and maps update | European Climate and Health Observa-tory | CDP | European Climate Assess-ment & Dataset | Climate Chip | Climate4Impact Europe | Inspire Dataset (Infrastructure for spatial informa-tion in Europe | JRC Climate Change Impact Assess-ment Data |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Year of Publication/ Last Update** | depending on the dataset | 2021 | depending on the dataset | 2022 | 2022 | 2022 (mostly) | 2011-2023 | 1946-2022 | 1980-present | NA | NA | NA |
| **Climate-related data** | Various indicators: Biologically Effective Degree Days, Climatic Suitability for the Tiger Mosquito, Climatological Heatwave, | Various indicators: Consecutive wet days, Precipitation (total amount, Xth percentile frequency, max X-day amount), number of | Various indicators: Agriculture, Air pollution, Biodiversity - Ecosystems, Climate change adaptation, Climate change mitigation, | Various indicators: Hazards (Geophysical ,Hydrological ,Meteorological,Climatological, Biological); Assets (Population, Building, | Various indicators: Hazards (wildfire, drought, flood (costal and fluvial and flash), heat, ); Assets (primary sector, | infectious disease transmission (climate suitability), pollen season, exposure to heat, heat-related mortality, labor supply | Hazard data (climate hazards, vulnerable groups, sectors exposed, proportion of population exposed, impacts of vulnerability, | Temperature Precipitation, Drought, Pressure, Snow, Sunshine, Compound, Wind, Humidity, Cloudiness, Radiation (various | Online Heat stress index calculator (based on temperature, humidity, solar radiation and wind speed). | Temperature, Precipitation, Humidity, wind, radiation, pressure, evaporation. | Thematic data clustered according to environmental domains (air, nature, water, noise, waste, industrial emissions and industrial accidents) and data | frost free days, meteorological water balance map, Rate of change of flowering date for winter wheat, High resolution |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  | Daily Maximum Temperature, Daily Mean Temperature, Daily Minimum Temperature, Days with a High Amount of Natural Snow, Fire Weather Index, Fire Weather Index/ Fire Danger, Frost Days, Health Heatwave, Mean Relative Sea Level, Precipitation Sum, Precipitation extremes, Thermal Comfort Indices, Mean Radiant | events exceeding 20mm, number of wet days. | Energy, Environment and health, Industry, Land use, Resource efficiency and waste, Soil, Sustainability transitions, Transport, Water and marine environment. | critical services, environment), projections of economic impacts of climate change. | population, cultural sector, environment, infrastructure /industry/service), sensitivity (social, economic), capacity (institutional, economic, infrastructure, social, technological). | and temperature, population vulnerability to extreme heat, heatwave to health, thermal comfort, fire weather index, air pollution due to ozone). | probability of hazard, magnitude of hazard, expectations of future changes in hazards, timeframe for expected future changes), Vulnerability and Climate Risk Assessment (Factors considered in assessment; adaptation goal or adaptation plan), Adaptation Actions, Water, Energy. | indices for each category). |  |  | themes (atmospheric conditions, agricultural and aquaculture facilities, area management, bio-geographical regions, buildings, environmental monitoring facilities, energy resources, habitats and biotopes, human health and safety, land use, meteorological geographical features, mineral resources, natural risk zones, oceanographic geographical | SPEI monthly projection, precipitation, temperature. |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Temperature, Universal Thermal Climate Index, Total Winter Snow, Tropical Nights, Flood Risk. | | | | | | | | | | features, population distribution, production and industrial facilities, species distributions, soil, sea regions, statistical units, utility governmental services, elevation, geology, land cover, orthoimagery). | |
| **Spatial Coverage** | Europe | Europe | Europe | Europe (down to Nuts3 and cities) | Europe (down to Nuts3 and cities) | Europe | Worldwide, only covers active regions/ cities that disclose information to CDP via the CDP-ICLEI questionnaire. | Europe (weather-station based) | based on personal input | | Europe; Country/ regional data | Europe |

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| **Temporal resolution** | season, annual, 10-day, hourly etc. ->depends on the dataset; future, past present data | daily, monthly, yearly, 30year statistics | | 1,2,5,10,15,25 years | depends on the indicator | depends on the indicator | 2011-2023 | daily data (indices aggregated to yearly) | NA | 3hr, 6hr, daily, monthly, yearly; modeling acc. To SSPs | depends on the data | daily |
| **Spatial Resolution** | depends on the parameter | Europe | depends on the parameter | NUTS0, NUTS1, NUTS2 and NUTS3 and LAU depending on the availability of data | aggregated at NUTS3 | aggregated at NUTS4 | from state level - cities level | weather-station | NA | depending on parameter | depends on the data | not specified |
| **Pure Observational Data** | both | yes/ no | no | no | no | no | no | both | yes | yes | yes | |
| **Product types** | Climate Indices, Climate projections, in-situ observations, reanalysis, satellite observations | gridded data (NetCDF-4) | Indicators | Indicators | Indicators | Indicators | questionnaire answers | indicators, mapping | indicator | Climate indices, Climate projections | geospatial data | geospatial data |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | , seasonal forecast | | | | | | | | | | | |
| Projections | Yes (CMIP5) | no | | 25 years | RCP2,6, RCP4,5, RCP8,5 | RCP4,5, RCP8,5 | no | no | no | yes | no | SRES A1B scenario (-2099) |
| Timeframe | B: 1981-2010 P: 2011-2099 | 1950-2019 | 2000-2019 | | 1981-2010 2070-2100 | 1971-2099 or 1951-1985 or 1980-2021 | 2011-2023 | 1946-2022 | personal entry | personal entry | depends on dataset | 1951-2099 |
| Format | Web applications (map) & XML& GIB2&NETCDF4& | NETCDF-4 | maps & graphs | Map viewer (risk analysis tool and loss data tool), figures, Risk Estimation Dashboard, Metadata (tabular) | csv files, maps | maps | Excel table | map, text document | Web applications | download modelled data | web-based (data can be downloaded; application/gml+xml) | download modelled data |
| Costs | free | free | free | free | free | free | free | free | free | free | free | free |
| Category | hazards and risks | extreme precipitation | hazards and risks | risks, exposure, vulnerability | risks, exposure, vulnerability, sensitivity, adaptive capacity | Interactive Map Viewer | Climate hazards, risk and vulnerability, adaptation actions | Indices of extremes, map viewer and downloadable data | Heat Stress Index | CMIP6, CMIP5, CORDEX | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Usability** | easy; operational use not research | medium-hard | very easy | easy | medium | easy | easy | easy | very easy | advanced (scientific use) | medium/ advanced, interactive map | advanced (scientific use) |
| **Summary** | It supports European climate policies and actions; consists of a complex set of systems that collect data from multiple sources: earth observation satellites and in situ sensors, such as ground stations, airborne and sea borne sensors. | The dataset presents climate impact indicators related to extreme precipitation in Europe under current climate conditions. The suite of indicators include recent historic records, recurrence intervals, and other relevant statistical measures to evaluate the magnitude | It supports all phases of environmental policy making, from designing policy frameworks to setting targets, and from policy monitoring and evaluation to communicating to policy-makers and the public. | GIS web-based interactive platform of European wide risk data (hazard, exposure, vulnerability) based on different datasets. | to update data and indicators related to climate change exposure of Europe's regions, to climate change sensitivity and aggregated potential impact of climate change on Europe's regions and to adaptive capacity and vulnerability of European regions to | The Health observatory is linked to the Climate Adapt Database and contains indicators of EEA, Lancet Countdown Europe Indicators and Copernicus Climate Indices, all relevant for human health. | CDP offers climate change and sustainability data from more than 1,200 city, state and regional governments. This data is reported by cities through CDP-ICLEI Track, and by states and regions, providing rich insight that is informing policy and investor decisions. | ECAD's data is a daily, high-resolution data set of in-situ meteorological observations (also indices calculation for climate extremes) within Europe gridded into geographic projection. | The Heat Stress Index Calculator is a web-based tool that needs temperature and humidity entry. | The aim of Climate4impact portal is to enhance the use of climate research data. The portal aims to support climate change impact modelers, impact and adaptation consultants, as well anyone else wanting to use climate change data. | INSPIRE is a platform that gathers existing geodata as well as some statistical data from EU member countries and communities to harmonies data for interoperability. That is achieved by either changing (harmonizing) and storing existing data sets or transforming them via services for publication in | The goal is to assess the physical and socio-economic impacts of global warming on hydrological extremes and on water resources availability in Europe. |

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| | | and frequency of extreme precipitation events. These are provided as gridded products, with one product covering the whole of Europe, and the other higher resolution product focused on 20 European cities that were identified as vulnerable to urban pluvial flooding based on stakeholder surveys. | | | climate change. | | | | | | the INSPIRE infrastructure. | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| URL | https://cds.climate.copernicus.eu/cdsapp#!/home | https://cds.climate.copernicus.eu/cdsapp#!/dataset/sis-european-risk-extreme-precipitation-indicators?tab=overview | Indicators (europa.eu) | https://drmkc.jrc.ec.europa.eu/risk-data-hub/#/ | Project data package: CLIMATE - Data and maps update | ESPON Database Portal | Indicators on climate change and health — European Climate and Health Observatory (europa.eu) | https://data.cdp.net/browse | https://www.ecad.eu/ | Climate Change Heat Impact & Prevention | Climate CHIP | https://www.climate4impact.eu/c4i-frontend/search | INSPIRE Geoportal (europa.eu) | Joint Research Centre Data Catalogue - Climate change impact assessment - European Commission (europa.eu) |
| URL2 | https://climate-adapt.eea.europa.eu/en/knowledge/european-climate-data-explorer | CMCC DDS | | | CLIMATE - Data and maps update | ESPON | Urban Adaptation Map Viewer (health focus) — European Climate and Health Observatory (europa.eu) | | | | | | |