D4.2 Guide for Regional Climate Adaptation

MOUNT RESILIENCE

Deliverable Information Sheet

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Lead Partner	Euromontana
Authors	Marie LAURENT, Alicia MORENO, Guillaume CORRADINO
Contributing Partners	UMIL Dario PEZZOTTI, Gloria CAOTTI, Stefano SALA
Reviewers	UMIL, REVOLVE (Areti Vlachodimou)
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Version	1

List of Acronyms

CC	Climate change
CCA	Climate change adaptation
RD	Regional demonstrator

MOUNT RESILIENCE

PMB	Project management board
NbS	Nature-based solutions
MR	MountResilience
STES	Socio-Technical-Ecological Systems

List of Figures

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Executive summary

The impacts of Climate Change (CC) are intensifying globally, with especially visible effects in mountainous areas, highlighting the urgent need for effective adaptation strategies. MountResilience further aims at maximising the replicability potential of the innovations and methodology developed within the project, thus contributing directly to the Mission on Adaptation to CC's aim to bring climate resilience to 150 regions by 2030. However, effective adaptation hinges on anchoring decisions in the latest science, understanding the nexus between climate hazards and socioeconomic vulnerabilities, and integrating inclusive governance mechanisms and nature-based solutions (NbS). Mountain territories need guidance to develop their own CC strategies which are tailored, based on a region's particularities. To this end, this deliverable offers a first version of the **structured methodology developed in MountResilience to guide European mountains through their adaptation strategies**.

Complementing the Practice Abstracts (D4.3), the Guide for Regional Climate Adaptation Action Plan deployment will provide guidance to mountain regions on how to develop their own plan, using findings from the project.

The overall aim is to describe in simple terms the process behind the definition, establishment, implementation and monitoring of the climate change roadmaps tested within the project. It also highlights the mechanisms and tools to provide insights for non-project partners and project replication regions that have not followed the process as closely as the demonstrator regions of the project. This deliverable is mainly aimed at potential replication regions within and beyond the MR consortium. However, it will also serve as a valuable tool for local stakeholders in MR (MountResilience) demonstration regions, for researchers, and for public and private entities that could support the replication process in other territories.

Several steps are described:

Step 1	Identification of climate change challenges
	Specific territorial climate change-related challenges are identified through workshops, interviews and desk research.

Step 2	Stakeholder mapping and conceptualisation of a Local Council
	Classification of stakeholders based on their potential impact on the identified challenges, level of interest and influence.

Step 3	Identification of adaptation options
	A mapping exercise is carried out to gather appropriate and relevant information on possible solutions to the challenges identified. This will be used to develop a catalogue of adaptation options.

Step 4	Local Council establishment and co-creation workshop

Establishing Local Council and organising a first co-creation workshop. All stakeholders previously identified (step 2) are convened in person for a co-creation workshop to collaboratively brainstorm ideas and develop solutions, guided by specific factsheets.

Step 5	<u>Feedback and implementation roadmap suggestion</u>

Considering all the discussions in previous steps, an implementation roadmap is suggested: serving as a working tool, outlining specific activities, objectives, and timelines for engaging local stakeholders throughout the entire duration of the implementation phase.

Step 6	<u>Implementation and monitoring</u>

An implementation plan ensures that local stakeholders are involved in the process, whenever appropriate. This engagement allows stakeholders to remain invested in the climate adaptation planning and ensures their insights are reflected. Monitoring and evaluation mechanisms are also established to assess the effectiveness of stakeholder engagement and of the measures selected measures.

The content of the deliverable will be further elaborated and packaged as a guidebook at a later stage, taking stock of the project's achievements and allowing for inputs from other European projects that have worked on similar processes.

1. Methodology

1.1. Objectives and audience

Complementing the Practice Abstracts (D4.3), the Guide for Regional Climate Adaptation Action Plan deployment will provide guidance to mountain regions on how to develop their own plan, using findings from the project.

The overall aim is to describe in simple terms the process behind the definition, establishment, implementation and monitoring of the climate change roadmaps tested within the project. It also highlights the mechanisms and tools to provide insights for non-project partners and project replicator regions that have not followed the process as closely as the demos. This deliverable is mainly aimed at potential replicators regions beyond the MR consortium but will also serve as a valuable tool for local stakeholders in MR demonstrators and replicators regions, for researchers, and for public and private entities that could support such a process for replication in other territories.

1.2. Sources and content

The content has been selected from several submitted deliverables. It draws from WP1 (Support framework for transformation to climate resilience) and WP2 (Regional demonstrators) deliverables, and particularly, D1.1 Conceptual model for climate resilient transformation, D1.2 Regional diagnosis for CCA, D1.3 Climate resilient regional transformation strategies and D2.1 Demo implementation roadmaps. The content was also complemented by partners' feedback and considering challenges discussed in various project meetings.

Ultimately, the content outlines the methodology on:

- *How baseline studies were conducted (from D1.2)*
- *How examples of NbS solutions and other projects were compiled, presented and shared (from D1.3)*
- *How regional adaptation strategies were established (from D1.3)*
- *How local councils were created: identification of stakeholders, engagement strategy, selection (from D2.1)*
- *How regional factsheets were elaborated (from D2.1)*
- *How validation processes with local councils, co-creation processes and activities were organised (from D1.3 and D2.1)*
- *How implementation roadmaps were elaborated for each regional demonstrator (RD) (from D2.1)*
- *Lessons learned on the different steps, extracted from Project management board (PMB) meetings, State of the art meetings.*

1.3. Layout suggestion

To maximise its dissemination potential, the guide will ultimately be packaged in a booklet, structured as follows:

- 1 initial double page with the list of steps which could be followed (chronological outlook) and a short description of each. This first overview could serve as a table of content for the guide itself.
- 1 page per step (with some exceptions: more pages will be required for complex steps involving several tools) including:
  o A generaldescription of the objective of each step
  o The chronological indication related to the step to better determine when it should take place, how long it can last and what should be kept in mind regarding the previous and following steps.
  o The tools available for each step
  o The stakeholders to be involved
  o Lessons learned from the MountResilience project on each tool used.

It is proposed to use the upcoming MountResilience Community of Practice to engage external stakeholders in the review process and improve the guide, before creating the booklets. This practice will enhance the replicability of the guide's content.
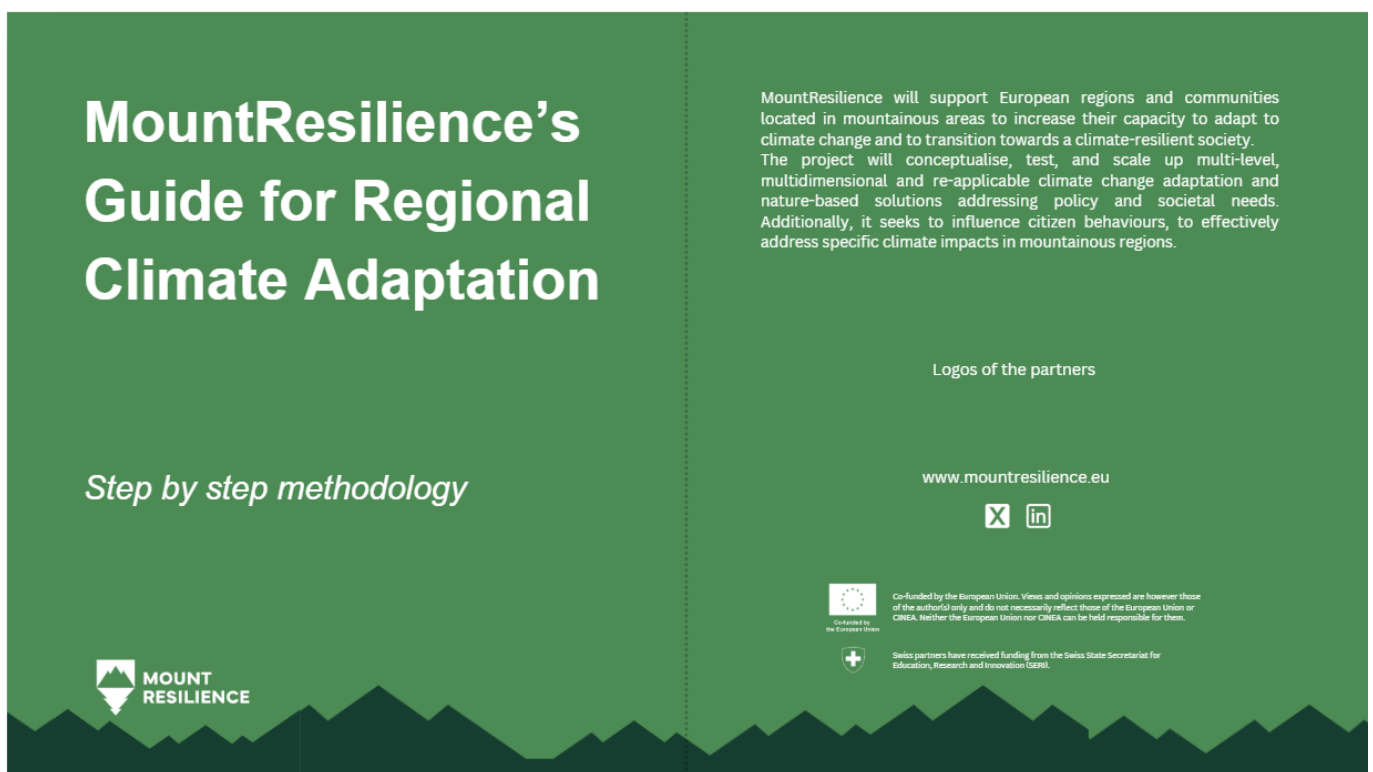

Figure 1: Example of cover page of the Guide (final version may differ)

MountResilience's path towards climate change adaptation

General objective of this mountain's path

To develop and implement a regional climate adaptation plan, a territory needs to carefully coordinate its actions. This guide, based on the work of the MountResilience project, describes a standardised and common methodology. It provides general guidelines and tips, including lessons learned from the project and its different pilots in terms of context, challenges, resources and objectives. It is intended as a flexible tool to be adapted to specific local needs. Concrete tools, chronology and lessons learned from the MountResilience project are provided. In this methodology, stakeholder engagement is treated as a core concept underpinning every aspect of the project's execution, ensuring that climate adaptation solutions are implemented with strong community and partner support. Stakeholders in this Guide refer to citizens, companies, academia, governmental bodies etc. not directly leading the strategical planning work (not the "leaders").

STEP 1:
Identification of climate challenges

Specific territorial climate change-related challenges are identified through workshops, interviews and desk research.

STEP 2:
Stakeholder mapping and conceptualisation of a Local Council

Classification of stakeholders based on their potential impact on the identified challenges, level of interest and influence.

STEP 3:
Identification of adaptation options

A mapping exercise is carried out to gather appropriate and relevant information on possible solutions to the challenges identified. This will be used to develop a catalogue of adaptation options.

STEP 4:
Local Council establishment and co-creation workshop

Establishing Local Council and organising first co-creation workshop All stakeholders previously identified (step 2) are convened in person for a co-creation workshop to collaboratively brainstorm ideas and develop solutions, guided by specific factsheets.

Who is this guide for?

The Guide is designed for organisations who aim to develop climate change adaptation plans and concrete solutions for their territory. Such group of organisation(s) can take various forms, depending on the territorial context, the participating organizations, and the level of involvement desired by regional authorities. It can for instance be universities, regional authorities, regional development agencies, companies etc. A generic term has been used throughout the Guide to name such entities leading the climate change adaptation planning: "leaders".

STEP 5:
Feedback and implementation roadmap suggestion

Considering all the discussions in previous steps, an implementation roadmap is suggested: serving as a working tool, outlining specific activities, objectives, and timelines for engaging local stakeholders throughout the entire duration of the implementation phase.

STEP 6:
Implementation and monitoring

An implementation plan ensures that local stakeholders are involved in the execution where appropriate. This engagement allows stakeholders to remain invested in the process and ensures their insights are reflected in the implementation. Monitoring and evaluation mechanisms are also established to assess the effectiveness of stakeholder engagement and of the selected measures.
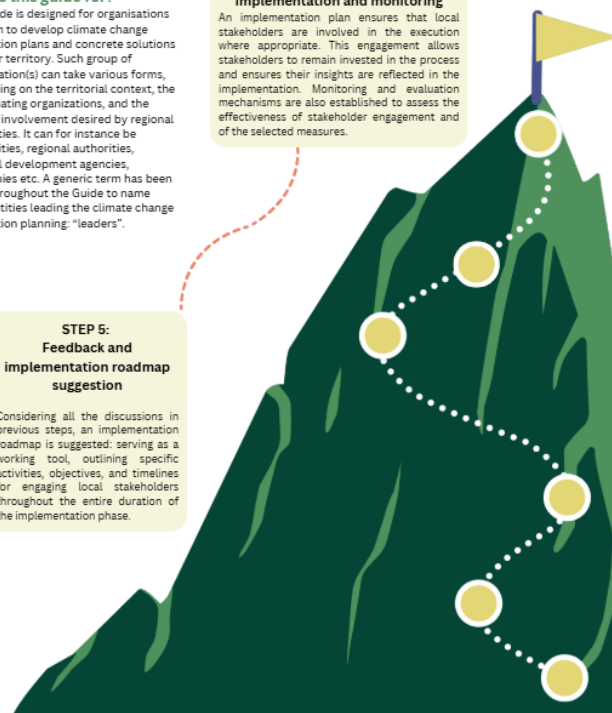
Figure 2: Tentative layout of the first two pages of the Guide containing the Table of content (does not include final text)

Step 5: Establishing Local Councils and first co-creation workshop

When does this take place?

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Objective

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Outcomes and lessons learn

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Tools available

Name of the tool
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Step 3: Mapping stakeholders

When does this take place?

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Objective

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Templates for stakeholder mapping

Tools available

Workshops
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Interviews
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Desk research
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Outcomes and lessons learn

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Figure 3: Examples of pages showcasing the specific steps, with detailed descriptions

2. Content of the Guide

The Guide will take the format of a booklet with a first snapshot of the whole process, accompanied by several factsheets zooming in on important steps and further elaborating on the tools used, the stakeholders involved, and the lessons learned.

2.1. Table of content

Header	The MountResilience Guide provides a standardised and common methodology to facilitate climate adaptation at the regional level across Europe. It provides general guidelines and tips, including lessons learned , challenges, resources and objectives. The guide is a flexible tool that can be adapted to the specific local needs of a European territory. In this methodology, stakeholder engagement is treated as a core concept underpinning every aspect of the project's execution, ensuring that climate adaptation solutions are implemented with strong community and partner support. In this Guide "stakeholders" refers to citizens, companies, academia, governmental bodies, etc. who are not directly leading the strategical planning work.
Who is this guide for?	The guide is designed for organisations that aim to develop plans and concrete solutions for adapting to climate change in their area. These may universities, regional authorities, regional development agencies, and businesses. In this guide, such entities that lead climate change adaptation planning are referred to as "leaders".
Step 1	Identification of climate change challenges Workshops, interviews and desk research help identify specific territorial climate change challenges.
Step 2	Stakeholder mapping and conceptualisation of a Local Council Classification of stakeholders, based on their potential impact on the identified challenges and theirlevel of interest and influence.
Step 3	Identification of adaptation solutions A mapping exercise enables the identification of possible adaptation solutions to the regional faced challenges. This information will be used to develop a catalogue of climate adaptation alternatives.
Step 4	Local Council establishment and co-creation workshop The identified stakeholders (Step 2) are structured into a Local Council, and participate to a co-creation workshop to brainstorm ideas and develop solutions.
Step 5	Feedback and roadmap implementation

An implementation roadmap serves as a working tool and outlines specific activities, objectives, and timelines for engaging local stakeholders.

Step 6	Implementation and monitoring
	The implementation plan allows continuous engagement of local stakeholders to ensure successful climate adaptation planning. Monitoring and evaluation mechanisms are also established to assess the effectiveness of stakeholder engagement and the measures selected .

2.2. Different steps

2.2.1. Step 1: Identification of climate challenges

Title	Identification of climate challenges
Chronology	This is the crucial first step on which all the other steps will build upon. During the MountResilience project, it lasted 6 months in total.
Small description	Given the complexity and heterogeneity of the regional dynamics shaping CCA responses, it is recommended to follow a mixed-methods research design, combining different sources.

As a first step, the territorial challenges can be identified, through desk research, workshops and interviews. By implementing a co-creation approach with a first group of experts and stakeholders, more scientific and technical aspects of the CC challenges can be covered. With such a complete overview of the challenges, it will be easier for local stakeholders to participate in the follow-up exercises, in particular in steps 2 and 4, always highlighting the most important regional aspects and CC problems in their territory.

Below, as an indication, is an overview of the number of documents analysed during the desk research, interviews and MountResilience workshops in each territory. Regional Demonstrators (RD) are the areas that will implement solutions during the course of the project with funding and support from the MountResilience project partners, while Replicator Areas |

will develop their plans for CCA with their own funding sources and will be inspired by the Demonstrator Areas. .

Demonstrator region	Analysed documents	Conducted interviews	Workshop participants
Gabrovo	9	5	35
Lapland	18	9	21
Piedmont	17	8	26
Râu Sadului	7	5	16
Tyrol	17	9	16
Valais	14	6	14
Total	**82**	**42**	**128**

Replicator region	Analysed documents	---	---
Catalonia	9	---	---
Friuli-Venezia-Giulia	14	---	---
Primorje-Gorski Kotar	9	---	---
Subcarpathian Region	4	---	---
Total	**36**	**---**	**---**

Figure 4: Number of analysed documents, interviews conducted and workshop participants in Step 1

Tool available: systemic risk assessment (SRA)	A SRA identifies and analyses the multiple levels of interdependencies and cascading effects of CC. It identifies the key climate risk(s) facing the region and their impacts on other aspects of the regional socio-environmental system, providing an informed basis for the development and implementation of effective transformative adaptation measures.

The SRAs are based on desk research, drawing on available data from policy documents and regional and national reports, as well as scientific sources. Two components need to be examined:

1) **Regional structural profile**: Firstly, regional mapping with desk research on regional characteristics was conducted, to gain an overview of underlying functional and structural conditions, relevant for regional CCA implementation. Therefore, reginal topography, land cover, environmental characteristics, population and socio-economic indicators, as well as the regional self-image and the governance framework were analysed. The method of choice in Mountesilience is desk research or secondary research and involves existing data from the internet, (EU/national/regional) databases, reports, assessments, scientific literature or regional information platforms that provide information concerning climate change on the regional level. This can be combined with a snowballing technique, where one analysed document or data source gives reference to another useful source of information.

2) **Regional climate induced hazards and ensuing systemic risks**: It consists of two consecutive steps: First, the analysis of climate hazards to be derived from European sources such as ESPON Climate Update, or, depending on availability, national or regional climate change assessments and reports providing information on climate hazards on subnational level. And second, an analysis of systemic risks based on the integration of hazards with the above regional structural analysis and further socio-economic data from resources such as OECD Statistics, Eurostat, national or regional reports and statistics (to the extent that it is necessary/ available). Here as well, the method chosen in MountResilience was desk research in combination with a snowballing technique. Data was derived from resources such as OECD Statistics on

productivity, trade and innovation; Eurostat data on economy, environment, industries and social conditions; National/regional reports and (if available) regional & local statistics.

Data gaps were filled through regional workshops and interviews with regional experts (see below). It is important to keep in mind that SRAs are based on data, but also normative decisions about priorities, targets and settings. To avoid too much bias, a participatory approach is recommended and has been employed in the development of the SRAs for the MountResilience Demonstrator Regions. For more details on the methodology followed for an SRA, consult the deliverable D1.2 Regional diagnosis for climate change adaptation, section 11.2 Methodology.

Tools available: desk research, online survey and interviews	**Desk research to screen CCA governance** can be key to gaining basic insights into the current state-of-play. In MountResilience, in addition to the initial governance research carried out in the SRA, more in depth analyses were conducted. For example, project academic partners have looked at the CCA governance framework of each demonstrator region to outline the range of CCA strategies, projects, policies, key actors, and perceived gaps in knowledge, tools, or methodologies, to stimulate discussions about existing/expandable capacities for transformative CCA. This step of analysis should begin with a general overview of the distribution of competencies for CCA-related issues between the national, regional and municipal levels to clarify the relevance and potential impact of CCA-related strategies. It then collects the 3-5 most relevant strategic documents (e.g., sustainable development concept, CCA strategies, or similar) and systematically analyses their content regarding how CCA is being addressed and how it should be addressed from the authorities' perspective.

Relevant questions for assessment include: *1) How is CCA being framed and interpreted? 2) What is considered the biggest regional challenge? 3) What is already being done to address CCA and how are these measures legitimised? 4) Who is involved and who should take future action – which actors, sectors, and how?*

To gain additional information on regional CCA, setting up online surveys with targeted stakeholders is also insightful. In MountResilience for instance, scientific partners used this tool with other regional partners who identified regional (i) key strategic CCA documents, (ii) pioneering CCA implementations, and (iii) key stakeholders.

Finally, semi-structured interviews can also be conducted with regional experts, first identified by desk research, online surveys, and regional partners themselves. These interviews can be analysed with a focus on regional adaptation challenges, opportunities and practices resulting in the identification of transformative capacities. In MountResilience, interviewees spanned from local authorities to non-governmental organisation and regional experts. Depending on the complexity of the issue and onthe depth of information from prior desk research and document analysis (and the consequent knowledge gaps), at least 5-8 interviews should be conducted. Overall, these interviews should ideally represent views from different societal spheres, e.g., academia, the public and private sector, and/or people involved in relevant CCA implementation actions. Interviews may be analysed using the |

Qualitative Content Analysis approach, for traceability, audio recordings and transcripts should be stored.

Tools available: Regional validation workshops	Building on the prior analysis, scientific and regional leaders can develop initial hypotheses on transformative capacities and pathways for each region. These can, in turn, become the basis of online regional validation workshops. The validation workshops help to share findings with a wider local audience, to present ensuing hypotheses and discuss further towards the formulation of concrete advice for the activities and beyond. Through the workshops, identified CCA measures, challenges and opportunities in the region are addressed, but participants can also define further needs related to resources and capacities to successfully govern regional CCA actions.
	In MountResilience, an online format was chosen to allow workshop participation for all interested regional actors, notwithstanding their (remote) location. The Miro tool was used for visualization and collaboration.
	In such kinds of workshops, 10-25 regional experts with relevant knowledge should be invited.
	Practically speaking, MountResilience workshops consisted of two parts:
	In the first session, regional CCA measures, challenges and opportunities deriving from previous analysis (desk research, survey and interviews) were presented and subsequently debated in smaller groups as well as in the plenary session.
	In the second session, regional transformative capacities that were identified as relevant by the research team (the research partners in the project, not the regional demonstrator) were introduced and put up for discussion. This gave participants the opportunity to share feedback, give concrete examples stemming from their own experience or bring in new ideas for effective CCA governance.

The online tool Miro was used to facilitate visualization of discussion points and the workshops lasted 2 hours. Below is an example of a Miro board used for the workshop held in Lapland.
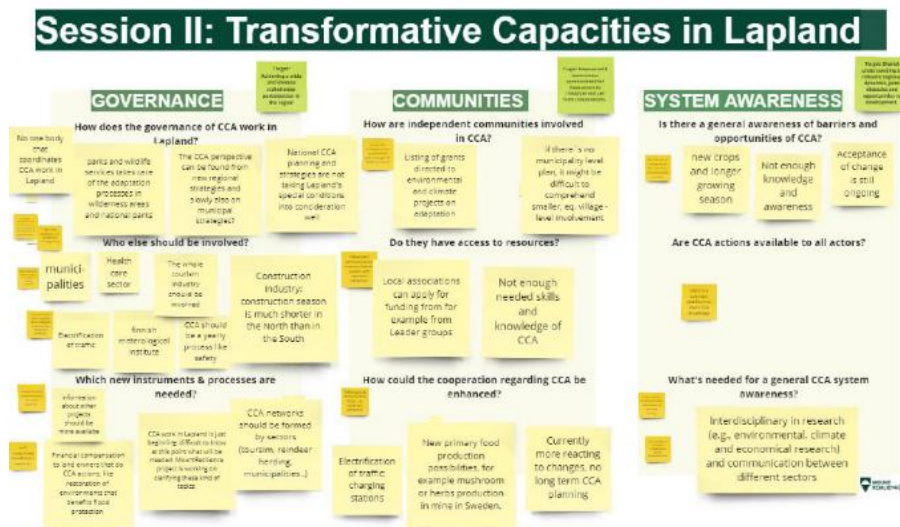

Figure 5: Miro Board Lapland validation workshop

Lessons learned	The online survey for data collection was rather poorly received in MountResilience, possibly due to a lack of time from the partners, too little communication or too many questions. This solution took a high level of involvement for the scientific partners: a lot of effort was putted into filling the survey with regional information researched beforehand, which did not pay off in the end. Using a simple excel sheet for gathering information would be a better strategy.

The conducting of the interviews worked well, despite there was already some knowledge of the region, and more concrete questions could be asked. Most of the interviewees were well-engaged and helpful, offering to be contacted again for follow-up questions, which underlines their interest in the project. Some advice especially for stakeholders who are not used to giving interviews, is to remove any possible uncertainties beforehand (e.g., being clear about language barriers, how to solve them, giving a general idea of topics and questions, data security issues, further process of the data, etc.).

In MountResilience, the online format ensured a broad participation to the validation workshops, regardless of location (see Miro board above). Regional partners distributed and managed workshop invitations which helped with building trust and ensuring capturing the right target audience. However, it was important to clearly define the roles and responsibilities, as regional partners also attended the workshop. In hindsight, it would have been good for some workshops to involve the regional leaders more in the workshop process itself so that they could help with the participants engagement.

Overall, this first step implies a strong conceptual background that will also be useful for the monitoring process (see step 7). In MountResilience, the conceptual framework has constituted a full deliverable, which is open source and so can be used for its process replication (D1.1 Conceptual model for climate resilient transformation).

2.2.2. Step 2: Mapping stakeholders

Title	Mapping stakeholders
Chronology	Following the first identification phase, the mapping exercise usually lasts several months, though it may vary depending on the size of the territory and the ambitions for the Local Council's size. In MountResilience, the mapping exercises took place over 3 months.
Small description	Exposure to climate risks varies in levels, as does the territories' preparedness for change and their adaptive capacity. This is why it is recommended to adopt a bottom-up, place-based approach that considers the territory's specific characteristics, resources, and needs. Moreover, the importance of this bottom-up approach lies in ensuring the engagement of key stakeholders affected by climate change and their adaptation strategies at the national, regional, and community levels, while also customising this engagement through preliminary regional diagnosis or personalised support.
	To achieve this, the territory and partners should initiate a CCA plan or all relevant stakeholders from the quadruple-helix (see explanation below) can be identified and classified. Finally, this detailed stakeholder mapping process provides a clear identification of core stakeholders for the Local Council establishment (step 4).
	In MountResilience, this step was performed by regional local project partners with support from the Technical University of Vienna and the University of Milan (horizontal scientific partners in the project). They assessed the level of interest and influence of each stakeholder mapped on the project.
Important concept : quatruple helix	It is considered effective to integrate strong and active stakeholder engagement into the collaboration of the partnership, specifically through the quadruple-helix approach. This model serves as an ideal framework as it integrates the efforts of four key actors from academia, industry, government and community-civil society. All four leverage their unique strengths and perspectives to formulate comprehensive and effective climate adaptation actions to be implemented. The quadruple helix model represents a novel social dynamics framework centered on networking, breaking down barriers between institutions, and fostering integration and cooperation across various social sectors. Another important

aspect of the approach is the involvement of entities at multiple levels for each quadruple helix actor: local, regional, and national.

Tool available: stakeholder map	To gather all the necessary information while at the same time keeping the data manageable, the mapping exercises need to be carefully designed and targeted. A preliminary baseline can be established with the responsible (s) local organisation(s) leading the strategic planning.

In MountResilience, each regional demonstrator coordinator was asked to conduct a mapping exercise to establish a preliminary baseline. Some of the Canva used to facilitate stakeholder mapping are described below:

1) Stakeholder Register: This first Canva served as a register of stakeholders present in each area of demonstrators, organized into three levels, local, regional, and national and grouped according to the four sectors of the quadruple helix framework. The register requested the following information for each stakeholder.

Figure 6: Stakeholder register Excel file template

2) Stakeholder matrix: The third and final Canva sheet contained a table with three columns: one reporting the name of the institutions, the second indicating the level of interest and the third the level of influence that each identified stakeholder has regarding the themes that MR focuses on in each pilot area.

Figure 7: Stakeholder matrix Excel Template
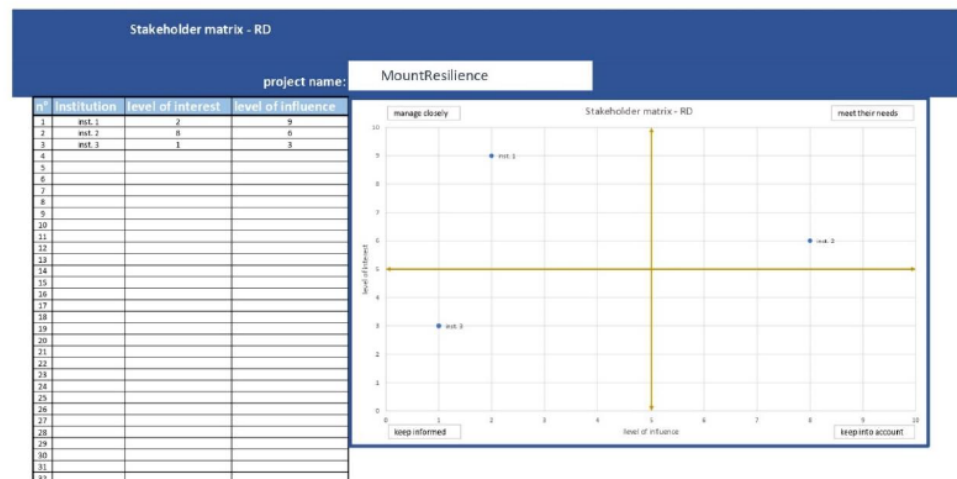
Through mapping exercises, stakeholders identified are considered as, potentially, the most relevant ones able to guarantee the active participation and continuity needed. The mapping exercises also help develop a strategic plan outlining how and when stakeholders will be engaged throughout the project. The identified actors can eventually be invited to become members of the Local Council (see Step 4).

Lessons learned	In MountResilience, support was provided by scientific partners, in particular the Technical University of Vienna and the University of Milan. They assisted all the pilot territories with tailored tools and meetings. For instance, bilateral meetings between a scientific partner (the University of Milan-UMIL in the case of MountResilience) and the leaders of each regional demonstrator were conducted to review the core stakeholders identified from the stakeholder matrix and jointly plan the first Local Council meeting (the Local Council Establishment see step 4). These discussions focused on understanding the specific needs and expectations of each stakeholder, ensuring that the approach offered by UMIL was tailored and effective. By fostering open communication, the aim was to strengthen the project's collaborative efforts and improve overall stakeholder relations.

2.2.3. Step 3 : Identifying adaptation options

Title	Identifying adaptation options

Chronology	This step can be performed in parallel with the previous steps (1 and 2The open-source catalogue (main tool derived from this step) can be used in subsequent steps, and especially for the factsheet exercise in step 4). In MountResilience, this step took about six months.
Small description	This step can be under the responsibility of specific organisations (as was the case in MountResilience). A research partners can coordinate the work, aggregate the information from various sources, review and select them. Eventually, in the project MountResilience, it led to the creation of an open resource for other projects willing to learn about CCA projects and articles published, with a specific focus on NbS. The solutions and projects explored in the open-source catalogue are linked to the challenges identified in step 1. The catalogue provides a scientific foundation for the co-creation exercise to be performed in step 4 with the local stakeholders. It is also useful for internal iteration and eventually, to support the implementation of roadmaps and future decision-making.
Tool available: open source inventory	It is recommended that a research organisation, or neutral expert not part of the local administration, takes a coordinating role for this tool. One research organisation can for instance oversee the development of the tool. It involves performing bibliographic research on a set of defined keywords linked to Nature based Solutions (NbS) and adaptation strategies related to these specific CC challenges. The inventory also includes some solutions not strictly related to RDs challenges (i.e. biodiversity loss, water scarcity, depopulation, over tourism). It allows other stakeholders, including end-users, funding organisations, investors, and decision-makers — to explore them and encourage public and private investments, supporting the implementation of local and regional adaptation strategies to address the impacts of climate change. **ARTICLES** - The research process can make use of SCOPUS, where keywords related to local CC challenges can be inserted to search for papers that contain them in the title, abstract or keywords. **PROJECTS** - The investigation can make use of the CORDIS and Keep.EU project databases (e.g., Horizon 2020, Horizon Europe, Interreg, EIT KICs, LIFE+, Structural Funds, EIB, EBRD, and other national programs). **FUNDING SOURCES** – This research process targets funding sources at different levels covering CCA and its many different aspects (education, environmental protection, agricultural practices, tourism). In MountResilience, this was performed by a project partner specialized in finance and ethical banking: FEBEA (European Federation of Ethical and Alternative Banks and Financiers). Such research ensures a level of sustainability for the inventory platform and increases the replicability potential, allowing future users to understand which sources of funding are available.

The first identification phase allowed the project consortium to gather a preliminary total of 280 articles, 159 projects and 37 funding opportunities which composed the initial database.

In MountResilience, all this information is available in the form an online, open-source inventory (see MountResilience's website 'solutions database'). The content from this tool was used for co-creation exercises in the territories in step 4, to have a basis on what already exists and learn from previous experiences.
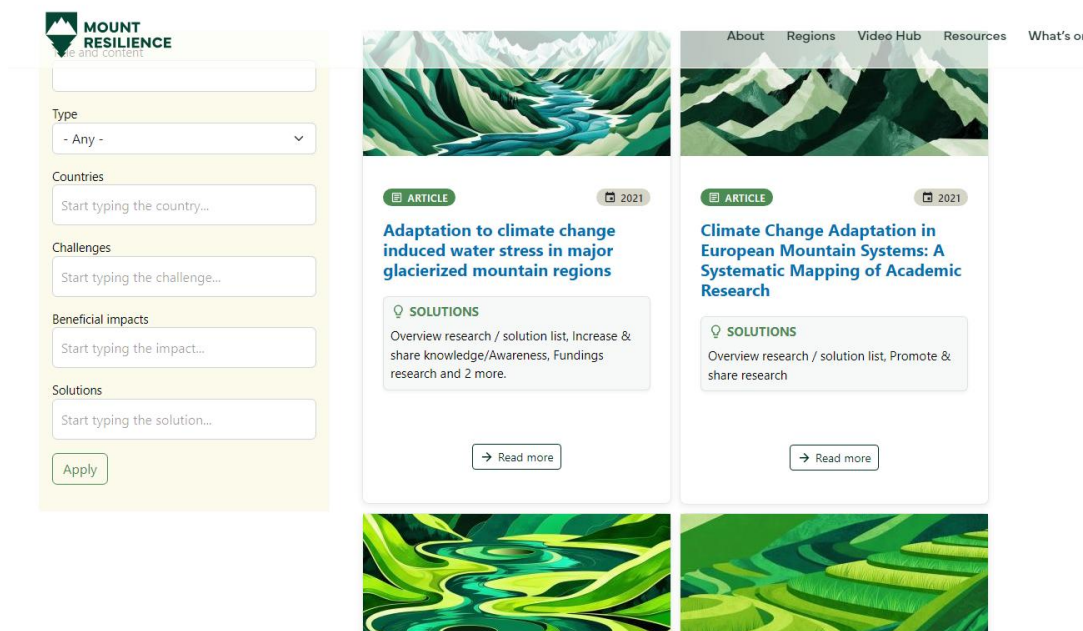

Figure 8 - Screenshot from the MountResilience Solution Database

Lessons learned	The creation of a comprehensive database, including a wide range of articles and projects, required a standardized approach—a systematic review process. To achieve this, the PRISMA Flow Diagram (Page et al., 2021) was adapted to guide the information flow through the scientific review phases in MountResilience (see diagram below). SCOPUS was

the primary platform used to search for scientific articles.
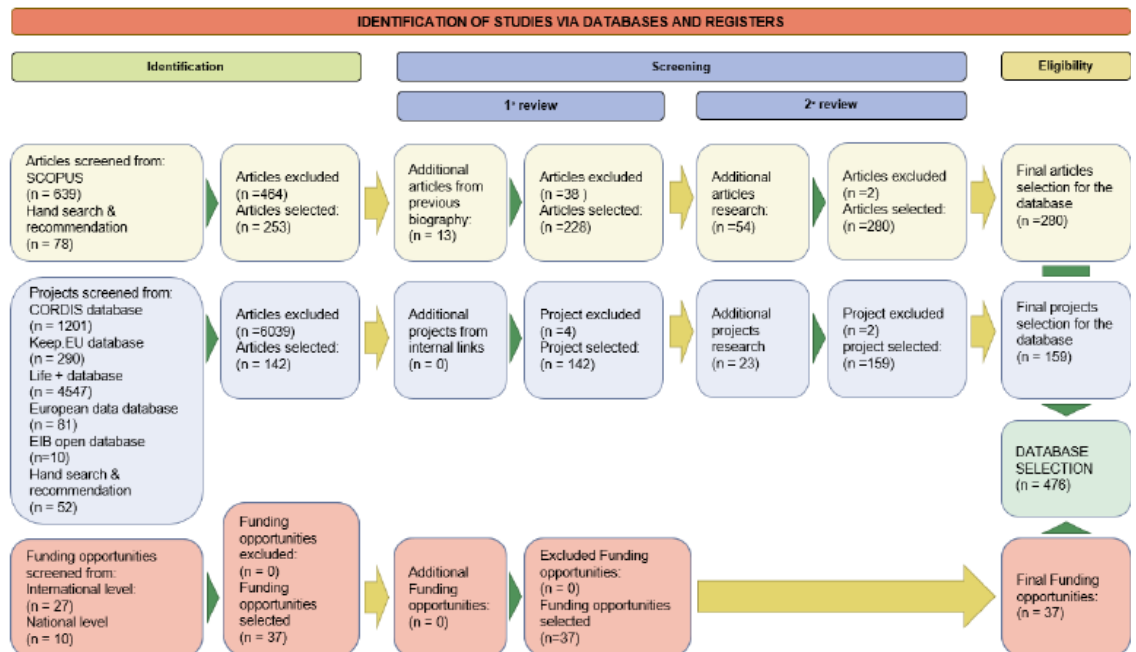
Figure 9: Flow diagram for identifying studies and projects (adapted from PRISMA model) UMIL, 2024

In addition to this, a review process is essential for all the sources identified initially. In MountResilience, it meant removing duplicates, articles with only abstracts available, articles from old dates etc. Based on the project's experience working manually with Excel documents, it is recommended to use programs that automatically check the information related to the "mechanical" article selection.

In MountResilience, the technical aspects of the project faced criticism principally regarding the database and the clarity of the information provided, which was initially in the form of an Excel document listing projects and scientific articles. For instance, Local Council members (see step 4) expressed concerns about the approach and found that many of the articles "provide information rather than actionable solutions".

Additionally, the co-creation exercises based on this database (see step 4) were recognized as too difficult given the level of details and complexity provided in the database: "For us, it's difficult to identify sources. There is no time to see what is the result that refers to the database. We didn't go through these databases deeply. This is the part we're missing". This confirms the necessity to transpose this information to a User-friendly tool.

It must be noted that this step requires a lot of human resources and is time consuming. Indeed, it involved the conversion of an Excel database into a structured web-based database using Drupal 10.3. The default configurations were sufficient for MountResilience's needs.

The frontend was designed to be embedded via an iframe, ensuring easy integration with external websites.

2.2.4. Step 4: Establishing a Local Council and organising the first co-creation workshop

Title	Establishing a Local Council and organising the first co-creation workshop
Chronology	The establishment of a Local Council and the launch of its first co-creation exercise requires the knowledge base of Step 3 to develop the activities based on the inventory. This step takes place after the Local Council members have been identified (through the mapping exercise in Step 2) and formally invited to participate as stakeholders. In MountResilience, the establishment of the Local Council took 3 months, from the time the stakeholder mapping was completed the time the process leader convened the Local Council. In MountResilience, Local Councils will meet every six months, but this should be tailored to each area and the availability of stakeholders.
Small description	Leaders should organize a co-creation workshop during which stakeholders can collaboratively brainstorm ideas and develop solutions guided by factsheets. Such workshops are ideally organised during Local Council meetings. They provide a platform for meaningful interaction, allowing stakeholders to actively contribute to the strategical planning. The group of stakeholders can be asked to define the climate adaptation path to address the regional climate change challenges that were identified at the beginning of the project (step 1). Participatory methods can be used to facilitate stakeholder engagement (such as interview, questionnaire, co-creation laboratory, validation of the factsheets etc).
Tool available : Local Council	The name might suggest a council made up of local government bodies; however, this is not the case. In line with the principles of multi-scale and multi-sectoral involvement, the stakeholders in the Local Council represent local, regional, and national levels. The term "local" is used here to emphasize the connection with a specific territory, not the level of the members involved. Additionally, it is important to outline the functions and expectations of this body: the Local Council is established for a territory and is an informal working group created in collaboration with a research organisation. Its purpose is to ensure greater involvement of the quadruple helix stakeholders in project activities, thereby adhering to the principle of co-creation. The Local Council's role is to form working groups of stakeholders who, while being external to the leaders' group itself, are nonetheless essential to its success. These stakeholders should be competent in their field or representative of a key stakeholder group, and willing to be engaged actively and consistently throughout the planning phases.

In MountResilience, it was decided that Local Councils would meet twice a year (every six months) in their native language. In the project, it was important to create and establish a clear position for a Local Council coordinator: one organisation overseeing the meetings, engagement strategy, streamlining the communication with stakeholders (through predetermined communication channel such as Emails, shared folders, newsletters or PowerPoint presentations) and leading the exercises (as described below in the factsheets).

Tool available: factsheets	The factsheets capture insights from exercises conducted previously (Step 1 especially on climate challenges) and the knowledge aggregated in the open-source inventory (step 3). It thus consolidates validated feedback from the variety of sources and actors involved at this stage in the planning process (leaders and stakeholders). The overall objective of this tool is to allow local stakeholders to easily review available resources, removing what they deem are non-relevant articles/ projects/ funding sources but also add more research topics. It provides a basis for discussion in the first Local Council but it can also be useful in other instances of co-creation.

In MountResilience, a research partner oversaw the elaboration of the factsheets (UMIL). The University provided the regional demonstrator coordinators with validation factsheets. In these factsheets, project partners and stakeholders had the opportunity to offer suggestions and comments regarding the necessary implementation actions for each regional demonstrator.

Several exercises can be offered to the leaders of the CCA strategical planning locally, but also to the selected local stakeholders. Examples of such exercises offered by a scientific partner in MountResilience to local leaders are given below.
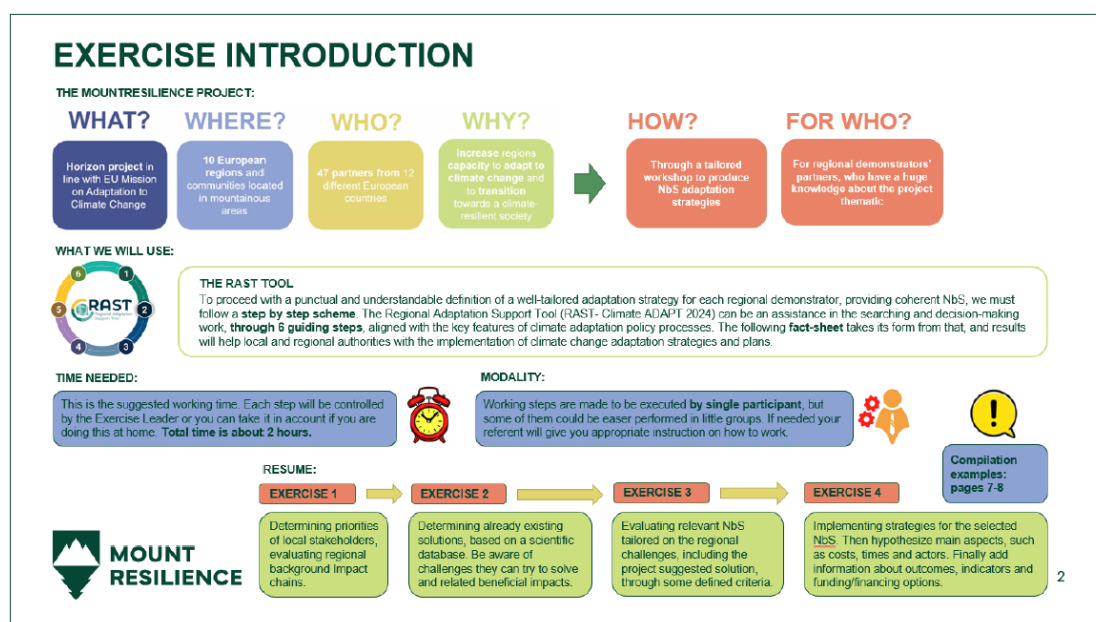
Figure 10: Factsheet template in MountResilience for demonstrator project partners

Figure 11: Factsheet template exercise 1

Figure 12: Factsheet template exercise 2

Figure 13: Factsheet template exercise 3

Figure 14: Factsheet template exercise 4

In MountResilience, the regional Local Council coordinators administered these exercises by organizing workshops, one for local project partners and one for stakeholders. The group of stakeholders was asked to define the climate adaptation path to address the regional climate change challenges that were identified as at the beginning of the project. Local Councils Coordinators, were in charge to deliver, collect and resume the results, and to organize the validation councils.

Figure 15: Local Council held in Gabrovo

With these factsheets, research organisations can investigate discussion points which emerged from the exercises, concerning problems and possible proposed solutions and create a suggested implementation plan (see implementation roadmaps next step). In MountResilience, the same research partner elaborated the exercises and the roadmaps in step 5.

Lessons learned	For the Factsheets, to optimise the validation process, MountResilience developed differentiated regional Factsheets based on the recipients' level of involvement in the project. A total of 12 factsheets were produced: 6 for regional project partners (see previous section), containing more technical content and detailed information, and 6 for regional stakeholders, designed to be simpler and accessible to those without specialist knowledge. In addition, 4 factsheets with the same structure as the stakeholder versions were produced for replicators to actively involve them in the project, although this wasn't required at this stage (but was expected to be helpful for future stages). The details of the Factsheet templates can be found in the MountResilience Deliverable 1.3, Annexes, 5.2.2 Regional Demonstrator Stakeholder Factsheet and Regional Replicator Partner Factsheet. The document also lists guidelines for conducting such an exercise locally.

The exercises presented above aimed to not only help participants understand the challenges related to Climate Change and the possibilities for adaptation but allows them to identify the most useful solutions for their regions and to reach ideas for implementing them. Moreover, by acknowledging the stakeholders' input, it is demonstrated that their expertise is valued and directly influences the project's direction. The aim is to cultivate a sense of ownership among stakeholders.

Besides these efforts, Local Council Coordinators identified the following challenges in the workshops held in MountResilience:

- Tight timelines
- Language barriers because the factsheet templates and open-source inventory from step 3 were provided in English
- Difficulties with the manipulation of technical-scientific topics. To overcome this difficulty, in the case of Tyrol, a questionnaire was elaborated for the Local Councils to fill (easier than the PowerPoint exercise). Then, the contributions were added to the factsheet original structure.

- Difficulties managing stakeholder engagement

On this last point, the MountResilience partners reflected on a few tips to foster lasting stakeholder engagement:

- Be transparent about the project's goals, processes, and potential impacts, including sharing information. This openness helped establish credibility and foster trust among all parties involved.
- Establish regular communication channels (e.g., newsletters, updates) to keep stakeholders informed and engaged throughout the project.
- To streamline stakeholder engagement, establish clear roles and responsibilities for all team members. The RD coordinator serves as the primary contact for the Local Council and all stakeholders: RD's coordinator is the Local council Coordinator. This designation clarified accountability and ensured that communication was both effective and efficient. By defining these roles, it aims to eliminate any ambiguity and promote a more organized engagement process.

Finally, from the project partners' point of view, it would have been better to follow a bottom-up process from the beginning (which was not completely the case because pathways were identified from the submission phase already). This led to difficulties when implementing the co-creation process conducted later.

2.2.5. Step 5: Elaborating climate adaptation roadmaps

Title	Elaborating climate adaptation roadmaps
Chronology	This step takes place right after the co-creation exercise. In MountResilience, it was performed by a research partner and lasted about eight months.
Small description	Roadmaps are meant to suggest solutions and actions for implementing adaptation. The roadmaps show what emerged as a priority for implementation from step 4. Based on the information obtained from the exercises carried out, a leader can identify regional strategies containing solutions tailored to the region starting from participants perceptions. In MountResilience, a research partner was taking the lead on writing the roadmaps and then sharing it with regional demonstrators.
Tool available: implementation roadmaps	Roadmaps serve as both a guiding framework and a crucial monitoring tool, facilitating effective planning, stakeholder engagement, and adaptive management. It provides a clear, structured path that guides each phase of implementation, aligning tasks with deadlines and assigning responsibilities.

For instance, below is an excerpt for one of the RD of the project in Tyrol. Several roadmaps were proposed by a scientific partner in MountResilience, focusing on specific challenges (identified in previous steps) and offering solutions which match the discussion held in the Local Council (step 4). In the example below, the specific topic of buildings and heat is explored. After reviewing the main challenge in a few paragraphs, the roadmap suggests a solution, with its strength, weaknesses and challenges, as well as implementation stages with a clear calendar and main actors leading each phase. When possible, potential outcomes, indicators and funding possibilities are also mentioned (see below). The exact format and structure depend on local contexts and these template examples from MountResilience can be adapted. For inspiration, the content of all the RD can be found in D2.1 Demo implementation roadmap and in a dissemination format in the abstract deliverable of the project MountResilience D4.3.

What does an implementation roadmap help with?

- An implementation roadmap allows leaders to track progress against set milestones and timelines. This enables leaders to monitor advancements, identify potential delays, and adjust plans as necessary.
- The roadmap helps identify the resources (financial, human, and material) required for each implementation phase. This facilitates better planning and allocation of resources to ensure that the project stays on track.
- By visualizing the various components of the solution, the roadmap can help identify potential risks and challenges early on. This allows leaders to develop strategies for mitigation and ensure a good adaptation to unforeseen circumstances.
- The implementation roadmap can serve as a communication tool for engaging stakeholders, helping them understand the progression and how their contributions fit into the plan.

Compared to the factsheets, the roadmaps follow more closely what the partners want to do, creating a roadmap that is well tailored to the strategy they intend to pursue.

Discussed area: Buildings and heat

In the Austrian Alps, average temperature change predictions indicate an increase of 0.8–1.2°C (low/high emission scenarios) by the 2030s, 1.6–2.6°C by the 2050s, and 2.8–4.2°C by the 2080s (Steiger & Stötter, 2013). Existing buildings and structures are inadequate to cope with rising temperatures and the heat island effect, which not only challenge infrastructure but also increase the vulnerability of the local population (D1.2; p. 112).

Current adaptation measures to address heatwaves and the heat island effect in buildings are generally deemed insufficient (D1.2; p. 106). Consequently, the primary objective is to "*prevent buildings from overheating*" (T-EP), which is a medium to long-term goal. Urban areas and densely populated regions are particularly exposed, leading to a focus on re-naturalization systems, guidelines for mitigating overheating, and cooling solutions in the database. The issue impacts not only infrastructure costs, including energy and water use, but also public health, placing additional burdens on residents and workers. The most significant health risks identified include increased stress on the population, strain on the healthcare system, heightened social inequality, and financial loss (T-EP).

Suggested solution for the implementation	Strengths	Weaknesses and challenges
Changes in the buildings and settlements, avoiding overheating through active and passive measures	• *More data and simulation* • *Better comfort and livelihood* • *Quality of living spaces and life in general* • *Less air conditioning (heating in winter) and energy consumption* • *Long term sustainability*	• *Initially expensive* • *Difficult to be implemented in the existing buildings* • *Limited effectiveness*

IMPLEMENTATION STAGES	SET-UP TIME	PROJECT MONTHS SUGGESTION	PROJECT PHASE	COSTS	MAIN ACTORS
Collecting data on which buildings are affected by overheating problems and the cause	3 months	(M15-M18)	Early phase	\	Project partners, municipalities, house owners
Simulation of the building and derivation of measures	2 weeks each	(M18-M22)	Early phase/Middle phase	Medium, costs for the simulation software	Project partners
Support in the implementation of the measures and implementation of the measuring points for monitoring	3 months	(M22-M25)	Middle phase	Medium, costs for the measuring instruments	Project partners, municipalities, house owners
Derivation of the results and development of counselling services and information material	Implementation phase	(M25-M30)	Middle phase	high (print, advertising agency)	Project Partners, advertising agency

Figure 16: Example of a roadmap (implementation suggestion) for a regional demonstrator

In the project, a simplified graphical representation (in PowerPoint format) was also elaborated by a research partner, to ensure the dissemination among local partners (see below).
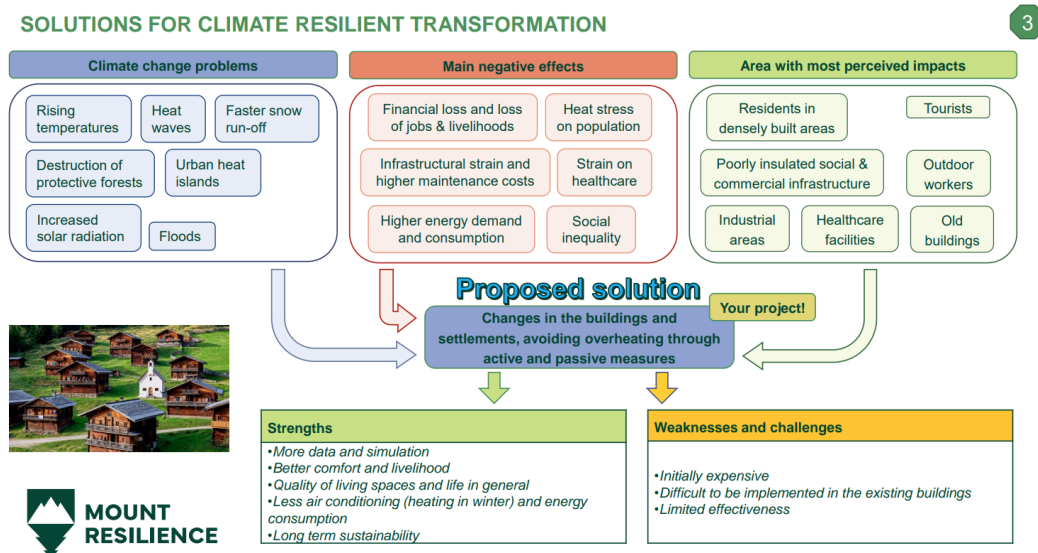

Figure 17: PowerPoint presentation summarising the state of the process following the feedback from Local Councils in the Tyrol MountResilience region (UMIL, 2024)

Lessons learned	The roadmaps allow stakeholders to imagine concretely how the discussions and work done in the co-creation process will produce concrete actions.
	In MountResilience, it was important to have this double passage to verify that information obtained in early stages from stakeholders is the same at the end of the roadmap creation.
	A participative process is fundamental for the success of CC adaptations, because a strong collaboration between local authorities and stakeholders is needed to correctly implement NbS and promote the population acceptance..

2.2.6. Step 6 : Implementation and monitoring

Title	Implementation and monitoring
Chronology	This is the final step (though there are multiple other steps which could follow, notably dissemination of the a, exploitation activities which are not detailed in this guide). In the case of MountResilience, the implementation and monitoring within the project will last until the official end of the project in 2028 (the project started in September 2023) but it is interesting to have a long-term planning for monitoring to measure the impacts.
Small description	An implementation plan ensures that lead organisations and stakeholders are involved in the execution where appropriate. This allows stakeholders to remain invested in the process and ensures that their insights are reflected in the implementation. Monitoring and evaluation mechanisms are also essential to assess the effectiveness of stakeholder engagement and project outcomes.
Important concept : transformative adaptation	In MountResilience, an important concept that guides all the steps described in this guide is transformative adaptation. Behind these vague words is a deliberate attempt to address place-based vulnerability through innovation that is contextualised to the local social and environmental dynamics of the region. In MountResilience, for example, no single innovation can bring about systemic change on its own, but activities that address all three dimensions of STES (social, environmental and technological objectives) and touch on all three spheres of transformation (personal, practical and political) are more likely to diffuse from pilots into the mainstream and lead to long-term change. Drawing from this analysis, it is interesting to keep in mind that there are certain types of responses that should be avoided. Sometimes responses do not go so far as to fundamentally change the system or bring about long-term resilience but rather tend to make the system worse or bring about marginal changes. These responses are often referred to as maladaptation, coping mechanisms and incremental adaptation. Maladaptation' describes an immediate response to climate impacts with short-sighted objectives, resulting in the same problems or even exacerbating the original problem.
Tool available: Baseline and monitoring framework	A Monitoring framework helps track progress. In MountResilience, it draws from the Socio-Technical-Ecological Systems (STES) concept to ensure alignment with the project's social, ecological, and technological objectives. Based on the conceptual model for climate resilient transformation work (in MountResilience, more details in the specific project deliverable D1.1 Conceptual model for climate resilient transformation), regional diagnostics and baselines for climate adaptation can be developed. In MountResilience, this task was performed by research organisations where they focused on assessing the current state of climate change adaptation (CCA) in the area, ensuring that solutions are well integrated into regional

structures and processes, and making use of existing capacities and networks (related to step 1 work).

In Mountresilience, it was agreed that a reporting on the monitoring would be performed every 6-months (with meetings, reports and workshops). This can enable local leaders to track progress and make informed adjustments as necessary, ensuring alignment with stakeholder expectations. Regular updates to stakeholders about the progress, challenges, changes are essential. Additionally, maintaining open lines of communication are crucial for transparency and building trust, keeping stakeholders informed, allowing for a collaborative approach to problem solving.

Tool available : impact assessment	Developing an impact assessment framework aims to measure the impact of the activities through indicators. Pre-selected list of indicators can be elaborated by leader organisations to draft the data collection plan. A feedback and discussion mechanism is essential between leader organisations to establish a data collection plan for every intervention planned. Impact indicators can be varied: spanning from environmental, economic to social. In MountResilience, a research partner (the Technological University of Wien) oversees this work.
Lessons learned	The stakeholder feedback loop established in MountResilience to identify lessons learned and areas for improvement for future engagements during the implementation phase not only enhances understanding of the stakeholder experience but also contributes to continuous improvement of engagement strategies. In terms of impact assessment, many MountResilience project partners acknowledged that the project is an important support. Indeed, some regional authorities do not yet have a strategy, indicators or database on CC issues. For some regions it is also interesting to collect new data and/or to rationalise what is already collected to best fit the objectives set. For example, in Valais, to measure the psychological impact indicators on water-related issues, a lot of data needs to be collected, but there is also a need to carefully rationalise the objectives first.