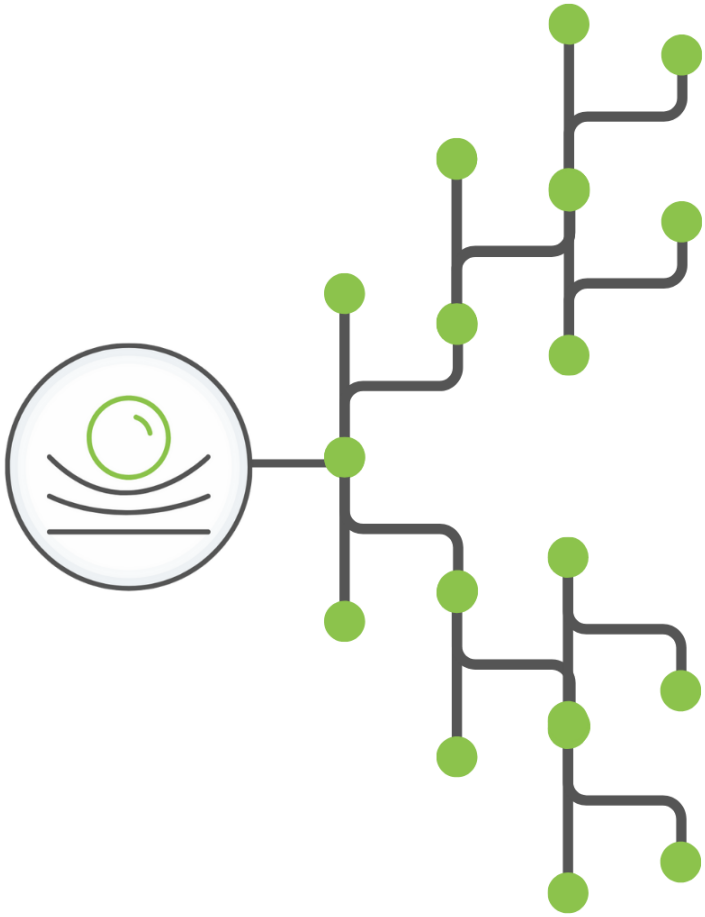
REGILIENCE

Regional Pathways to Climate Resilience



Principles and practices of transformational pathways

DECEMBER 2022

www.regilience.eu

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement no. 101036560.

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 Factsheet	
Full title	Deliverable 4.1 Principles and practices of transformational pathways
Work Package	WP4 Implementation pathways and longterm exploitation
Task(s)	T4.1 Success and failure theory and practice
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Date	December 2022

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

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement no. 101036560.

Version	Date	Main modification	Entity
V0.1	30.11.2022.	Draft version distributed for quality review	REGEA
V0.2	6.12.2022.	Internal Quality review	Fresh Thoughts Consulting
V0.3	13.12.2022.	Review by the project coordinator	IEECP, Fresh Thoughts Consulting

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How to cite this report: REGILIENCE (2023). D4.1. Principles and practices of transformational pathways.

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.

The project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101036560.

Project partners

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List of Acronyms

AR6	Intergovernmental Panel on Climate Change' Six Assessment Report
CRDP	Climate-resilient development pathways
EU	European Union
IPCC	Intergovernmental Panel on Climate Change
NECP	National energy and climate plans
WP	Work package

Executive Summary

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. This deliverable aims to help understand why certain processes succeed and why others fail as well as what works and what doesn't. These findings are crucial for the development of the regional resilience pathways which will steer the focus development of sustainability and long-term exploitation by the project partners and the European regions. The deliverable builds on information and knowledge gathered in WPs 1, 2 and 3 and develops the prioritised strategy to guide activities under WP1, and the development of online tools. The results will be utilised in the development of the prioritisation strategy and the Long-term sustainability and exploitation strategy.

This deliverable provides an overview of the success and failure theory and practice, including the literature review, stakeholder input through workshops and interviews, and the importance of maladaptation and the drivers for success and failure. A mixed research methodology is applied, combining desk-based analysis of principles and practices of transformational pathways, workshops conducted on both European and regional levels, and semi-structured in-depth interviews with national and regional stakeholders. The interviews complement the desk review and highlight stakeholder experiences with views on the practical implementation of projects, good practices and lessons learned, which are necessary to achieve transformational change in response to the ever-growing climate change impacts.

Structure of the report

This document aims at setting a clear understanding of why certain processes succeed and why others fail as well as what works and what does not. These findings are crucial for the development of the regional resilience pathways, which will steer the development of sustainability and long-term exploitation by the project partners and the European regions. Specifically, we identified lessons learned, critical drivers for success and points of failure related to coordination, policy, planning, implementation and monitoring processes. This report contains a brief discussion of each of these areas.

To this end, the report is divided into five main parts:

- Following the introduction, Chapter 2 provides a background and literature review of published results and information about the main dimensions behind the perceived success or failure of implemented activities, namely those relevant to transformational change towards climate change resilience, adaptation and, to a lesser extent, mitigation.
- Chapter 3 illustrates the stakeholder input and an overview of the process and the results of the stakeholder engagement
- Chapter 4 presents the importance of maladaptation
- Finally, Chapter 5 reflects on the overview of everything addressed before and highlights the most common points of success and failure identified in the assessment.

Gender statement

The need for gender mainstreaming arises from persistent inequalities in power distribution and access to services and opportunities between people of different sex and/or gender identities. As demonstrated by literature[1] and advocated at the European and international arena[2], this influences the understanding and perception of climate change dynamics and effects. Women and men, but also people in the LGBTQI+ community, are differently affected by the accelerated change of climate. Only by taking into consideration their diverse visions can scientific research reach meaningful and universal conclusions that properly inform climate action.

For these reasons, the REGILIENCE consortium is committed to including gender and intersectionality as a transversal aspect in the project's activities. In line with EU guidelines and objectives, all partners – including the authors of this deliverable – recognise the importance of advancing gender analysis and sex-disaggregated data collection in the development of scientific research. Therefore, they commit to paying particular attention to including, monitoring and periodically evaluating the participation of different genders in all activities developed within the project, including workshops, webinars and events but also surveys, interviews and research, in general. While applying a non-binary approach to data collection and promoting the participation of all genders in the activities, the partners will periodically reflect and inform about the limitations of their approach. Through an iterative learning process, they commit to plan and implement strategies that maximise the inclusion of more intersectional perspectives in their activities. Within this deliverable, gender aspects were also considered by aiming towards being gender-neutral in all activities, such as workshops, interviews and surveys.

1 Senja, O. (2021). Gender and Climate Change: Challenges and Opportunities. HAPSc Policy Briefs Series, 2(2)
Pearse, R. (2017), Gender and climate change. WIREs Clim Change, 8 Ed. By Irene Dankelman (2010), Gender and Climate Change: an introduction.
Valerie Nelson, Kate Meadows, Terry Cannon, John Morton & Adrienne Martin (2002), Uncertain predictions, invisible impacts, and the need to mainstream gender in climate change adaptations, Gender & Development, 10:2

2 European Committee of the Regions (2021), Gender equality and Climate change: towards mainstreaming the gender perspective in the European Green Deal
European Commission (2020), A Union of Equality: Gender Equality Strategy 2020-2025
UN Women (2022), Explainer: How gender inequality and climate change are interconnected
UNFCCC (2022), Gender & Climate Change: an important connection

1 Introduction

The type and intensity of climate change impacts differ from region to region, with the south of Europe, mountain areas and coasts particularly negatively affected due to reasons ranging from geographical characteristics to socio-economic circumstances. Limited financial and know-how capacity is often identified as a core issue preventing decision-makers from initiating actions and processes that would trigger transformational changes in response to the ever-growing climate change impact. In addition, the (over)abundance of strategies, action plans and guidelines on adaptation and building resilience, offering little to no specific or practical information, sparks confusion and aggravates the policy-making process. Coping with the growing impact of climate change requires thorough analysis and consideration of all affected or soon-to-be affected areas (society, environment, agriculture, economy, and others). Only after understanding the local conditions and the influence climate change has within all relevant sectors and at different levels, societies can start shaping their transformational pathways to integrate mitigation, adaptation and sustainable development successfully.

The IPCC report (2022) suggests that pathways can range from sets of scenarios or narratives of potential futures to solution-oriented decision-making processes to achieve desirable societal goals. Such a definition leads to the conclusion that a one-size-fits-all pathway is not common or feasible and that creating transformational trajectories on a regional level requires a deep understanding of current and future regional needs and characteristics. As the results of climate change adaptation actions will unfold over a long time period, developing transformational pathways that chart long-term processes and goals requires an innovative approach that will challenge existing systems. Furthermore, given the long-term nature of adaptation, effective and real-life examples are necessary to ensure a holistic and sustainable approach to climate resilience.

This document outlines the existing theory and practice in the climate change adaptation domain, including principles and practices of transformational pathways and tools used to develop them and shape cross-sectoral adaptation solutions. It features success and failure examples of climate change adaptation processes, enabling policymakers and forward-looking catalysers in different regions to understand the formation of these processes and the potential of their practical use in various settings. Showcasing good practices and pinpointing the reasons behind the failure of less successful ones enables decision-makers on all levels to steer climate policies toward a more sustainable and resilient environment.

This document aims to highlight good practice examples to inspire similar or more innovative solutions in regions with similar climate issues and to draw conclusions from the ill-fated climate processes. Using this approach, regional and local authorities interested in streamlining the climate change adaptation aspects in the existing policy framework will have an overview of the potential activities that could improve the quality of life and reduce the vulnerability of their regions to climate change.

2 Literature review

While the focus of REGILIENCE is to support the development of regional resilience pathways under the EU Mission on Adaptation, the objective of this review is to lay the scientific groundwork and rationale behind such development. To do so and to provide a proper communicational basis, concepts need to be clarified so their understanding can be shared within the project and with other projects and regional stakeholders.

The goal of this chapter is to present a snap review of some of the key existing literature and information about the main dimensions behind the perceived success or failure of implemented climate resilience activities, as well as some readily available tools and methods, namely those relevant to steer transformational change towards climate change resilience, adaptation and to a lesser extent mitigation.

The following subchapters provide an overview of scientific literature and concepts regarding success and failure theories, the framing of climate-resilient pathways and of some of the available methods and tools for their development.

2.1 Success and failure theory and practice

Success and failure theory is an attribution-based theory originally proposed by Weiner et al. (1971). An attribution theory is "a theory about how people make causal explanations" (Weibell 2011). The original concept by Weiner et al. (1971) proposes a cognitive-based attributional model of motivation based on the assumption that beliefs about the causes of success and failure serve as mediators between stimulus (sources of information) and subsequent actions (responses or achievement behaviour). This phycological-based attribution theory of motivation has been widely used in education studies (Weibell 2011) and branched out to several other areas of study and practice, such as management, business, political science, economics, computer science, communication, environmental sciences, and more recently to climate action and resilience.

Success and failure theory evolved over time but retained a basic model for classifying causal dimensions. The original attribution model of motivation hypothesises that individuals use four elements to interpret or predict an outcome of an action. These four causal elements or determinants of behavioural outcomes are ability, effort, task difficulty and luck (Weiner et al. 1971; Weiner 2010). While ability and effort are internal to a person, task difficulty and luck can be considered external or environmental (Weiner et al. 1971; Weiner 2010; Weibell 2011). Additionally, two causal properties or dimensions (locus and stability) and two linkages (value linked to causal locus and expectancy linked to causal stability) were proposed (Weiner et al. 1971; Weiner 2010; Weibell 2011). A schematic depiction of Weiner's attribution theory of motivation ("success and failure" theory) is presented in Figure 1.

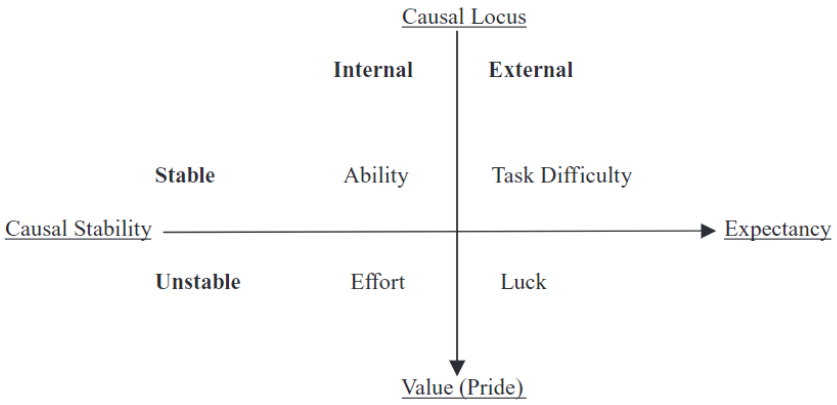

Figure 1: Schematic representation of the four main causes of behaviour, including their dimensional properties (locus and stability), and linkages to affect and expectancy (Source: Weiner (2010)).

This original proposition was subsequently developed by incorporating, among other issues, a third causal dimension (causal control) and the expansion of a list of emotions linked to causal beliefs (Weiner 2010). The final structure of Weiner's attribution-based theory of personal motivation, or "success and failure" theory, is depicted in figure 2.

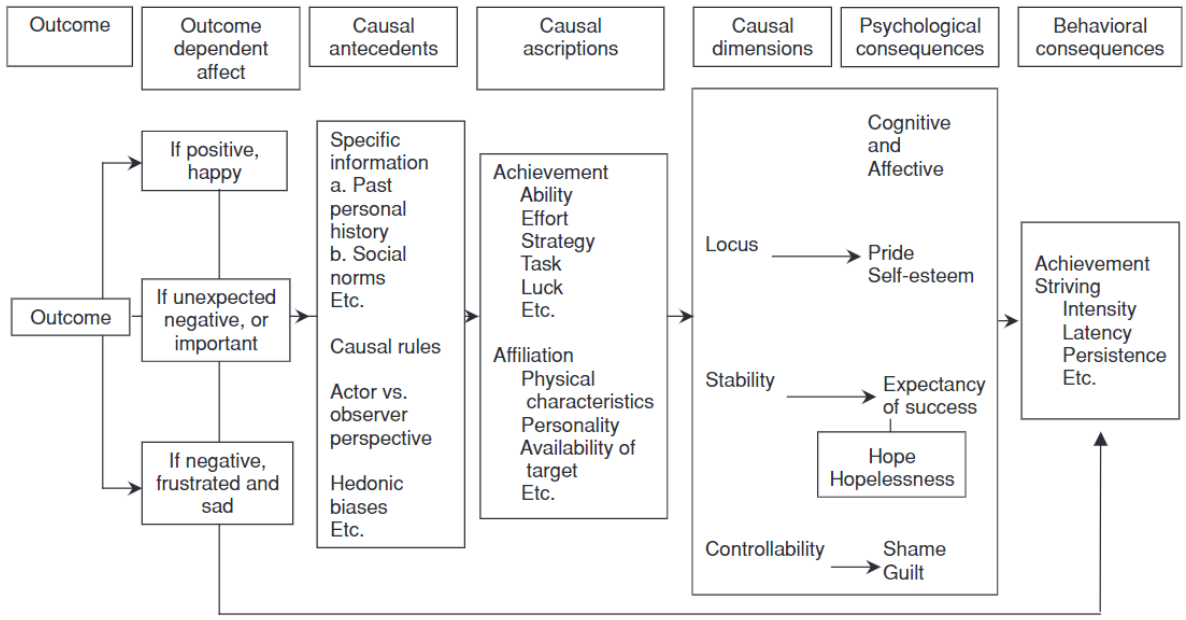

Figure 2: Final schematic representation of Weiner's attribution-based theory of motivation (Source: Weiner (2010)).

Weiner illustrated the temporal sequence of the model (from left to right in figure 2) with two examples (Weiner 2010):

Example 1 - Assume a student fails an important exam. The initial experience following failure is unhappiness. Then there is a search for causality. Presume this person failed in the past even though they studied hard, whereas others succeeded on this exam. This pattern of information gives rise to the belief that the current failure is due to a lack of aptitude. Aptitude is an internal, stable, uncontrollable cause, so there is a lowering of self-esteem, low expectancy of future success, hopelessness and helplessness, and shame and humiliation. Low expectancy

(hopelessness) accompanied by these negative effects promotes the decision to, for example, drop out of school.

Example 2 - Now imagine that another student fails the same exam. This person also initially experiences unhappiness. But they have been successful in the past, and the night before the test, they were partying rather than studying. Their current failure, therefore, is ascribed to insufficient effort. This internal, unstable, and controllable cause lowers personal regard but also gives rise to the maintenance of expectancy, hope, guilt, and regret, all of which are positive motivators. Hence, motivation increases, and they try harder in the future. As noted earlier, prior failure or non-reinforcement can have positive or negative future motivational consequences.

The application of success and failure theories to environmental sciences, climate change and climate resilience in particular is poorly described. However, a snap literature review on the theme provided some interesting results that are described in table 1 below.

Table 1: Summary review of literature on the application of success and failure concepts in environmental sciences.

Summary	Reference
Six primary categories were extracted from the public sector, private sector, procurement process, risk management, project information, and external. The private sector, project information, and procurement process were the most influential on success.	Hai, D. T., Toan, N. Q., & van Tam, N. (2022). **Critical success factors for implementing PPP infrastructure projects in developing countries: the case of Vietnam**. Innovative Infrastructure Solutions, 7(1), 1–13. https://doi.org/10.1007/S41062-021-00688-6/TABLES/7
Success or failure of these practices depends on how they are staged and the context in which they are conducted. Factors that shape the effects of participatory futures practices: institutional landscape constrains; participatory culture; project design; methods applied.	Mangnus, A. C., Vervoort, J. M., Renger, W. J., Nakic, V., Rebel, K. T., Driessen, P. P. J., & Hajer, M. (2022). **Envisioning alternatives in pre-structured urban sustainability transformations: Too late to change the future?** Cities, 120, 103466. https://doi.org/10.1016/J.CITIES.2021.103466
Solar energy policy in Gujarat, India: linking the policy success heuristic with the multiple streams framework (MSF) throughout a qualitative assessment with a process trace of policy making. Failure resulted largely from a top-down push for a policy without a problem.	Goyal, N. (2021). **Explaining Policy Success Using the Multiple Streams Framework: Political Success Despite Programmatic Failure of the Solar Energy Policy in Gujarat, India**. Politics & Policy, 49(5), 1021–1060. https://doi.org/10.1111/POLP.12426
Environmental crowdfunding. 473 successful and failed campaigns on the online crowd funding platform were analysed. The online findability and increased reach through social networks, increased success. Other environmental campaigns competing reduced the chance of success. Wider applications of marketing grow the chance of success.	Kubo, T., Veríssimo, D., Uryu, S., Mieno, T., & MacMillan, D. (2021). **What determines the success and failure of environmental crowdfunding?** Ambio, 50(9), 1659–1669. https://doi.org/10.1007/S13280-021-01522-0/TABLES/3
Literature review of the period 2007–19 throughout transformation theory and preconditions (practical, political, and personal). While significant progress occurred in the practical sphere, moderate in the political sphere and limited in the personal sphere. Increasing resilience requires components from all spheres, and interactions with stakeholders are essential.	Nzeyimana, L., Danielsson, Å., Andersson, L., & Gyberg, V. B. (2021). **Success and failure factors for increasing Sub-Saharan African smallholders' resilience to drought through water management**. International Journal of Water Resources Development. https://doi.org/10.1080/07900627.2021.1991285/SUPPL_FILE/CIJW_A_1991285_SM3791.PDF
Organizations focus on past (success beliefs) and neglects unlearning of what did not work (failure beliefs). The differences between beliefs exhibit: different temporal dynamics because their underlying mechanisms are different; organizations gain more unlearning failure beliefs, and unlearning failure beliefs is the more robust strategy.	Martignoni, D., & Keil, T. (2021). **It did not work? Unlearn and try again—Unlearning success and failure beliefs in changing environments.** Strategic Management Journal, 42(6), 1057–1082. https://doi.org/10.1002/SMJ.3261

Summary	Reference
Success and failure within the concepts of successful adaptation and maladaptation were applied in large-scale seawater desalination. Present a matrix to organize complexity and discuss adaptive and maladaptive in 3 arguments: study maladaptive enables understanding the effects adaptation actions and their spatial and temporal distribution; highlight the trade-offs and constraints can support decision-making; complex approach to adaptation outcomes can assist in problematizing the social-political drivers and consequences of adaptation.	Tubi, A., & Williams, J. (2021). **Beyond binary outcomes in climate adaptation: The illustrative case of desalination.** Wiley Interdisciplinary Reviews: Climate Change, 12(2), e695. https://doi.org/10.1002/WCC.695
Initiatives in companies, citizens, or municipalities for greenspace in urban areas. Interviews were conducted to create initiators of success, tuned with the current social climate. A failure factor is the 'green space has no value' compared to the value of land and buildings. The involvement and integration of greenspace with social and economic development is possibly making it more resistant to building.	Aalbers, C. B. E. M., Kamphorst, D. A., & Langers, F. (2019). **Fourteen local governance initiatives in greenspace in urban areas in the Netherlands. Discourses, success and failure factors, and the perspectives of local authorities.** Urban Forestry & Urban Greening, 42, 82–99. https://doi.org/10.1016/J.UFUG.2019.04.019
Identify the extent and characteristics of failed project reporting, focusing analysis on social dimensions as opposed to biological causes. Qualitative thematic analysis to identify the social causes of project failure. Stakeholder relationships are more commonly reported than other causes of failure.	Catalano, A. S., Lyons-White, J., Mills, M. M., & Knight, A. T. (2019). **Learning from published project failures in conservation.** Biological Conservation, 238, 108223. https://doi.org/10.1016/J.BIOCON.2019.108223
Efficacy of community-based adaptation remains unknown. Additionally, exacerbation of vulnerability resulting from top-down adaptation approaches were addressed. Future community-based adaptation should integrate contextual specificities and gender equality.	Clarke, T., McNamara, K. E., Clissold, R., & Nunn, P. D. (2019). **Community-based adaptation to climate change: lessons from Tanna Island, Vanuatu**. Island Studies Journal, 14(1), 59–80. https://doi.org/10.24043/ISJ.80
Large social-ecological system facing a tipping point that could result in major ecosystem changes, considering multidimensional and trade-offs with costs and benefits in space and time. Forest management conflicts should be framed in terms of the cost of failure of negotiations. negotiations may benefit from: quantification success and failure, and trade-offs, allowing for solutions that are heterogeneous in space and time.	Wood, C. M., & Jones, G. M. (2019). **Framing management of social-ecological systems in terms of the cost of failure: the Sierra Nevada, USA as a case study.** Environmental Research Letters, 14(10), 105004. https://doi.org/10.1088/1748-9326/AB4033
For marine protected areas, common factors of success and/or failure (effectiveness) were identified. Stakeholder engagement was considered to be the most important factor and also a need for the application of standardized metrics to assess stakeholder engagement, the role of leadership, the capacity of	Giakoumi, S., McGowan, J., Mills, M., Beger, M., Bustamante, R. H., Charles, A., Christie, P., Fox, M., Garcia-Borboroglu, P., Gelcich, S., Guidetti, P., Mackelworth, P., Maina, J. M., McCook, L., Micheli, F., Morgan, L. E., Mumby, P. J., Reyes, L. M., White, A., … Possingham, H. P. (2018). **Revisiting "success" and "failure" of marine**

Summary	Reference
enforcement and compliance with objectives. Recommendation: ecological, social, and economic data incorporated into adaptive management.	protected areas: A conservation scientist perspective. Frontiers in Marine Science, 5(JUN), 223. https://doi.org/10.3389/FMARS.2018.00223/BIBTEX
Analytical judgment on risk often do not fully explain behaviour, consider emotions is necessary. No significant difference in risk aversion with respect to gender, age group, or region. Also, being very concerned with climate change, was not associated with taking fewer risks. Emotions had little impact on decisions but were a response to success and failure. Fear and anxiety may motivate risk management practices. Generally, emotions play an important role in climate-related risks decisions.	Lebel, L., & Lebel, P. (2016). Emotions, attitudes, and appraisal in the management of climate-related risks by fish farmers in Northern Thailand. Journal of Risk Research, 21(8), 933–951. https://doi.org/10.1080/13669877.2016.1264450
Retrospectively the root cause of the failure is not technical, but managerial. Using contingency theory in three distinct frameworks. Constraints of policy of 'better, faster, cheaper' lead to failure. It is necessary to promote an analysis of the project's uniqueness on uncertainty and risk and rely less on heuristics and apply differently a project management design.	Sauser, B. J., Reilly, R. R., & Shenhar, A. J. (2009). Why projects fail? How contingency theory can provide new insights – A comparative analysis of NASA's Mars Climate Orbiter loss. International Journal of Project Management, 27(7), 665–679. https://doi.org/10.1016/J.IJPROMAN.2009.01.004
The attribution-based theory of motivation is presented "grand" theory of motivation (from drive and expectancy/value theory) perspective, how past influence the present and the future (as Thorndike accomplished), and the incorporation of causes and their properties (from Heider and Rotter). The goal of this approach is the formulation of a conception in which causes influence action via the mediating mechanisms of specific affects and expectancy.	Weiner, B., Frieze, I., Kukla, A., Reed, L., Rest, S., & Rosenbaum, R. M. (1971). Perceiving the causes of success and failure. In Attribution: Perceiving the causes of behavior. (pp. 95–120). Lawrence Erlbaum Associates, Inc.

2.2 Climate-resilient pathways

To set a clear path towards climate resilience, it is important to understand why certain processes succeed and why others fail, as well as what works and what does not. Climate-resilient pathways and their scope must be clearly defined to avoid epistemic confusion and to promote their actual implementation across socio-ecological systems. Understanding the concept and how it has evolved is even more important as it enters policy and practice, such as is in the case of Horizon 2020 and Horizon Europe funded research.

A comprehensive scientific review of the theory and practice of climate-resilient and transformational pathways is beyond the scope of this deliverable. The current scientific literature on climate change and sustainability uses the concept of 'pathways' in an extremely broad way, spanning from climate system related pathways to societal, transformative and normative pathways for action. Additionally, the concept of pathways is often used interchangeably with the concept of 'scenarios' adding additional uncertainty to the field.

The REGILIENCE approach

REGILIENCE identified the complexity of dealing with the notion of pathways already in the proposal stage and noted that: "*The call text refers to 'regional pathways' fostering 'solutions', 'inter-sectorial change' and 'systemic change'. The wording implies a possible confusion with the pathway language used in climate change (especially SSPs (shared socioeconomic pathways) and RCPs (Representative Concentration Pathways)), but it has been kept in REGILIENCE in coherence with the call text, subtopic 1 projects and the proposed Horizon Europe mission. However, we will individually discuss with the selected regions on their preferences, which could also consider 'strategies', 'plans', 'trajectories' (recently established in this field as APTs (Adaptation Policy Trajectories) or other options, even based on local language. We also propose to discuss such terminology with the Innovation Packages in the frame of T5.3. Language shall be an enabler, and in no case a barrier!*".

Since the IPCC's definition that most closely relates to the REGILIENCE remit is **climate-resilient pathways** (and **climate-resilient development pathways**) this was the base definition applied to the review presented below.

2.2.1 Pathways

> The latest IPCC's Six Assessment Report (AR6) report defines **pathways** as "The temporal evolution of natural and/or human systems towards a future state. Pathway concepts range from sets of quantitative and qualitative scenarios or narratives of potential futures to solution-oriented decision-making processes to achieve desirable societal goals. Pathway approaches typically focus on biophysical, techno-economic, and/or socio-behavioural trajectories and involve various dynamics, goals, and actors across different scales" (Pörtner et al. 2022).

Pathways can thus be described as a given trajectory in time, leading to a specific future situation, which reflects a particular sequence of actions and consequences against a background of autonomous developments. Pathways can thus be described as a given trajectory in time, leading

to a specific future situation, which reflects a particular sequence of actions and consequences against a background of autonomous developments.

Pörtner et al. (2022) further defines nine different types of pathways in an attempt to capture their wide and complex nature as a climate change science dimension. These include:

- Adaptation pathways: A series of adaptation choices involving trade-offs between short-term and long-term goals and values. These are processes of deliberation to identify solutions that are meaningful to people in the context of their daily lives and to avoid potential maladaptation.
- Climate-resilient development pathways (CRDPs): Trajectories that strengthen sustainable development and efforts to eradicate poverty and reduce inequalities while promoting fair and cross-scalar adaptation to and resilience in a changing climate. They raise the ethics, equity, and feasibility aspects of the deep societal transformation needed to drastically reduce emissions to limit global warming (e.g., to well below 2°C) and achieve desirable and liveable futures and wellbeing for all.
- Climate-resilient pathways: Iterative processes for managing change within complex systems in order to reduce disruptions and enhance opportunities associated with climate change.
- Development pathways: Development pathways evolve as the result of the countless decisions being made and actions being taken at all levels of societal structure, as well due to the emergent dynamics within and between institutions, cultural norms, technological systems and other drivers of behavioural change.
- Emission pathways: Modelled trajectories of global anthropogenic emissions over the 21st century are termed emission pathways.
- Overshoot pathways: Pathways that first exceed a specified concentration, forcing, or global warming level, and then return to or below that level again before the end of a specified period of time (e.g., before 2100). Sometimes the magnitude and likelihood of the overshoot is also characterized. The overshoot duration can vary from one pathway to the next, but in most overshoot pathways in the literature and referred to as overshoot pathways in the AR6, the overshoot occurs over a period of at least one decade and up to several decades.
- Representative Concentration Pathways (RCPs): Scenarios that include time series of emissions and concentrations of the full suite of greenhouse gases (GHGs) and aerosols and chemically active gases, as well as land use/land cover (Moss et al.,2008; van Vuuren et al., 2011). The word representative signifies that each RCP provides only one of many possible scenarios that would lead to the specific radiative forcing characteristics. The term pathway emphasises the fact that not only the long-term concentration levels, but also the trajectory taken over time to reach that outcome are of interest (Moss et al., 2010; van Vuuren et al., 2011). RCPs usually refer to the portion of the concentration pathway extending up to 2100, for which Integrated assessment models produced corresponding emission scenarios. Extended concentration pathways describe extensions of the RCPs from 2100 to 2300 that were calculated using simple rules generated by stakeholder consultations, and do not represent fully consistent scenarios. Four RCPs produced from

Integrated assessment models were selected from the published literature and are used in the Fifth IPCC Assessment and also used in this Assessment for comparison, spanning the range from approximately below 2°C warming to high (>4°C) warming best-estimates by the end of the 21st century: RCP2.6, RCP4.5 and RCP6.0 and RCP8.5.

- **Shared socio-economic pathways (SSPs):** Shared socio-economic pathways (SSPs) have been developed to complement the Representative concentration pathways (RCPs). By design, the RCP emission and concentration pathways were stripped of their association with a certain socio-economic development. Different levels of emissions and climate change along the dimension of the RCPs can hence be explored against the backdrop if different socio-economic development pathways (SSPs) on the other dimension in a matrix. This integrative SSP-RCP framework is now widely used in the climate impact and policy analysis literature (see e.g., http://iconics-ssp.org), where climate projections obtained under the RCP scenarios are analysed against the backdrop of various SSPs. As several emission updates were due, a new set of emission scenarios was developed in conjunction with the SSPs. Hence, the abbreviation SSP is now used for two things: On the one hand SSP1, SSP2, …, SSP5 is used to denote the five socio-economic scenario families. On the other hand, the abbreviations SSP1-1.9, SSP1-2.6, …, SSP5-8.5 are used to denote the newly developed emission scenarios that are the result of an SSP implementation within an integrated assessment model. Those SSP scenarios are bare of climate policy assumption, but in combination with so-called shared policy assumptions (SPAs), various approximate radiative forcing levels of 1.9, 2.6, …, or 8.5 W m-2 are reached by the end of the century, respectively.
- **Sustainable development pathways (SDPs):** Trajectories aimed at attaining the Sustainable Development Goals (SDGs) in the short term and the goals of sustainable development in the long term. In the context of climate change, such pathways denote trajectories that address social, environmental, and economic dimensions of sustainable development, adaptation and mitigation, and transformation, in a generic sense or from a particular methodological perspective such as integrated assessment models and scenario simulations.

2.2.2 Climate-resilient (development) pathways

The concept of climate-resilient development pathways is still relatively young, with little literature focusing on what motivates action in pursuit of this type of development rather than its subcomponents of climate action and sustainable development (Pörtner et al. 2022).

The definition of **climate-resilient (development) pathways** has been recently introduced by the IPCC's Fifth Assessment Report (AR5) (Field et al. 2014) and further developed in the IPCC's Special Report on 1.5 °C Warming (SR1.5) (IPCC 2018) and the IPCC's Six Assessment Report (AR6) (Pörtner et al. 2022).

It is noteworthy, that despite the importance and impact of the IPCC reports, both in terms of research agenda setting and policy-making uptake, little evidence exists on a proper evolution of the concept between these two assessments (Werners et al. 2021). So far, Climate-resilient

pathways remain poorly conceptualised (Singh and Chudasama 2021) and still requiring the establishment of reference levels if progress is to be measured (Schleussner et al. 2021).

> The IPCC AR5 WGII (Field et al. 2014) defined **climate-resilient pathways** as "A continuing process for managing changes in the climate and other driving forces affecting development, combining flexibility, innovativeness, and participative problem solving with effectiveness in mitigating and adapting to climate change. If the effects of climate change are relatively severe, this process is likely to require considerations of transformational changes in threatened systems if development is to be sustained without major disruptions".

The following paragraphs provide the most up-to-date definitions of the concept as introduced by the IPCC, while trying to clarify its potential role for the development of regional resilience pathways under the EU Mission on Adaptation.

Climate-resilient pathways can be seen as iterative, continually evolving processes for managing change within complex systems that combine adaptation and mitigation processes with effective institutions that seek to realize the goal of sustainable development (Field et al. 2014).

When coupled with notions of development – i.e., efforts, both formal and informal, to improve standards of human well-being, particularly in places historically disadvantaged by colonialism and other features of early global integration - **climate-resilient development pathways** can be defined as aspirational trajectories that successfully integrate mitigation, adaptation, and sustainable development in an attempt to steer societies towards low-carbon, prosperous and ecologically safe futures (Pörtner et al., 2022).

The introduction of the wording "development" thus allows for a nuanced perspective of how these rather theoretical pathways can be used to promote real-life change in regions and systems of interest. Because climate change calls for new approaches to sustainable development which need to consider the complex interactions between climate and social-ecological systems (Field et al. 2014), developing resilience pathways that respond to such challenges will necessarily need to account for sustainable development considerations.

However, the IPCC's AR6 highlights that current development pathways combined with the observed impacts of climate change, are leading away from, rather than towards sustainable development. Among other social and economic consequences, this means that if prevailing development pathways keep hindering the advance of climate resilient development, some low-emissions pathways and safer climate outcomes are unlikely to be realized (Pörtner et al., 2022).

The current framing of human development and well-being have historically been linked with economic growth, resulting in decades of policy focus on growing economies across all scales, from the individual to the regional and global. This implies that the same processes historically connected to current climate challenges, e.g., economic growth based on natural resource use and intensive energy regimes, are also seen as the pathways for improving human well-being, therefore placing climate resilience and current development modes in actual opposition to each other (Pörtner et al. 2022).

Therefore, climate resilient development (and its pathways) will most likely need to depart from previous modes of economic growth and accounting of human wellbeing, while sustaining the necessary processes of implementing greenhouse gas mitigation and adaptation measures that support sustainable development for all. This type of development needs to build capacity for climate action, including contributing to reductions in greenhouse gas emissions while enabling the implementation of adaptation options that enhance social, economic and ecological resilience to climate change (Pörtner et al., 2022). This means climate-resilient pathways must focus on taking the necessary steps to reduce vulnerabilities to climate change impacts in the context of new models of development that include the proper consideration of societal needs and available natural resources, while building the capacity to increase the options available to cope with unexpected threats (Field et al. 2014).

Having such needs in mind, climate-resilient pathways are thus the contexts that shape choices and actions related to mitigation and adaptation having sustainable development as the end goal. The pursuit of climate-resilient pathways will generally involve:

- Identifying vulnerabilities to climate change impacts.
- Assessing opportunities for reducing risks.
- Taking actions that are consistent with the goals of sustainable development.

To do so, climate-resilient pathways normally include two main categories of responses (Field et al. 2014):

- Actions to reduce human-induced climate change and its impacts, including both mitigation and adaptation toward achieving sustainable development.
- Actions to ensure that effective institutions, strategies, and choices for risk management will be identified, implemented, and sustained as an integrated part of achieving sustainable development.

Additionally, climate-resilient (development) pathways build upon five core elements that underline the pursuit of integrating resilience into development (Pörtner et al. 2022):

- Climate change poses a potential risk to the achievement of development goals.
- Dependency on achieving transitions in key systems including energy, land and ecosystem, urban and infrastructure, and industrial systems
- Equity and social justice as central to the design of interventions.
- Development interventions are contingent on the presence oof multiple enabling conditions, operating at different scales
- Processes must involve diverse actors, at different scales operating within an environmental, developmental, socio-economic, cultural, and political context.

This means that a climate-resilient pathway will not only manage biophysical changes, but also address institutional asymmetries that can further reinforce current inequalities in the way common pool resources are managed (Field et al. 2014). Pursuing sustainable development will mean to also account for synergies and trade-offs in its relationships with every element of climate risk: the emissions and mitigation determining hazard, the size, location, and composition of development determining exposure; and the adaptive capacity determining vulnerability (Pörtner et al. 2022). All these dimensions carry along several key challenges for the development of regional climate resilience pathways.

Firstly, opportunities for climate-resilient development vary by location and show significant regional heterogeneity in exposure and vulnerability to climate change, climate-resilient pathways may have very different starting points, as well as mitigation, adaptation, and sustainable development opportunities, synergies, and trade-offs. One of the most challenging aspects of climate-resilient pathways is that they exist in distinctive local contexts, where they are shaped by external linkages that connect them across scales and time.

In second place, both adaptation and mitigation are integral parts of climate-resilient pathways, and because each benefit from the progress with the other, integrating the two kinds of climate change responses within the broader context of sustainable development has been suggested as an aspirational goal for climate-resilient pathways (Field et al. 2014). This is, however, an additional challenge to the development of such pathways. One of the reasons is that, in practice, mitigation and adaptation involve different time frames, communities of interest, and decision-making responsibilities so they are likely to be more effective when designed and implemented in the context of other interventions included in a broader context of sustainability and resilience (Field et al. 2014).

Thirdly, climate-resilient pathways call for decisions and actions that consider both short- and long-term time horizons and discussions of climate-resilient pathways cannot be separated from levels of climate change. Mitigation responses taken in the short term will have a strong influence on climate-resilient pathways in the future, shaping needs for transformative adaptation over a long-time horizon (Field et al. 2014). The uncertainty associated with achieving specific pathways and climate outcomes is a risk factor to consider in planning, with plausibility and transformational challenges, as well as trade-offs and synergies, affected by technology, policy design, and societal choices (Pörtner et al. 2022). For example, variations in future economic growth, population size and composition, technology availability and cost, energy efficiency, resource availability, demand for goods and services, and non-climate-related policies (e.g., air quality, trade) individually and collectively may result in different climates and contexts for mitigation and adaptation (Pörtner et al. 2022).

Finally, for both adaptation and mitigation options, insights from aggregate-level feasibility and sustainable development mapping work are high-level and difficult to apply to a specific mitigation and adaptation context or local reality. This should be accounted for when designed aggregated regional climate-resilience pathways. For example, Pörtner et al. (2022) point out that successful adaptation requires not only the avoidance of incremental adaptation actions that extend current unsustainable practices, but also the ability to manage and overcome the barriers which arise when the limits of incremental adaptation are reached. How adaptation can challenge development and create a situation where climate-resilient development effectively becomes transformative adaptation remains unclear (Pörtner et al. 2022). On the mitigation side, the technical and economic challenge of limiting warming increase with greater ambition, fewer mitigation options, less than global cooperative policy designs, and delayed mitigation action. As mitigation constrains the emissions future societies can produce, it alters development opportunities, affects markets, resource allocation, economic structures, income distribution, consumers, and the environment (Pörtner et al. 2022).

In summary, the interdependence between patterns of development, climate risk, and the demand for mitigation and adaptation action is fundamental to the concept of climate-resilient development (Pörtner et al. 2022) and therefore underlines any future operationalisation of climate-resilient pathways.

2.2.3 Transformational change and transformational adaptation

The IPCC AR5 WGII (Field et al. 2014) defined **transformational change** as "a fundamental change in a system, its nature, and/or its location that can occur in human institutions, technological and biological systems, and elsewhere. It most often happens in responding to significantly disruptive events or concerns about them. For climate-resilient pathways for development, transformations in social processes may be required to get voluntary social agreement to undertake transformational adaptations that avoid serious disruptions of sustainable development".

More recently, the IPCC AR6 WGII (Pörtner et al. 2022) defined **transformative change** as "a system-wide change that requires more than technological change through consideration of social and economic factors that, with technology, can bring about rapid change at scale".

The implementation of regional climate resilient pathways requires change. The process of changing from one state or condition to another in a given period of time can occur in individuals, firms, cities, regions and nations, and can be based on incremental or transformative change. Given the magnitude of the challenges ahead, it is very likely that in some cases climate resilience can only be sustained through transformational changes in selected systems. However, climate induced transformational change and adaptation will involve losses and gains that will often be different for different groups (Mach and Siders 2021).

Additionally, the IPCC AR6 WGII (Pörtner et al. 2022) defined **transformation** as a change in the fundamental attributes of natural and human systems, including (a) Deliberate Transformations - A profound shift towards sustainability, envisioned and intended by at least some societal actors, facilitated by changes in individual and collective values and behaviours, and a fairer balance of political, cultural, and institutional power in society; and (b) Societal (social) Transformations - A change in the fundamental attributes of human systems advanced by societal actors.

Since climate change is a threat to sustainable development, transformational changes are very likely to be required for climate-resilient pathways - both transformational adaptations and transformations of social processes that make such transformational adaptations feasible (Field et al. 2014).

Therefore, transformational adaptation includes actions that change the fundamental attributes of a system in response to actual or expected impacts of climate change. This means transformational change can be considered a means of reducing risk and vulnerability, not only by adapting to the impacts of climate change, but also by challenging the systems and structures, economic and social relations, and beliefs and behaviours that contribute to climate change and social vulnerability (Field et al. 2014).

2.2.4 System transitions

System transitions are defined as "the process of changing (the system in focus) from one state or condition to another in a given period of time". Systems transitions can therefore enable climate-resilient development, when accompanied by appropriate enabling conditions and inclusive arenas of engagement. Five systems transitions were considered in the IPCC's AR6: energy, industry, urban and infrastructure, land and ecosystems, and societal (Pörtner et al. 2022).

The enabling conditions for transitions include effective governance and information flow, policy frameworks that incentivize sustainability solutions; adequate financing for adaptation, mitigation, and sustainable development; institutional capacity; science, technology and innovation; monitoring and evaluation of climate resilient development policies, programs, and practices; and international cooperation (Pörtner et al. 2022).

It is worth noticing that there are complex interconnections between transformation and transition, and they are sometimes used as synonyms in the literature. These terms are often used as synonyms although different schools of thought understand them as sub-components of each other, e.g., transition driving transformation, or transformation driving transition (Pörtner et al. 2022).

Although not necessarily transformative in themselves, system transitions are often identified in the literature as being necessary processes for large-scale transformations thereby making them a core enabler of climate-resilient development pathways. Transformations are often considered to involve deeper and more fundamental changes than transitions, including changes to underlying values, worldviews, ideologies, structures, and power relationships (Pörtner et al. 2022).

Table 2 reproduces some of the specific options that facilitate system transitions and that need to be potentially considered in the development of regional climate-resilient pathways.

Table 2: Specific options that facilitate system transitions (Source: Pörtner et al. (2022).

Transition	Examples	Reference
Energy systems	Fuel switching from coal to natural gas Expansion of renewable energy technologies Financial incentives to promote renewable energy Reduced energy intensity of industry Improvements in power system resilience and reliability Increased water use efficiency in electricity generation Energy demand management strategies	(Gielen et al., 2019); (Mulugetta et al., 2019); (IEA et al., 2019); AR6 WGIII Chapter 2
Urban and infrastructure systems	Increased investment in physical and social infrastructure Enhance urban and regional planning Enhanced governance and institutional capacity supports post-disaster recovery and reconstruction (Kull, 2016)	(IPCC, 2018b): D3.1)
Land, oceans and ecosystems	Expanding access to agricultural and climate services Strengthening land tenure security and access to land Empowering women farmers Improved access to markets Facilitating payments for ecosystem services Promotion of healthy and sustainable diets Enhancing multi-level governance by supporting local management of natural resources Strengthening cooperation between institutions and actors Building on local, indigenous and scientific knowledge funding, and institutional support Monitoring and forecasting Education and climate literacy and social learning and participation	(IPCC, 2019 f): C2.1; (IPCC, 2019 f): C4.5; (IPCC, 2019 f): C4
Industrial systems	Promote material efficiency and high-quality circularity Materials demand management (IEA 2019, 2020) Application of new processes and technologies for GHG emission reduction Carbon pricing or regulations with provisions on competitiveness to drive innovation and systemic carbon efficiency Low-cost, long-term financing mechanisms to enable investment and reduce risk Better planning of transport infrastructure Labour market training and transition support Electricity market reform Regulations—standards and labelling, material efficiency Mandating technologies and targets Green taxes and carbon pricing, preferential loans and subsidies Voluntary action agreements, expanded producer responsibilities Information programmes: monitoring, evaluation, partnerships, and research and development Government provisioning of services—government procurements, technology push and market-pull	(Åhman et al., 2017; Bataille et al., 2018; Material, 2019); (Tanaka, 2011; Schwarz et al., 2020); (Ciwmb, 2003); (Romero Mosquera, 2019); (Tanaka, 2011); (Ryan et al., 2011; Boyce, 2018); (Taylor, 2008); (UNEP, 2018b); (Kaza et al., 2018); (Söderholm and Tilton, 2012); (Bataille et al., 2018); (Ghisetti et al., 2017); (Taylor, 2008; Fischedick et al., 2014; Hansen and Lema, 2019); (Crippa et al., 2019; IEA, 2019); (Cavaliere, 2019; IEA, 2020); Vogl et al. (2018); (Pauliuk et al., 2013; Quader et al., 2016)
Societal systems	Inclusive governance Empowerment of excluded stakeholders, especially women and youth Transforming economies Finance and technology aligned with local needs Overcoming uneven consumption and production patterns Allowing people to live a life in dignity and enhancing their capabilities Involving local governments, enterprises and civil society organisations across different scales Reconceptualising development around well-being rather than economic growth (Gupta and Pouw, 2017), Rethinking, prevailing values, ethics and behaviour Improving decision making processes that incorporate diverse values and world views Creating space for negotiating diverse interests and preferences	(Fazey et al., 2018b; O'Brien, 2018; Patterson et al., 2018); (MRFCJ, 2015; Dumont et al., 2019); (Popescu et al., 2017; David Tàbara et al., 2018); (de Coninck and Sagar, 2015; IEA, 2015; Parikh et al., 2018); (Dearing et al., 2014; Häyhä et al., 2016; Raworth, 2017); (Klinsky and Winkler, 2018); (Hajer et al., 2015; Labriet et al., 2015; Hale, 2016; Pelling et al., 2016; Kalafatis, 2017; Lyon, 2018); (Holden et al., 2017); (Cundill et al., 2014; Butler et al., 2016; Ensor, 2016; Fazey et al., 2016; Gorddard et al., 2016; Aipira et al., 2017; Chung Tiam Fook, 2017; Maor et al., 2017); (O'Brien and Selboe, 2015; Gillard et al., 2016; DeCaro et al., 2017; Harris et al., 2018; Lahn, 2018; Roy et al., 2018); Sections 5.6.1 and 5.5.3.1

2.2.5 Operationalising climate-resilient (development) pathways

As the concept of climate-resilient (development) pathways suffers from obvious issues of ambiguity, its applicability may be narrow and the evaluation of its operational aspects difficult. One clear example of such difficulty is the assessment of the success and failure aspects of a given climate action intervention.

Werners et al., (2021) reviewed the literature available on the concept between the IPCC's AR5 and AR6 and discussed what conceptual advances could still be required to make it operational. The authors concluded that although narrowing the definition of climate-resilient pathways may restrict application, without a proper agreement on what they entail, the concept may become void of applicability. They suggested that consensus should be reached regarding the concept definition, and in line with the IPCC definitions, that it should refer to a process of integrating climate action (both adaptation and mitigation) and development decisions towards sustainable development (see figure 3). In other words, the concept of climate-resilient pathways should always include the consideration of adaptation, mitigation and development dimensions, even if there is more emphasis on one of the aspects, depending on the context. Additionally, it should always consider trade-offs and synergies across all three dimensions.

Figure 3: The four domains for the practical application of climate-resilient development pathways (Source: Werners et al., (2021)

Werners et al., (2021) further pointed out the need to account for justice and equity in the development and assessment of climate-resilient pathways. Additionally, presenting such pathways as apolitical may ultimately fail to capture social, political and power dynamics at play, at the scales and decision context of the interventions. The acknowledgement and participation of local actors, including the most marginalised and vulnerable ones is therefore essential. For example, recognizing and discussing whether regional sustainable development goals can be re-framed as targets of climate-resilient development pathways could support their monitoring and evaluation.

Finally, Werners et al., (2021) proposed the recognition of these pathways as a planning approach that deals explicitly with ambiguity and uncertainty inherent to climate, resilience and development science, policy and practice. In practice, this means that care must be taken when setting long-term goals for climate-resilient pathways with no defined end, as these need to acknowledge uncertainties, complexity, non-linearities and feedbacks. Additionally, these may conflict with development projects that require proper revenue and budget components to be sustained and have a defined end date. Disaggregating long-term future pathway goals into short-term actions seems fundamental to sustain applicability as well as monitoring and evaluation capabilities.

These views are very much aligned with the analysis by Singh & Chudasama (2021) that attempted to further conceptualise climate adaptation pathways by using simulations based on fuzzy cognitive maps aided by stakeholder insights. The authors call the attention that there are potentially no established pathways that will fulfil all SDGs and the goals of the Paris Agreement. It is therefore necessary to ask whether there is even the possibility of having a global climate-resilient pathway or whether each nation (and in this case region) will have to create its own. This is an important aspect for REGILIENCE, as regions are expected to charter their own climate-resilient pathways against the background of international, European and national contexts.

2.3 Tools

2.3.1 Framing ambition and intent

Setting up transformational pathways or implementing climate adaptation policies requires visualising the end goal and a thorough understanding of the setting and the environment where such policies will be implemented. However, at the beginning of a journey towards an environment adapted to climate change, it is paramount to define the parameters, terms and purpose of activities related to creating such an environment. Framing the intent behind the transformational changes required to step up the climate adaptation progress sets up a common ground for everyone involved in the process, thus leading to a clear concept of the ambition behind such policies and actions. A clear outline of the ambition of transformational pathways leaves little space for misconceptions and misunderstandings that may later lead to weak performance. Such an approach requires reaching an agreement on concepts and definitions that will be used throughout the pathway creation process and its terms. Providing unambiguous answers to questions such as – What is a transformational pathway? What is the scope of it? What is the difference between climate change mitigation and adaptation activities? Which activities are considered climate change adaptation activities? – will support stakeholders in conceptualising the ambition and defining a clear end goal.

2.3.2 System mapping

EIT Climate-KIC, in its handbook *Challenge-led system mapping: A knowledge management approach*, (Climate-KIC, 2020) defines system mapping as an interactive, participatory approach whereby multiple actors use visual tools as well as open, facilitated and dynamic discussions to collectively create a common understanding of the socio-technical system in which they are embedded. Through a visual narrative, system mapping gives an overview of different factors that form particular systems and their connections. An example of a system that can be mapped is a region or a city comprising multiple distinct elements and sub-systems: physical, social, economic, political and natural. System mapping enables stakeholders from different backgrounds sharing the same vision to participate in discussions, create an interactive environment, and examine various components integral to a specific system.

Furthermore, system mapping helps to better understand the system, the interdependence between components, and the systemic issues. It facilitates the learning process by assisting stakeholders in visually perceiving a system and its features and co-creating a solution to systemic challenges. Designing the system mapping process requires the involvement of multiple stakeholders to ensure an inclusive approach. It can be initiated by the challenge owners, who can be city officials or local initiatives seeking to find a solution to an issue that hinders different social communities. Understanding the context and the setting of the system will lead to a clear definition of the challenge that will be tackled throughout the process, and consequently designing activities aimed at switching from incremental responses to climate change to more transformative ones.

One example of utilising this tool to understand how a city manages climate change issues is a system map illustrating the findings of a newspaper article on how Paris meets climate change (Kuchenbecker, 2019).

2.3.3 Portfolio-building

Pursuing climate resilience and creating transformational pathways requires a reassessment of the existing portfolios of policies and projects and the development of policy and action portfolios with a stronger focus on climate change adaptation. Building a diverse portfolio that combines both adaptation and mitigation actions puts the portfolio owners ahead of the game regarding sustainable long-term development. When creating a portfolio that will support further development and tackle climate change risks, it is vital to consider the local context, strategic priorities, available mitigation options, sustainable development synergies and trade-offs and economic costs that will influence the success of implementing the transformational pathway. Where possible, portfolio actions and policies should build on the synergy of adaptation, mitigation and sustainable development interventions instead of developing single-strand interventions, thus resulting in incomplete and fragmented efforts.

2.3.4 Sense-making and orchestration

Sense-making is a dynamic process innate to people and can be characterised as the interpretation of the present observation inherent to changes based on the existing frame of reference consisting of own knowledge, beliefs and experiences. In their article on the results of transdisciplinary research exploring coastal adaptation to climate change, Vanderlinden et al. argue that sense-making has the potential to influence agencies within local communities and appears to be a significant part of responding to climate change (Vanderlinden & al., 2020).

“If the first question of sense-making is “what’s going on here?”, the second, equally important question is “what do I do next?” (Weick et al., 2005). Sense-making interacts differently with the individual and collective agency when it comes to making decisions on climate change adaptation. This was evidenced in the case studies examined by Vanderlinden et al. Decision-making in the examined case studies did not always reflect scientific methods and results and instead, it mirrored the community's identity and the adopted and settled narrative about climate change.

Tackling different narratives surrounding climate change requires a transformation of well-established frameworks instilled in the areas affected by climate change. In this sense, orchestration goes hand in hand with sense-making as it introduces an indirect mode of governance through incentives and uses an all-carrot-no-stick approach to initiate positive changes. Such governance mode is common in many areas of global governance. Still, it has become more pronounced in climate governance, where non-governmental, intergovernmental or transdisciplinary climate bodies have grown in number. This type of governance increases the resilience of climate governance and decision-making, as it was the case in the US when the climate-sceptic Trump administration withdrew the US from the Paris Agreement and faced criticism from established intergovernmental organisations and other countries (Jordan et al., 2018). Although intergovernmental organisations often lack authority to enforce changes to the decisions made by national governments, they all have legitimacy and authority with relevant audiences based on their institutional positions and expertise, enabling them to steer the activities of target audiences towards shared social objectives. In this sense, targets of climate orchestration can be subnational actions (city or region level) that are deemed essential to achieve the EU’s climate goals and contribute to the transition towards a climate-neutral economy on a national and EU level. To nudge the cities in that direction, many initiatives such as C40 Cities or ICLEI – Local Governments for Sustainability act as both orchestrators and intermediaries by supporting the local governments in their efforts to tackle climate issues.

3 Stakeholder input

The purpose of the stakeholder input is to share experiences, strategies and most notably points of successes and failures in the planning and implementation of actions and projects within climate change resilience, adaptation or mitigation. Within the development of principles and practices of transformational pathways, a mixed research methodology was used. First, a literature review was used, described and outlaid in the chapters prior. Second, REGILIENCE has organised several stakeholders engagement events to foster knowledge exchange from different stakeholders through an online survey, developed within WP1 and broadly distributed among European regions and communities, a series of four workshops, and a series of individual interviews with key actors identified from the results of stakeholder's inputs from prior activities. The detailed engagement of a plethora of local and regional stakeholders through these four steps included:

- A literature review and assessment of the results from past and ongoing EU funded activities and research
- Building on the outcomes, information and knowledge gained from a survey, made within WP1 on 50 respondents, targeting a broad set of local and regional governments and other relevant stakeholders such as local and regional agencies and NGOs on the topics of successes and failures in the field of climate and energy. Within the research, data required for this deliverable was also included, to identify factors of success and failure that favor or hinder the uptake of resilience pathways in the targeted regions
- A series of in depth, distributed interviews with 8 selected cases which provide the most interesting results from the initial survey performed within WP 1, along with the 30 interviews The organisation of 4 workshops, two on a European level and two on a regional level to discuss the topics related to the *success and failure theory and practice* utilizing some or all of the above-mentioned tools (framing ambition and intent, systems mapping, portfolio-building, demonstration, sense-making and orchestration).

Successful stakeholder engagement is at the backbone of creating a successful platform to ensure that the research and outputs from REGILIENCE are holistic and comprehensive. The aim of the stakeholder engagement is to capture the experiences and opinions of what are thought to be climate resilience industry leaders to ensure ownership of the solutions for climate resilience in regions through co-creation processes. Gathering stakeholder input has the potential to inform quality improvements by incorporating multiple perspectives. It can improve success and failure characterisation via local or regional knowledge, improve choice of measures or actions through tacit knowledge and include recommendations for the change in regulation.

The objective of gaining stakeholder input was to ensure we carefully target our communications and messaging, facilitating the integration of new knowledge in the development activities and validation of results. Workshops at both European and regional levels fostered ideation and collaboration and feedback into the project's research to guide the preparation of portfolios of solutions. This high-level mapping then cascaded into more detailed stakeholder mapping across all activities and workshops, including selected expert input to formulate region-specific lessons learned to address the replicability and sustainability of cross-sectoral solutions.

3.1 Structure and process

This section is a synthesis of 4 workshops and 8 interviews conducted within this work package, which builds on the thorough survey and 30 individual interviews done within the work package 1, which have provided relevant information to highlight needs in Europe to accelerate transformative pathways towards regional resilience.

This chapter provides a summary of the main outcomes highlighted by the variety of different stakeholders working with different sets of sectors, focused on good practices and lessons learned within their cases in relation to adaptation planning processes, including policy, implementation and monitoring. While most of the projects and actions implemented by stakeholders address more than one theme, there were thematic areas identified for each case for the purpose of the analysis, which are policy, planning, implementation and monitoring. The interviews were also focused on the background of the activity, links to the legislation, planned impacts and outcomes of the activity, the key factors of the success and failure as well as the lessons learned.

3.2 Interview and survey outcomes

The interview partners and stakeholders were selected based on the results of the WP1 survey, maladaptation interviews done within the WP3 and the literature review. The interview structure was prepared using the initial findings of the literature review with the aim of achieving a deep and detailed understanding of drivers for success and failure.

The semi-structured interviews with European and regional stakeholders were used to complement the overview developed during the literature review and to identify key stakeholders' opinions and commentaries about drivers for success and failure, lessons learned and good practices emerging from the case studies and the review of knowledge and experiences acquired through activities on adaptation planning processes.

The process began by developing a long list of potentially relevant stakeholders to interview, including stakeholders from international and regional organisations with national knowledge of adaptation cases. Stakeholders were selected based on geographical scope (having experience in working on adaption), interesting cases which came up throughout the workshops and surveys done in other work packages to ensure a spread of different types of stakeholders, including varying governance levels, industry/business associations, NGOs and academia. A shortlist of stakeholders for interviewing was then developed, based on further discussions amongst the team members and their existing contacts and networks, and attempting to ensure representation different stakeholder types.

A semi-structured interview guideline was developed to guide the interviews, including a short introduction to the REGILIENCE project, some general introductory questions on the background of their projects, and questions related to key factors driving the success and key factors for the lack of success (Annex I: Interview guidelines). The interviews were carried out remotely by email or online (zoom interviews). Interviews typically lasted under an hour. Of the total of 8 cases, 4 provided information on ongoing adaptation cases and 4 provided information on completed actions. A summary with notes of each interview was prepared by the respective interviewer and

can be found in the Annex II: Interview reports, of this document. The summary of cases interviewed, and their main outcomes can be found in the table below.

Table 3 Summary of interesting cases of climate change resilience adaptation and mitigation.

The project	Adapted by	Summary and impact
River restoration strategy (Spain)	Ministry for the Ecological Transition and the Demographic Challenge, Spain	Information on the River restoration strategy and the insights into the importance of synthesis of knowledge and information and the adaptive management approach.
Ecomap of the city of Zagreb (Croatia)	Teaching Institute for Public Health "Dr. Andrija Štampar"	Detailed information on the project EcoMap of the city of Zagreb, insights on the importance of maladaptation and knowledge sharing
Natural water retention measures in the Altovicentino area (Italy)	Municipality of Santorso, municipality of Marano Vicentino, the reclamation consortium Alta Pianura Veneta, University of Padua, Veneto Agriculture and ALDA association	Information shared on the BEWARE project and the Natural Water Retention Measures in the Altovicentino area (Italy), insights on the participatory approach and process in including stakeholders
Innovative methodologies for adaptation to climate change in the Mediterranean area (Spain)	Catalan Office for Climate Change, CREAF, Pyrenean Ecology Institute, IRTA	Insight into the LIFE MEDACC project, the importance of stakeholder engagement and the permanent network of local actors, as well as transversal stakeholders throughout the region
Environment-friendly urban street design for decentralized ecological rainwater management (Austria)	Municipality of Ober-Grafendorf, Provincial Government of Lower Austria, Climate Alliance Lower Austria	Background on the project Eco-street, the importance of intense preparation, careful planning, professional process management and sufficient resources within the project
Insurance company supporting adaptation action in small and medium size enterprises (Italy)	A public-private partnership involving insurers, local authorities and SMEs	Overview of the Derris project, the importance of the involvement of municipalities and the success factor of trainings and intermediate players.
Building fire resilience using recycled water (Spain)	The municipality of Riba-Roja de Túria	Insight into the GUARDIAN project, the importance of stakeholder engagement and awareness raising campaigns for citizens
Scheme to preserve the water resources of the Meuse catchment area.	Partner organisations from Germany, Belgium, France and the Netherlands	Insight into the project, importance of stakeholder management and effective communication among the project partners.

The semi-structured interview guideline allowed the discussion to go in various directions, depending on the knowledge and expertise of the stakeholder interviewed. As a consequence, the amount and quality of information varied across themes, topics and EU countries. Some stakeholders elaborated more on the policy topics, others on monitoring, and every interviewee had a perspective on the implementation topic. The outcomes directly related to each of the mentioned topics are discussed in the chapter 5 of this deliverable.

3.2.1 Drivers of success

The stakeholder interviews revealed their opinions on the most important drivers for success throughout the project implementation in planning and execution phases. Some of the interviewees regard the collaboration with multiple stakeholders as a crucial aspect of project's success. A consultant stated the following: "*the creation of a permanent network of local actors in the three watersheds, as well as transversal stakeholders throughout the region, all of whose knowledge and experience has contributed to project execution. It is necessary to create forums which allow for the due representation for regional actors, administrations, and research and technological centres, with the objective of achieving consensus on and designing adaptation measures to be undertaken. Such forums should be founded in multilateralism due to the complex nature of these issues, and since classical bilateralism results in the execution of only those measures which are proportional to the influence of a given actor over the public administration. This creates the need for a new governing body which facilitates the development and execution of active and efficient adaptation policies.*"

Other interviewees highlighted the importance of the project not being a one-time investment but having continuous development due to the project's activity and nature is crucial to its success as well as its multi-sector orientation of the project and its activities. Preparation of adaptation knowledge, as well as information transfer, by experts, and the organisation of different workshops or lectures on the specific topics for the citizens were also seen as the factors of success by some interviewees. One interview highlighted their experience of having a pilot phase of the project, which was successful to acquire useful skills and contributed to the development and testing of the functions and content of the tool developed later within the project.

The interviews shared that in order to be well-performing, the participation process required intense preparation, careful planning, professional process management and sufficient resources (financing, time), while at the same time leaving sufficient room for flexibility. Furthermore, the importance of having all partners on the same page was highlighted, maintaining good communication and avoiding or combating any kind of misunderstandings that may trigger a negative impact which is vital to successfully plan and implement the project.

3.2.2Key factors of failure

The support for local adaptation processes and project needs to be responsive, and it needs to match the specificities of each region and to take into account the preferences of individual stakeholders involved; there is no "one-size-fits-all" approach that works for all.

Most of the interviewees and workshop outcomes shared the key factors of failure were lack of awareness and participation. Some point out that the reasons is that there were not many direct economic benefits seen by the citizens and it was difficult to change the minds and behaviour of the citizens, for which regulation would needed to be successfully adopted.

Within the survey, most of the respondents recognised institutional fragmentation and difficult cooperation as one of the key institutional factors halting the implementation of adaptation, intensified by issues of overlapping competencies in most of the cases that impede to design more integrated policies.

One interviewee shared the following: *"The main difficulty was that at the time of implementing the process a regional adaptation strategy at provincial level was still missing. The adaptation options set out in the National Action Plan on Adaptation to Climate Change proved to be ill-suited for the local level, i.e. they were perceived as too abstract, strategic and distant."*

Besides the low level of awareness about climate-related risks and the options of risk mitigation, the availability of financial resources (funding, specific loans and/or fiscal instruments) appears to be a crucial limiting factor for the implementation of climate adaptation.

One interviewee noted the importance of focusing on having more impactful communication and focusing more on the psychological issue of transferring the information and awareness of the impacts of the risks and thus inducing behavioural change.

3.3 Workshop outcomes

The workshops were held within the project to facilitate the integration of new knowledge in the development activities and validation of results. Moreover, workshops at a both European and the regional level provided participatory space for all partners and relevant stakeholders to find appropriate involvement in the co-production of transformational pathways. The workshops were aimed at establishing an adoption and wide dissemination of regional climate resilience pathways. All workshops were strongly linked to relevant stakeholders to maximize the project's exploitation orientation, dissemination, and take-up of project results. The workshops focused on the interactions between the EU, national, regional and local levels in the process of climate planning and the implementation of climate measures.

Moreover, the focus on the examples of best practices, successful adaptation practices and lessons learned from failure has the potential for replication at a larger scale and using existing insights and experience in implementing best practices. Workshops facilitated debates on the topic of the current policy frameworks regarding climate change adaptation and resilience as well as its uptake at all levels through the mechanism of the National Energy and Climate Plans (NECP[3]). Through this debate valuable insight was acquired on how well climate is addressed, differences of interactions between regions and countries in the planning process and the lessons learned. Exchanging experience through European and regional workshops, interviews and other activities under the project is crucial for complementing the principles and practices of transformational pathways and for supporting project partners in realizing the objectives of the REGILIENCE project.

Within the project, there were four workshops organised, two on a European level and two on a regional level facilitating the implementation of a genuine multi-actor approach. The insights gained through the workshops and emerging lessons are described below.

3.3.1 Workshops on a European level

The first workshop organised on a European level was held in physical form during the FEDARENE General Assembly (in order to allow for the participation of the board members) on the 14th and

[3] The national energy and climate plans (NECPs) https://commission.europa.eu/energy-climate-change-environment/implementation-eu-countries/energy-and-climate-governance-and-reporting/national-energy-and-climate-plans_en

15th of June 2022 on the topic of "Climate Adaption- European Approach and Success Stories REGILIENCE". The workshop was divided into two phases: the first being the presentations of institutional plans and regional actions with the second being a participatory exchange focused on the presentation and discussion of successes and failures in resilience pathways with the presentation of good practices and project examples of climate adaptation and resilience.

The major value and achievement of the first European workshop was a common understanding and knowledge base of practical examples of climate change adaption practices being implemented on a European level. The workshop highlighted the need for alignment of adaptation planning at the national level through effective institutional arrangements. Therefore, the workshop included the in-depth presentation by Johannes Klumpers, Head of Secretariat for Climate Adaptation Mission at DG CLIMA, which shed the light on the common EU strategies including the Green Deal and the EU Adaptation strategy, which will support the further development and implementation of adaptation strategies and plans at all levels of governance.

All of the good practices and project examples of climate adaptation and resilience presented: the integration of climate and energy actions into the spatial plans of the city of Karlovac, the pedagogical support for collective reflection on climate change adaptation (ClimaStory[4]), artificially enclosing the land by dams in the Netherlands, employing dedicated Climate Managers by the communities, and the Remarkable project, showcased the creativity and adaption capacity of energy agencies in the development of new projects and increasing climate resilience.

The second European-level workshop was held online, on the 28th of June 2022, titled "National Adaptation Plans and Strategies in the Theory and Practice – Role of the National and Regional Governments" to discuss how present and future EU policies drive the necessary changes on the ground as well as lessons learnt from the processes of the drafting, implementation, and monitoring of the National Adaptation Strategies from several EU Member States. The presentations were held on the topics of: *National Adaptation Plans and the Mission on Adaptation to Climate Change*; *Climate planning in the Netherlands: the alignment of plans and actions from the local to the national level*; *Croatian National Adaptation Strategy – Reaching a national consensus for climate adaptation*; and *Monitoring and evaluation of the German climate change adaptation and resilience efforts*.

After the presentations of an overview of the national adaptation plans on a European level, the workshop ended with the Panel discussion *Lessons learnt of the Climate change adaptation and resilience planning, implementation and monitoring process* moderated by Vasileios Latinos, Coordinator of Sustainable Resources, Climate and Resilience at ICLEI Europe, where attendees were able to feed the discussion by asking their questions to the speakers. The discussion provided an overview of what the issues are on the European level and what different countries and regions have done on the adaptation. Cities and regions are essential for adaptation, however, the design of plans showed a very limited active role for cities and regions.

3.3.2 Emerging lessons learned

Building on and integrating institutional structures for adaptation into existing national institutional arrangements can facilitate early success through the smooth integration of adaptation into ongoing national development planning and the effective use of resources. When climate change

[4] ClimaSTORY: a pedagogical reflection and action tool on territorial climate change adaptation https://en.auvergnerhonealpes-ee.fr/projects/project/climastory

adaptation initiatives are conducted in isolation of on-going national planning and implementation activities, resources are wasted in creating institutional arrangements that duplicate existing functions. Furthermore, the focus on regions highlights the need for institutional support in raising awareness which is facilitated in great part by different EU-level projects that non-governmental organisations and energy agencies implement. The energy agencies contribute to the implementation of sustainable EU strategies and policies by working closely with public authorities and with small and medium-sized enterprises (SME's) and citizens at regional and local levels. This enables the maintenance of continuity of adaptation programmes and activities and allows for more effective implementation of projects and measures. The activities of energy agencies have evolved in recent years from raising awareness on energy issues and project planning on their territory (i.e., Sustainable Energy Action Plans or SEAPs), to actively working with public authorities on project implementation. It supported projects on creating more favourable market conditions, capacity building, exchanging experience and know-how, local/ regional policy development and implementation, awareness raising, education and training, (Leprêtre & Argyraki, 2015)

Furthermore, building and instilling local capacity strengthening of relevant stakeholders on different levels, while taking into account and assessing the continuous needs evolvement, is crucial in effective adaptation to climate change. Targeted learning based on tailored training and learning from previous examples of best practice could strengthen existing actors and scale up adaptation actions. The involvement of different regional energy agencies could provide a useful entry point through which the capacity of stakeholders and institutions could be strengthened and thus improving the coordination of climate resilience planning at different levels.

Work is being carried out to address the impediments emerging and the rising uncertainties in the geopolitical and economic sphere, including providing access to adequate financial resources, and adopting a flexible and decentralized funding structure to provide local and vulnerable communities with the ability to determine how to best use the financial resources made available from higher level authorities. The biggest effort should be made on capacity building and empowerment to ensure genuine systematic co-production of knowledge.

All positive and transformative solutions on the European level should be downscaled to trigger positive transformational change and to develop enabling conditions aiming to support regions in adapting and upscaling positive solutions. Lastly, upscaling positive technical solutions alone is not enough to achieve transformational change. What is need are improved and renewed governance structures, democratic participation, finance, learning capabilities and our use of social innovation. Together, these enable systemic transformation - transformation across domains and sectors with sufficient coherence and impact to shift society toward climate neutrality.

3.3.3 Workshops on a Regional level

The first workshop on a regional level was held virtually on the 8th of June in Spain on the topic of: *Climate-resilient pathways: barriers and opportunities*. Together with the Climate Change Office (Spanish Ministry for Ecological Transition and Demographic Challenge) and six representatives from Spanish regions, several challenges and opportunities facing the implementation of climate-resilient action, including bottom-up approaches, were actively discussed. The workshop focused

on the discussion of the importance of citizen awareness on the needs for climate adaptation and resilience actions. All participants agreed that there is far insufficient citizen awareness about the need for climate adaptation and resilience action. Citizen surveys could provide a better understanding of perception and acceptance of adaptation measures, but they are not the norm, although in Catalonia's bi-yearly survey climate change ranks as one of the top concerns. It was also mentioned that the interest in adaptation, mitigation and climate-resilience in general is growing among economic sector representatives; however, they shall demand rather sector-benefiting solutions without considering possible negative effects of (mal)adaptation on other sectors or geographic areas, e.g., by demanding more freshwater supply.

The second regional workshop, and the last REGILIENCE workshop within the scope of principles and practices of transformational pathways was organised on the 30th of June 2022 in Zagreb, Croatia, and it brought together 26 key Croatian stakeholders, including representatives of the local and regional governments, national utility companies and ministries. The participants discussed climate change adaptation and resilience and were unanimous on several points including that waiting on adaption measures until disaster strikes will be too late, considering the vast effects of climate change. The workshop participants concluded that the key actors in the process are the local and regional governments, their stakeholders and communities. The workshop concluded on a positive note, stating that climate change as well as climate change adaptation and resilience are slowly but surely becoming a relevant topic of conversation across Croatia. Considerations of adaptation to climate impacts are a mandatory section of new projects funded by public money and more and more funds are being made available to adaptation and resilience project and not only for climate change mitigation.

3.3.4 Emerging lessons learned

Several good practice examples of climate adaptation and resilience and lessons learned were highlighted emerging from the workshops and the review of knowledge and experiences shared through the workshops. They are described below.

Mainstreaming: the experiences with the implementation of adaptation actions in Spain identify mainstreaming as the most effective approach to adaptation. It is seen as a long-term process that requires early information and communication with all relevant stakeholders, facilitating exchanges on a regular basis and ensuring vertical exchange. Furthermore, coordination across European, national, regional, state and local levels facilitates informed decision-making at the national level.

Measuring, documenting, and communicating good practices provides an effective means by which to enhance awareness and replicate such practices at all levels. The review of planned and existing national adaptation actions helps in awareness-raising, identifies opportunities for scaling up and replicating actions, building on what is working, and enhances collaboration, where appropriate. Working with platforms such as the Covenant of Mayors (e.g., on the Balearic Islands) brings on board almost all municipalities, leading to the adoption of climate-energy plans, while fostering valuable exchanges between the regional and local levels.

Cooperation and coordination is needed on both vertical (across different levels of governance) and horizontal (across different sectors) levels, however the implementation of the necessary

actions will fall on the shoulders of our municipalities, cities and regions. This is why the cooperation and support of all stakeholders are needed in this process since the climate emergency we are facing can not be solved with top-down measures alone. It is vital to act in a coordinated manner, funding, plans and actions need to be aligned and harmonised horizontally and vertically to maximise the impact of the utilized resources. Especially the utilisation of existing national or regional measures, such as the Spanish Citizens Climate Assembly, which just recently published its final recommendations, which is an interesting experience to replicate at the regional levels. It has actively addressed adaptation as well as mitigation.

Provision of financial resources: Provision of financial resources is effective; however, it does not guarantee successful implementation of adaptation actions unless it is coupled with effective institutional set-up, sustainable financial schemes and non-financial services such as education programmes. The funding is necessary to support both project development as well as prepared actions to act short and long term, which could play a critical role in the success of any adaptation scheme.

Lastly, it is also important to consider the constraints that emerged from the workshops in fostering cooperation for climate adaptation, in relation to the cooperation and coordination. One of the constraint mentioned in particular, was the lack of horizontal cooperation at the regional level, with climate offices not being involved in the adaptation measures carried out under the scope of different departments. And the lack of vertical cooperation between the local, regional and national scales that prevent the setup of a governance structure to properly manage coastal areas under risk. All of the mentioned constraints can be overcome by implementing the lessons learned and mentioned above.

4 The importance of maladaptation

Why is it important to consider maladaptation in climate resilient pathways??

Adaptation to current and future impacts of climate change is urgently needed, but should not be done unplanned or rushed, to avoid maladaptive outcomes. Especially considering that climate change requires transformative adaptation, learning lessons from success and failure is crucial to ensure any kind of intervention does not contribute to maladaptation. Maladaptation can create irreversible damage and increase vulnerability. Maladaptation comes in different forms, such as lock-ins, or drawbacks for various groups in the short- or long-term, or by creating compromises in the same or a different sector than the actual adaptation action. It occurs, when climate change adaptation actions have negative side-effects or outcomes, directly or indirectly, at a later point in time or in other areas, sectors, or parts of society, usually unintended. Additionally, adaptation actions are often enabled through high investments, which can turn into 'sunk costs' when for instance infrastructure is built for the adaptation action and there is no flexibility to adapt the planned measures if necessary. This way resources are lost.

Maladaptation has been defined by different researchers. To date there is no one definition that is widely accepted, but based on a wide assessment of all existing definitions, the definition REGLIENCE uses was formulated as:

Maladaptation refers to a process of planning and implementing an intentional adaptation action that may in the short- or long-term lead to increased vulnerability (to climatic or non-climatic risks) or diminished well-being (of the same or other systems, sectors, or social groups targeted by the adaptation action). Furthermore, maladaptation can also be associated with negative impacts that undermine sustainable development for the society as a whole. Adaptation actions that likely reduce the flexibility to adapt in the future or ignore local contexts are associated with a high risk of maladaptation.

What are the roots and causes of maladaptation?

Different conceptualisations including types of maladaptation exist. When analysing the concept and cases of maladaptation it is inevitable to mention the roots and causes, which can be broadly categorized into: 1) Not dealing with future scenarios and uncertainties adequately; 2) Being stuck in siloed systems and lack of participation; 3) Unsustainable financial steering; 4) Prioritizing short-term, popular solutions; 5) Limited information and improper use of data; 6) Geographic or demographic reasons; 7) Implementation failure/ shortcomings. Therefore, it is important to link to the roots and causes the risks for maladaptation to be able to spot maladaptation risks in advance.

How can maladaptation be avoided??

While in many cases, maladaptive outcomes cannot be avoided entirely, the risks of maladaptation can be reduced by identifying them while planning the adaptation actions. Therefore, there is a need to guide and push for careful considerations in the planning phase of adaptation actions. The risk of such negative outcomes on potentially different groups and sectors at different points in time should be taken seriously, so as not to worsen the situation inadvertently. There are different ways of adaptation maladaptation:

1. **Better anticipating future development:** The temporal dimension of adaptation makes it challenging to anticipate future outcomes, as the future is inherently uncertain. Using scenario analysis, associated with low regret strategies, i.e., strategies that are beneficial

even without climate change. It is important to highlight the importance of maintaining flexibility in face of current and future climate-related changes or new scientific knowledge.

2. Dealing with maladaptation complexity: The evaluation of adaptation processes and impacts is fundamental to be able to identify maladaptation and expand our knowledge of maladaptation. The evaluation of maladaptation can never be truly objective, as there are no fixed boundaries that determine successful adaptation, failed adaptation, or maladaptation. Therefore, (Magnan, 2014) points to the need to enhance objectivity and refers to the lack of quantitative and objective indicators.
3. It is important to understand adaptation and maladaptation jointly. There may not be an optimal adaptation. The authors argue that due to uncertainties trade-offs will be inevitable and should therefore be studied along with the adaptation options to decrease any negative impact. The risk of maladaptation should not keep stakeholders from focusing their efforts on adaptation.
4. Having all stakeholders and people impacted participate: People who might be affected by an adaptation action should be made part of its planning process. An informed decision-making process should be facilitated especially for marginalized groups who are likely to suffer the strongest in case of maladaptation should be made available and accessible.
5. Enabling more integration by aligning strategies and working across sectors: One solution to overcome silo- thinking that limits maladaptation could be to use, other 'doors'. International law already has a do-no-harm approach to policies of countries (i.e., transboundary harm), which could be a principle to explore also for adaptation planning. Similarly, the Paris agreement has the goal of adaptation and all signatories accept that risks and adaptation do not stop at the border. Here the objective could be building adaptive capacity and resilience (and reducing vulnerability) on the local, regional and national level, but aligned with the global goals that serve also transboundary cooperation.
6. Allocating funding to the right adaptation actions: With the continuation of traditional project assessment and awarding schemes, as well as a current trend towards financialization (of utilities), there is a need to limit the risk of maladaptation that is caused by finance incentives.

These six different ways of avoiding maladaptation can help guide planners to plan adaptation action with less risk of maladaptive outcomes in the future. Furthermore, the self-assessment tool for maladaptation was developed within the REGILIENCE Consortium (WP3). The tool helps planners and implementers of adaptation projects to spot and mitigate potential maladaptation risks (primarily in a regional context, but applicable to different contexts).

The objective of the self-assessment tool for maladaptation is to pre-check (ex-ante) adaptation actions for potential maladaptation risks. The target groups of this tool are primarily adaptation planners and practitioners on a regional level, but it can also be applied in a wide range of contexts. Most adaptation actions are fostered by the public sector, but the importance of the private sector and community organisations in adaptation is growing (IPCC, (2022a)), and we, therefore, encourage decision-makers on all levels to use the tool to spot potential maladaptation risks.

The maladaptation tool is based on the analysis of risk factors of maladaptation, which were fixed into 5 categories: 1) Lack of effectiveness; 2) insufficient knowledge and understanding; 3) lack of coherence; 4) lack of sustainability and path dependency; and 5) Lack of relevance. The tool was subject to a review by adaptation planners in a regional context. When sending out the self-assessment tool for maladaptation, an easily understandable introduction with what, why, who,

when, and how was added to give a quick overview of what the document is about, additionally, guidance was given, in the form of definitions and aspects the reviewers should pay attention to during the review.

For more information on the tool of maladaptation please consult the REGILIENCE deliverable D3.4. >> ADDRESSING MALADAPTATION - implications for decision-makers <<, which has detailed information on the methodology, the conceptualization and different categories of maladaptation, as well as how the tool for maladaptation was built.

5 Drivers for success and points of failure

The purpose of this report is to pool the knowledge gained throughout the project with the summary of the major challenges and the best practices the stakeholders have identified in the survey, workshops and interviews for future replication. The practices are classified in four groups relating to different aspects of the project: policy, planning, implementation and monitoring, aiming to highlight well-done actions and projects along with negative results in order to formulate future practical recommendations. They are necessary to provide stakeholders involved in the climate resilience projects and actions, and other mitigation and adaptation initiatives, with a wider range of possibilities that they could eventually consider, tailor, and use for their specific situations. Transformational pathways provide useful information and overview of the drivers for success and points of failure for the effective upscaling of the lessons learned. It overviews the entire project with an overview on policy, project planning, project implementation and monitoring, as well as stakeholder engagement. The main objective is to facilitate use of these findings in future areas and applications, and actively facilitate learning from experience in order to avoid repeating past mistakes or reinventing the wheel.

In the previous chapters, we have shared a number of lessons learned and good practices on adaptation planning processes emerging from the workshops and interviews and the literature review. This chapter is devoted to a detailed overview of the best practices and lessons learned and recommendations on what to do to avoid failure. This builds on the recognition that these common elements which have emerged from the activities within the project could be used as the common points of failure and drivers for success, which could be considered as a basis for transformational pathways.

5.1 Policy

The outcomes from surveys, workshops, interviews and literature review served to gauge real-world experiences of climate adaption projects and identify drivers and barriers that can contribute to the successful implementation. Based on the stakeholder input, the role of civil society was identified as crucial in helping to implement climate change adaption policy. However, public bottom-up initiatives are not considered sufficient to address climate change problems without a top-down national policy framework to regulate. Since different regional, national and local policies can be crucial in the successful process of transformational change for the environmental and climate resilient pathways, it is crucial to focus on the factors that contribute to the successes and failures of different policies.

The institutional fragmentation and difficult cooperation were recognised as one of the key institutional factors halting the implementation of adaptation, intensified by issues of overlapping competencies in most of the cases that impede to design more integrated policies.

Emphasis was put on **documenting and disseminating information and knowledge** at all levels and across multiple sectors to raise awareness of the public bodies implementing necessary changes

at national and local levels. Common databases encapsulating the outcomes, and the impacts of climate change addressing various themes, across different sectors and disciplines should work positively towards each other and can provide a helpful basis for scaling up and scaling out good practices.

Another main driver of adaption actions is the **existence of incentives, both monetary and nonmonetary** like positive publicity. A solid financial basis would support the introduction of innovative technologies since it can be challenging to incentivise the industry to change existing practices. Financial resources were and are a continuous problem if the government does not recognise the work as important.

Uncertainty in the requirements and the urgency of climate change issues is among the main barriers to appropriate policy implementation. Actions are frequently taken as a response to current events, rather than anticipating future change and preparing for and respond to a changing climate. Barriers within policy and governments are unlikely to occur independently of one another. Also, the multi-scaled and across-country nature of climate change requires horizontally and vertically integrated levels of governance and policy action. This is why it is important to plan more holistic and potentially more efficient projects and actions **by involving multiple stakeholders on different levels**, especially within the governing structures to introduce positive policy change, as well as experts within the field, practitioners, NGOs and others.

Furthermore, there is an existing lack of focus on climate change adaptation measures alongside mitigation actions with different approaches from existing experiences. It often occurs that many actions and planned adaptation measures are implemented within broader sectoral initiatives rather as stand-alone measures.

5.2 Planning

To achieve successful transformative adaptation, inclusive planning and flexible pathways are required, across different sectors and stakeholders, that encourage timely actions and positive outcomes across sectors and systems. Such an approach provides a solution space for adapting to long-term climate change (IPCC, Climate change 2022: impacts, adaptation, and vulnerability , 2022). **Collaborative stakeholder engagement** is one of the key outcomes from both the interview process and workshop outcomes. The active participation of stakeholders helps build trust, ownership and support for adaptation planning processes, making the project or an action more likely to succeed.

Some of the interviewees highlighted the need for a **good management plan** as a crucial step for the planning phase of the project, as it can define the project's scope, management of relevant project stakeholders, the key project impacts and outcomes, explore the possible project risks and have the change management plan in place. Effectively managing the project based on the good management plan contributes to the building of a knowledge base for adaptation and facilitates subsequent adaptation and evolvement of the project through assessments and future planning. The good management plan evolves with the project and is frequently updated to reflect the changes made in the project. In addition, it allows for all stakeholders to have a single dynamic document which encompasses all elements of the process, including and procedures, timelines,

methods and accountabilities for planning, monitoring, and controlling the project as it progresses, and it promotes the archiving and sharing of information.

Synthesis of knowledge and information. It is important to review and use information and knowledge from all sources, including overviewing traditional, local and contemporary scientific sources and ensuring that all such information is gathered and validated, since existing processes and procedures can frequently be found. Including different stakeholders through collaborative and co-construction processes, helps empower local communities, promotes shared understanding of the issues and strengthens the capacity of communities to implement adaptation actions.

Due to the different specific settings across Europe and different regions taken into account throughout interviews and workshops, it is important to keep specific settings and differences in circumstances in mind. Climate change, and the project resulting in combating it are highly dependent on the unique set of environmental, technological, economic, political and social-cultural circumstances, among others. This means that much of the transferable knowledge and experience on barriers to adaptation can be generic and principal-based, which is helpful for framing action, but difficult (and in some cases inappropriate) to directly re-deploy in different settings, which is important to keep in mind while taking all lessons learnt into account.

Throughout the planning process, a collaborative approach should be taken into account with a collective process of identifying options for existing problems, within the context of current policies and recommendations, ensuring actions are widely agreed and endorsed by local or national governments. Implementation of successful planning is crucial and should be aimed at a dynamic and systematic exploration of current barriers and enablers within the existing system and more beyond generic barrier considerations.

5.3 Implementation

The capacity level for projects' success and replication increases with increased collaboration between multiple stakeholders on a local or regional level.

Successful implementation of climate change adaption policies, strategies and projects require the mobilisation of resources and the decision-making process in a supportive institutional environment, while any frail institutional capacities can often become a key barrier in the implementation processes. Having a dedicated lead institution for the process and identifying how existing programmes can contribute to the process will ensure early success, help achieve a coherent adaptation response and inform how individual efforts can best be scaled up to national level.

Adaptive management approach was highlighted as an important tool to use in the decision-making process as it is optimal in adjusting as a response to ongoing uncertainties. It is important to work in a manner that is inclusive and responsive to stakeholder views and feedback throughout the process, while involving an ongoing, real-time knowledge creation. Due to the uncertainties of climate change impacts, multi-sectoral diversity of views on implementation processes is crucial.

Regional and local governments and their advising organisations (consultants, intermediaries such as government institutes, researchers and NGOs) need to access the common knowledge, and

practical information to implement adaptation on the ground, exchange experiences and report on the progress of existing successful projects. Participatory approaches and intergenerational dialogues are crucial to climate adaptation.

In addition to all mentioned above, the successful implementation is ameliorated if it is communicated and disseminated to a wider spectrum of users, consisting of decision-makers from all societal groups, such as businesses and business associations, non-governmental organisations, religious communities, trade unions, social partnership organisations, researchers and practitioners. They often act as 'multipliers' of information for interested citizens, who in turn become more engaged in planning and implementing adaptation.

5.4 Monitoring

Throughout the interview process and literature review, we identified several good monitoring practices which contributed to the success of the cases presented, as monitoring and evaluation are key stages in the adaptation process and are important as a means to demonstrate effectiveness and accountability. Some of the key monitoring practices emerged from the interviews, which we have highlighted below:

The design of a monitoring and evaluation system presents an essential part of any project or action and should be integrated into the implementation process. Involving monitoring measures (mechanisms for review, monitoring metrics, evaluation procedures) early on within the project or action helps prevent unforeseen consequences, correct measures if required and supports the overall learning process. Measurable indicators and evidence-based systems, including all relevant stakeholders, are beneficial for progress monitoring, successful adaptation and scaling up good practices. Indicators on monitoring the implementation process need to be clearly communicated with all stakeholders from the beginning and should be developed concertedly with all relevant stakeholders.

The successful monitoring performance and outcomes of climate change actions should contain the information on the direct project outputs, immediate and short-term outcomes and longer-term outcomes. Also, when appropriate indicators, associated measures and the explanation of the data to be collected over time are appropriately set up in the planning phase of the project or an action, it provides a framework to measure adaptation success and the project's success.

In case there is a national and sectoral strategy in place in a country, it is necessary for the monitoring and evaluation to align with the already existing, well-established systems or to upgrade the relatively developed and institutionalised systems. By using existing indicators from set frameworks and data sources, it provides a clear mandate for programmatic reporting, with maintaining the adaptive capacity of regions and helping build long-term monitoring.

The summary of the key barriers, their explanation and the drivers that could be used to alleviate those barriers for successful climate change adaptation, can be seen in the table below. It is important to mention that the drivers for success mentioned below can be used in a variety of actions and to overcome multiple types of barriers. The table presents a synthesis of the divers for success described in the prior sections.

Table 4. Synthesis of types of barriers and drivers for success

Type of barrier	Explanation	Drivers for success
The institutional fragmentation	The growing challenges in coordination among private and public organizations, projects that address the same issues	The mobilization of resources and the decision-making process in a supportive institutional environment and using **adaptive management approach**
Cooperation difficulties	The issues of overlapping competencies, and lack of cooperation in most of the cases that impede to design more integrated policies	Collaborative approach Having a dedicated lead institution for the processes Capacity building Good management plan
Documentation and dissemination of information and knowledge	All stakeholders need to access the common knowledge, and practical information to implement adaptation on the ground, exchange experiences and report on the progress of existing successful projects	Synthesis of knowledge and information Participatory approaches and intergenerational dialogues
Funding	A solid financial basis would support the introduction of innovative technologies since it can be challenging to incentivize the industry to change existing practices.	Existence of incentives, both monetary and nonmonetary
Uncertainty in the requirements and the urgency of climate change	Actions are frequently taken as a response to current events, rather than anticipating future change and preparing for and respond to a changing climate.	Participatory approaches and intergenerational dialogues Successful communication and dissemination of knowledge Involving multiple stakeholders on different levels
Demonstrating effectiveness and accountability	Lack of measurable indicators and evidence-based systems, including all relevant stakeholders. Defining objectives ensuring that everyone knows who is	The design of a monitoring and evaluation system Good management plan

	responsible for which elements of the project	
Lack of focus on climate change adaptation measures alongside mitigation actions	It often occurs that many actions and planned adaptation measures are implemented within broader sectoral initiatives rather as stand-alone measures.	Mobilization of resources and knowledge and the decision-making process Capacity building Keeping specific settings and differences in circumstances in mind

6 Conclusions

Reaching climate resilience demands collaborative action, understanding interdependencies between the impacts of our actions and regional change to overcome the barriers blocking change. In a systemic approach, this journey toward triggering transformational changes in response to climate change relies on several key factors described above that are necessary to achieve transformational change in response to the ever-growing climate change impacts. Some of the factors impacting transformational change can be considered as a means of reducing risk and vulnerability, not only by adapting to the impacts of climate change, but also by challenging the systems and structures, economic and social relations, and beliefs and behaviours that contribute to climate change and social vulnerability.

Although the stakeholders throughout the process provided examples of good practices, several gaps and key barriers exist in relation to the successful transformational change. The key barriers to successful transformational change are as follows: institutional fragmentation, cooperation difficulties, lack of efficient knowledge and information dissemination and communication. The uncertainty in the requirements and the urgency of climate change and the lack of focus on climate change adaptation measures alongside mitigation actions are also seen as key factors hindering successful projects and actions. Moreover, a solid funding practice for successful adaptation cases and a demonstration of effectiveness and accountability needs to improve.

A number of lessons learned and good practices on adaptation planning processes emerging from the stakeholder inputs and the review of knowledge and experiences shared through activities under this deliverable have been identified. The identified drivers for success are as follows: the mobilization of resources and the decision-making process in a supportive institutional environment, using adaptive management and collaborative approach, having a dedicated lead institution for the processes, and capacity building for relevant stakeholders. Participatory approaches are seen as vital to successful projects along with good management plans, sufficient funding, successful communication, dissemination and synthesis of knowledge and information, the design of a monitoring and evaluation system and the involvement of multiple stakeholders on different levels.

It is thus critical to recognise previous practices and lessons learnt on existing examples, using reflexive practice and adaptive management between diverse actors. Knowledge and experience sharing and common holistic databases between broader sets of stakeholders within regions seem paramount to achieve the successful transformational changes. Across this deliverable's interviews and workshops, key themes reoccur. They are the demonstration that transformational change is not an easy accomplishment. We need to improve and renew governance structures, democratic participation, finance, learning capabilities and broader sets of stakeholder engagement. Together, these enable a systemic transformation - transformation across domains and sectors with sufficient coherence and impact to shift society toward climate neutrality.

To achieve transformative adaptation, transdisciplinary approaches are required as well as interdisciplinary ones, where practitioners, researches, policy-makers and citizens all work together to enable positive social, institutional and governance change to drive the transformative process. Flexible, experience-based, multi-sectoral and long-term planning approaches are needed for successful adaptation.

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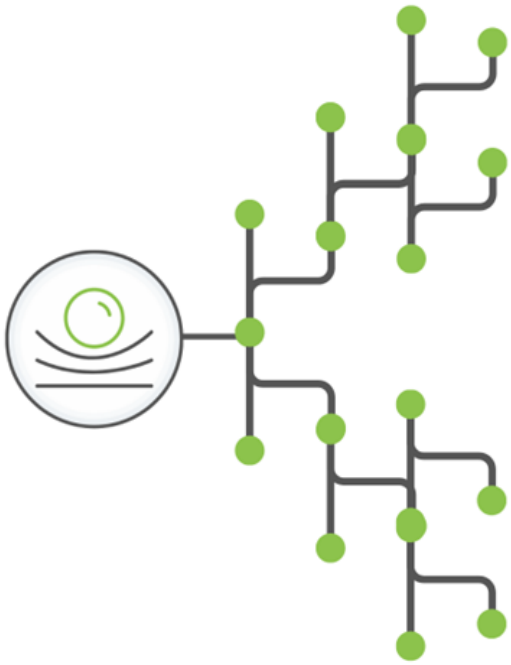
Annexes

Annex I: Interview guidelines

REGILIENCE
Regional Pathways to Climate Resilience



REGILIENCE T4.1: Interview Guide: Case studies of successful and failed climate resilience and adaptation initiatives and projects

OCTOBER, 2022.

www.regilience.eu

REGILIENCE T4.1: Interview Guide: Case studies of successful and failed climate resilience and adaptation initiatives and projects

Objectives

- Gather information on interesting cases
- Identify points of success and failure
- Gather additional contacts of involved participants in the project
- Potentially identify topics and participants for the planned workshops

Introduction

Thank you for taking-part in an activity carried out by REGILIENCE, a 4-year project funded by the European Union within the framework of Horizon 2020 Research and Innovation.

Currently, we are in the phase of bringing together lessons learned and insights from people – like you - who have worked on or researched successful and unsuccessful adaptations and aim to collect case studies and information on the points of success and failures in the planning and implementation of these activities.

Questions

1. Can you give us some background on the activity you have worked on?

Please give a brief description and context of the activity. (e.g. location, the approach of the activity, etc.)

Is this an EU, national, regional or local project?

Is this an activity initiated by a local or regional government?

Is the implementation of the activity mandated by a piece of legislation (e.g. Recovery and Resilience Plan, National Adaptation Plan/Strategy, National Energy and Climate Plan, Regional Adaptation Strategy, Sustainable Energy and Climate Action Plan, etc.)?

Is the activity focused on adaptation, mitigation and/or resilience?

What climate hazard(s) is the activity trying to tackle? A list of hazards can be provided.

If the action is an outcome of a piece of legislation:

Do you have any comment on the strategy/plan which was at the origin of the action?

Do you have any suggestions to better integrate (at national and regional levels) the different pieces of legislation?

2. What were the planned impacts and outcomes?

What did you hope to achieve?

What were the results?

3. What went well and why?

What were some of the highlights of this activity?

What were the key factors driving the success?

What were the key successes in the planning phase?

What were the key successes in the execution phase?

What would you have done differently if you had the chance to start the activity again?

4. What did not go well and why?

What are some of the points which did not fully succeed, or that failed?

What were the key factors for the lack of success?

What were the key issues in the planning phase?

What were the key issues in the execution phase?

5. Is there anything else you would like to add?

Finalisation

Thank you very much for sharing your knowledge and experiences with us! This helps us to better understand how climate actions succeed and fail and will help us greatly to define the parameters for the development of transformational pathways.

Annex II: Interview reports

REGILIENCE
Regional Pathways to Climate Resilience

REGILIENCE T4.1: Interview Outcomes: Case studies of successful and failed climate resilience and adaptation initiatives and projects

NOVEMBER, 2022.

www.regilience.eu

REGILIENCE T4.1: Draft Interview Outcomes: Case studies of successful and failed climate resilience and adaptation initiatives and projects

Objectives

- Gather information on interesting cases
- Identify points of success and failure
- Gather additional contacts of involved participants in the project
- Potentially facilitate use in future areas and applications, and actively facilitate learning from experience in order to avoid repeating past mistakes or reinventing the wheel

Introduction

Through interviews with experts and project leaders, we are bringing together lessons learned and insights from successful and unsuccessful adaptations and aim to collect case studies and information on the points of success and failures in the planning and implementation of these activities.

There were 8 interviews done within Task 4.1. with a variety of different stakeholders working with different sets of sectors, focused on good practices and lessons learned within the project or action in relation to adaptation planning processes, including monitoring and evaluation.

Interview 1, 20th of October 2022

Background on the activity

In the teaching Institute of Public Health Dr Andrija Štampar, there are currently a few projects on a European level and a few local/national projects.

The projects are mainly dealing with laboratory and field monitoring of water safety, food safety, and soil and air quality monitoring. Those are priorities described and recognised in the National strategy for climate change adaptation. Those are also actions recognized and written in Croatia in a national action plan, so the institute always applies for projects that are in accordance with those strategic EU and National documents and all its activities are aligned with the recognised priorities for Croatian climate change adaptation. The institute is a Public Health Institute and is obligated to help the policies and to give the preventive or corrective measurement measures from those analyses. The level of work is mostly national, through national projects with the addition of projects on the local level within the city of Zagreb. Preventative approaches and recommendations are given in a normal period of monitoring but also for the risk situations.

The project that was done was a local project called Ecological map of the City of Zagreb whose main goal is to unify existing data on the state of the environment, primarily air, water and soil, in order to enable the City offices to make quality decisions in the policy of renewal and further development of the city in accordance with sustainable development. The project is focused on adaptation. The eco map allows for a comprehensive and immediate insight into the results of monitoring various environmental media. This helps experts in information-based decision-making in the case of emergency and critical situations, while it will provide citizens with an improvement in the quality of life, the level of safety, trust in the rational disposal of funds for the purpose of researching the impact of the environment on health, and increasing the level of knowledge.

The connection between the institute and the local and national government is strong as a part of their budget is coming from the local and national government and a big part of the services they provide are made for the protection of health and the environment. The cooperation with local and national governments lies in helping the governments in identifying priorities and in planning budgets and activities.

Regarding the legislative changes, the representative of the medical and environmental sector from the Institute took part in the creation of the National adaptation strategy, which considered and implemented their needs and preventative measures. In a National Recovery and resilience plan, however, preventive actions from the area of environment and health are lacking since the plan is focused primarily on infrastructure. The European priorities for a digital and green transition need to be taken into account and more advanced actions are needed. Without the integration of the common databases connecting different sectors, cooperation will be a real problem in all fields since everything is interconnected, from meteorological databases to Health databases connected and agriculture databases, to name a few. Everything is interconnected and different multi-disciplinary databases should work positively towards each other.

Key factors driving the success of the activity

The key factor of the success is the project not being a one-time investment but having continuous development due to the project's activity and nature is crucial.

Multi-sector orientation of the project and its activities was crucial, and the engagement of different stakeholders from a variety of sectors was paramount.

The data coming from the eco map is shown in real-time and contaminants are directly shown, so the responsibility of the stakeholders impacting this data can't be shifted to other parties, as data is impartial. The data can also be used to inform future governance decisions. The replicability of the project and the adaptability of the eco map to other cities throughout Croatia.

Key factors of failure or hindering success

The main issue is the lack of a common database for the health and environmental sector which would allow for an increase in transparency and accountability and would promote progress and innovation. Misuse of data, poor management and security breaches, especially in the public sector, lead to widespread consequences, which a common database would help solve, along with an increase in efficiency. Also, having data and the collection of the data alone it's not useful if the interpretation or recommendations of the data doesn't exist.

Within the project, more emphasis should have been put on advocating heavily to different kinds of stakeholders and also on PR support, broadcasting the benefits and results of the project. We failed to communicate adequate benefits for the prevention of the health consequences due to the air contamination and to engage all the key stakeholders for support.

Financial resources to continue adapting these kinds of activities were and are a continuous problem if the government doesn't recognise the work as important.

Capacity building for national inspection bodies is important and should be improved.

Lastly, an important thing to note would be that all those tools developed could become maladaptation if continuous investments aren't made for the tools to adapt to the digital transition.

Interview 2, 14th of October 2022

Background on the activity

Two municipalities of the Altovicentino area, Santorso and Marano Vicentino, decided to promote the implementation of Natural Water Retention Measures (NWRMs) to increase the resilience of the territory to flooding. Within the BEWARE "Better Water Management for Advancing Resilient-communities in Europe" LIFE funded project, the two municipalities (in collaboration with the project partners: TESAF - University of Padua, Consorzio di Bonifica Alta Pianura Veneta, ALDA, Veneto Agricoltura) have implemented seven interventions including NWRMs. The catalogue available through the NWRM platform was used to identify the finally designed and implemented measures. The objective of the project was to use a participative approach to improve the resilience of a territory or against flooding due to the region but also in many parts of Europe and the world we saw an increasing rainfall which led to frequent floods.

Since the municipalities were involved in the project, the project had success in proposing and updating pieces of legislation on a national and regional level, some of which were: the modification of the building codes of the two municipalities, the elaboration of an inter-municipality action plan on hydraulic safety, and new regulations related to the use of natural retention measures so the citizens and also the municipality have to use natural water retention measures when realising new projects.

The main focuses of the activity were climate change adaptation, climate mitigation and climate resilience since natural water retention measures used had a combination of effects.

Planned impacts and outcomes

The impact was planned in two directions: one is flood mitigation and climate change adaptation through the generalization and dissemination of the interventions. The second one is the information and knowledge raising, activating a participatory process involving all main stakeholders to identify shared actions and foster citizens' commitment to reducing the flooding risk and showing the effectiveness of NWRM. Also, promoting a regulatory framework and specific technical skills and facilitating the widespread use of NWRM.

Key factors driving the success of the activity

The project contributed to the achievement of land use change and forestry policy priorities, also project had multiple benefits in other national priority areas such as the water framework directive because interventions and the creation of new habitats were realised.

The different activities realised had a participatory approach and process in including all stakeholders: citizens (important actors to proactively spread the adoption of small-scale actions aiming to collectively improve the hydraulic resilience of a territory), local municipalities (key role in driving the design and implementation of concrete adaptation measures), engineers, surveyors, architects, agronomists and foresters (contribute in disseminating knowledge on NMRM and encouraging their adoption), farmers (encouraged to adopt measures and practices for the good management of water resources in the agricultural sector), and students (represent another key target group of the project). The creation of an adaptation culture is a gradual process requiring a bottom-up approach, considering education, training and awareness-raising as key actions for the development of new skills.

Even though some participants were initially sceptical about the education and training provided within the project, however after finding new tools and solutions for successful adaptation, they changed their minds which was very gratifying.

The availability of EU funds, granted in the framework of the LIFE Programme, proved to be essential for the implementation of the NWRMs. It allowed the whole initiative to be developed on a larger scale than initially planned, proving its high potential for replication and upscaling. Another driver of success was that the municipalities of Santorso and Marano Vicentino have long been committed to the adoption of sustainable solutions for rainwater retention and infiltration. This also led them to start a process of public participation to support the identification of areas at hydraulic risk. Some of these areas were later actually selected for the implementation of NWRMs.

Moreover, the cost-benefit analysis performed within the BEWARE project represents another important driver for the success of the initiative and its further replication beyond the project.

The planning phase of the project was difficult as the project was submitted three times in three different years, and with the adoption of the comments from the European Commission and changing the area from climate change adaption solely, to including governance capacity raising which had a greater impact on the territory.

In the execution phase of the project, the key success was the cohesive and diverse work group of the partners.

Key factors of failure or hindering success

The main failure was that too many actions needed to be realised, and the time needed to realise these actions was underestimated. Also, the COVID-19 pandemic pushed all of the actions to be done online,

One of the factors that were not so successful was the group purchase program for citizens to buy NWRM for their homes, which didn't see a lot of participation since there weren't many direct economic benefits seen by the citizens and it was difficult to change the minds and behaviour of the citizens, for which the regulation was needed to be successfully adopted.

Expanding the implementation of NWRMs, involving the local population, represented a crucial issue for the success of this project. Unfortunately, the poor knowledge of the NWRMs among private citizens – but also among local practitioners (technicians and operators) – often dramatically limits their implementation, replicability and scalability.

Lastly, an important thing to note would be that sometimes reducing the number of actions and increasing the quality of those actions can be prosperous. Adaptive management would be one of the key things that can be used in the project management process.

Interview 3, 24th of October 2022

Background on the activity

The river restoration strategy is implemented by the Water general directorate within the Ministry for the ecological transition and demographic challenges of Spain. The river restoration strategy was initiated in 2005 as a tool to comply Water framework directive and Floods directive. It consists of the set of actions aimed at restoring and recovering the ecological integrity of river ecosystems, including both the structure, processes and functions, as well as the ecosystem services they provide. This process requires the elimination, reduction or mitigation of the pressures that alter and divert them from their natural state. The strategy is proposing a set of measures which will improve the management of rivers and their ecological status, highlighting those aspects that are more relevant and problematic currently. The strategy is integrated in mandatory processes, as the floods directive implementation and water framework directive implementation. In itself its not

mandatory but is incorporated in other measures. It is made in connection with climate change national adaptation plan of Spain.

Planned impacts and outcomes

The National Strategy outlines a couple of specific objectives, namely:

- To promote the integration of the management of river ecosystems with land use and management policies, following sustainability criteria,
- To contribute to improve training in areas related to the sustainable management of rivers and their restoration.

  To fully engage in the tasks of restoration and conservation of rivers, it is necessary to improve the scientific and technical training of those in charge of carrying out those tasks, meaning the technicians of the different administrations, as well as the entities that draft and implement projects. It is also necessary to publicize the experiences that have taken place in other European countries and disseminate knowledge and achievements through public participation forums.

- To provide information and experiences to improve the actions that are being undertaken in the realm of river restoration in Spain. The National Strategy intends to initiate the implementation of the concepts and approaches that must guide the tasks of restoration and recovery of a good ecological status of rivers, promoting pilot or 'demonstration' projects to give exposure to the proposed objectives and obtain in the middle and long run the expected results.
- To encourage citizen participation and engage all sectors of society in the management of river systems.

Key factors driving the success of the activity

The strategy proposed the gradual involvement of society in matters relative to river management and the use and distribution of water resources, in the endorsement of agreed upon procedures, and in the maintenance and monitoring of the work done. The achievement of these objectives will for: the improvement of the knowledge of the natural functioning and dynamics of Spanish rivers by the technicians in charge of their management, greater awareness of the relationship between the river and its watershed, greater public involvement in debates and decision making on the management of river channels and floodplains, more up to date and interdisciplinary training of the teams and individuals that presently draft and implement projects in rivers and finally new approaches for sustainable use planning of water resources and for the conservation of aquatic ecosystems.

Key factors of failure or hindering success

The importance in completing the strategy lies on the improvement of the training of technicians, facilitating information and experiences, the campaigns to provide information and raise social awareness. The participation of the public is seen as the key point of success. As the main problem was shown to be getting spaces for rivers and getting acceptance of the public for the measures the strategy is trying to implement. Also its important to seek direct and indirect sources of funding, which may come not only from river basin organizations, but also from funds or subsidies from agricultural jurisdictions, rural development funds, from contributions by business companies or

associations, and collaborations from financial entities. The collaboration between technicians and administrations is also important.

Interview 4, 31st of October 2022

Background on the activity

Please give a brief description and context of the activity. (e.g. location, the approach of the activity, etc.)

LIFE MEDACC "*Demonstration and validation of innovative methodology for regional climate change adaptation in the Mediterranean area*" (LIFE12 ENV/ES/000536) has developed innovative solutions to assist in adapting Mediterranean agroforestry and urban systems to the impacts of climate change. The project was carried out in three hydrographic basins representative of Catalonia (the Muga, the Segre and the Ter), though the methodological approach can be extended to other Mediterranean basins.

Is this an EU, national, regional or local project?

It's a national project developed during 2013-2018 in Catalonia, NE of Iberian Peninsula, with the support of the Life Programme from EU

Is this an activity initiated by a local or regional government?

By the national government of Catalonia (Generalitat de Catalunya)

Is the implementation of the activity mandated by a piece of legislation (e.g. Recovery and Resilience Plan, National Adaptation Plan/Strategy, National Energy and Climate Plan, Regional Adaptation Strategy, Sustainable Energy and Climate Action Plan, etc.)?

The implementation of the project activities is framed in the Catalan Strategy for Adapting to Climate Change 2013-2020 approved by the Government of Catalonia in November 2012. The results and experiences of the project have been included in the new Catalan Strategy for Adapting to Climate Change 2021-2030 (ESCACC30).

Is the activity focused on adaptation, mitigation and/or resilience?

The main activities of the project have been focused on adaptation and resilience:

- Diagnosis of trends in climate, land use, forests and water availability in the three basins over the past few decades.
- Estimation of the future impacts of climate change and global change on hydrological and agroforestry systems in the three basins through the year 2050.
- Development of a methodology based on indicators to assess the degree of adaptation of the three basins to the impacts of climate change.
- Implementation of pilot tests on the efficiency of different adaptation measures in the agriculture, forestry and water management sectors, designed jointly with local actors.
- Action plan for climate change adaptation of the three basins, including an evaluation of previous adaptation measures and a proposal and evaluation of new measures.

- Creation and consolidation of a network of local actors (monitoring and management committee) which provided its knowledge and experience during project execution.
- Dissemination and communication activities oriented towards informing and training actors at the local, county, and national levels.

What climate hazard(s) is the activity trying to tackle? A list of hazards can be provided.

- Climate hazards: global warming, heatwaves, summer reduction of precipitations, drought and increasing of evapotranspiration.
- Not climate hazards: land use changes (increasing forest area and decreasing agricultural area).

If the action is an outcome of a piece of legislation:

Do you have any comment on the strategy/plan which was at the origin of the action?

Yes, the Catalan Strategy for Adapting to Climate Change 2013-2020: measures to reduce vulnerability to climate change impacts in water management, forests and agriculture.

Do you have any suggestions to better integrate (at national and regional levels) the different pieces of legislation?

Yes, it's necessary a climate change law like the catalan one: Law 16/2017, of 1 August, on Climate Change to promote and guarantee the coordination of all sectoral planning instruments related to climate change and the coordination of all Catalan public administrations, as well as promoting the participation of citizens, social agents and economic agents.

What were the planned impacts and outcomes?

1.- Water: the main changes in the climate of the basins over the past few decades include overall reductions in precipitation -most notably during the summer more frequent and severe droughts, and an increase in the atmospheric evaporative demand. Regarding the water cycle of the watersheds, overall reductions in flows have been observed. These flow reductions vary depending on the section of the river and part of the basin considered. At headwaters, the observed reductions in flow are too severe to be only attributable to climatic factors. Therefore, it must be that changes in land use such forestland expansion have played a relevant role (in the Muga and Ter). In the lower river reaches, flow rates are strongly conditioned by the management regimes of the reservoirs. In this context, hydrological planning becomes a key adaptation measure.

2.- Forests: Both for their large area and sensitivity to climate, forests are one of the project's main subjects of study due to their vulnerability to the impacts of climate change. Over the past few decades, forested area has increased in the watersheds, consuming scrubland or previously farmed areas. This is a general trend in Catalonia, and is especially relevant at the headwaters of the watersheds. At the Muga headwaters this change has been particularly noticeable, with an increase in forested area of over 20% in 30 years (1970- 2005). In general, these new forests are dense and have little or no management, and for this reason they are especially vulnerable to drought and large forest fires. Monitoring of episodes of forest decline in Catalonia shows that during the most recent hot and dry summers, symptoms such as decolouring, defoliation, and mortality were around 3% (2012 to 2016). Forest management can help make forests more robust against future climatic conditions.

3.- Agriculture: Agriculture of the study watersheds is another one of the most vulnerable sectors to climate change if the crops are not adapted to new conditions, above all regarding aspects associated with phenology and efficiency of water use. Setting aside changes observed in the structure of agricultural land uses, over the past few decades another two problems associated with agricultural intensification have emerged: water use and nitrogen management. With global warming, many crops will have increased water requirements, and the period of irrigation will also need to be expanded in order to maintain the same levels of production. Irrigation offers greater benefits than dryland agriculture both in terms of productivity and profitability. With this in mind, it is clear that **improving water use efficiency is key for improving sustainability**.

What were the results?

1.- Water: In the Muga river basin, the expansion of the Darnius-Boadella reservoir does not have any positive influence on water availability nor in the number, frequency, or intensity of the emptying events, indicating that this measure is not effective as an adaptation measure for reducing the vulnerability of the basin; In the Ter river basin, a reduction in the volume of water transferred to the Barcelona Metropolitan Area causes a significant improvement in flows (from projected losses of 31.1% to flow reductions of only 16.7-17.4%); In the Segre river basin, the completion of the Segarra-Garrigues irrigation water infraestructurre, with a water demand of 342 hm^3/year, greatly affects the dynamics of the water stored in the Camarassa and Rialb reservoirs. Of these, the latter is especially relevant since it is expected that, starting in 2027, the complete emptying of the reservoir will occur during at least one month each year. **NOTE: this September, Rialb reservoir was empty, five years earlier ¡¡¡**

2.- Forests: In some pilot tests seasonal increments in soil humidity were observed where the management actions were carried out. During the spring and summer, high soil humidity is positively correlated with improved tree growth and health. Management also led to higher water contents of the vegetation in periods of elevated fire risk, which translates to lower flammability and combustibility of the vegetation. This was found both in parcels with black pine in the Solsonès region (Segre) and holm oak parcels of the Muga. In the case of the Scots pine at Montesquiu (Ter), forest management clearly reduced forest decline. Problems associated with drought in holm oak forests of Requesens (Muga) in the summer of 2016 barely manifested the managed areas (between 0 and 0.55% of the oaks showed symptoms of decline) while in the unmanaged parcel (control) 9.1% of the oaks showed signs of decline. Forest management proved key for reducing the vulnerability of the holm oak in the Muga basin, and for the Scots pine in the Ter basin, during the droughts of the summers of 2016 and 2017. In the case of the black pine in Solsonès (Segre basin) the effect was not as evident because the climatic anomaly was not as pronounced. In the Solsonès (Segre), the structural change of the black pine forests made through management clearly reduced vulnerability to fire by reducing the vertical continuity of combustible materials.

3.- Agriculture: Advanced irrigation management in the alluvial plains of the Lower Ter and Muga in corn and apple crops. Improvements in water use efficiency have been recorded in plots which followed the irrigation recommendations of the GIROREG system developed in the context of the project. This was true for both corn and apple crops, where reductions in water consumption were between 13 and 67%. In the case of apple, the value of production in the plot in which the GIROREG methodology was employed was 32,850 €/ha, representing a 4.2% increase with respect to the control plot. Evaluation of the effectiveness of relocating vineyards to different altitudes in the Segre watershed: significant losses were observed as compared to productivities

of the traditional grape-growing areas. However, production in these new areas lends to products with better organoleptic characteristics, giving an added value to the wines produced, and this may compensate for productivity losses.

What went well and why?

What were some of the highlights of this activity?

- The analysis of whether or not the three study basins (the Muga, Segre and Ter) are adapting to the impacts of climate change, through an elaboration of indicators for assessing and monitoring the adaptation measures.
- LIFE MEDACC has had a key role in the establishment of the Water Users Community of the Coastal Plain of the Muga; this community constitutes all users of the salinated aquifer in the coastal zone, having the objective of creating consensus and implementing measures to improve the problematic situation.
- LIFE MEDACC was also present in the conception and initiation of the Gavarres Plan 2025, led by the Consortium of Les Gavarres in the Ter basin, with the objective of making the cork industry more resilient to already oobserved impacts of climate change.

What were the key factors driving the success?

By way of the project's Monitoring and Management Committee, LIFE MEDACC has favored the creation of a permanent network of local actors in the three watersheds, as well as transversal stakeholders throughout the region, all of whose knowledge and experience has contributed to project execution. It is necessary to create forums which allow for the due representation for regional actors, administrations, and research and technological centers, with the objective of achieving consensus on and designing adaptation measures to be undertaken. Such forums should be founded in multilateralism due to the complex nature of these issues, and since classical bilateralism results in the execution of only those measures which are proportional to the influence of a given actor over the public administration. This creates the need for a new governing body which facilitates the development and execution of active and efficient adaptation policies.

What were the key successes in the planning phase? Knowing exactly what we wanted to do

What were the key successes in the execution phase? Have a multidisciplinary team.

What would you have done differently if you had the chance to start the activity again? Nothing at all.

What did not go well and why?

- Perhaps we are guilty of a certain lack of modesty, but the work done from Life MEDACC was so positive that the partners themselves are participating in a "child" project called Life MIDMACC (Mid-Mountain Adaptation to Climate Change).
-

Is there anything else you would like to add?

- It is necessary that population of coastal cities knows the fact that the provision of services, culture, wellbeing, and food all have associated costs; for reasons of resilience, the urban zone should help guarantee the provision of these services and foodstuffs. The agenda for adaptation to climate change of any city is incomplete if regional and sectorial planning do

not contribute to resilience of the surrounding environment which provides water, food, and services. This is a very important issue for the development of transformational pathways.

Interview 5, 3rd of November 2022

Background on the activity

The project of Eco street (Ökostraße) in the municipality of Ober-Grafendorf is an environment-friendly urban street design for decentralized ecological rainwater management. The problem of more frequent and more intense heavy precipitation events alternating with more pronounced drought periods has caused increasing challenges for municipal development. Excess surface water runoff from sealed surface areas has repeatedly caused small-scale flooding, overloading of the sewer and wastewater treatment system, and rising costs for its maintenance. On the other hand, during hot and dry periods the cost of irrigating and maintaining the urban greenery has been rising constantly. Based on observed climatic trends and climate projections, it is anticipated that these problems will be exacerbated by future climate change. The municipality has responded by implementing a smart, ecosystem-based rainwater management system that is incorporated into an environment-friendly street design. The adaptation solution helps to reduce public costs, delivers multiple benefits and holds considerable innovation potential for sustainable and climate-sensitive local road construction.

The project was initiated by the local municipality and was funded by the municipality. However, it is a very cost-neutral project which doesn't add any costs to maintain.

The project was developed and implemented as a CCA (Climate Change Adaptation) Measure. The project tackled climate change mitigation in stopping the production of more heat and reducing the heat island effect, climate change adaptation in facing the heavy rain occurrences, and climate change resilience with less energy use, water retention and being cost effective and easy to maintain.

Planned impacts and outcomes

One of the key planned impacts was the "eco-street" concept, which has been protected under the name DrainGarden®, which is a system of vegetated, aesthetically appealing roadside surface strips covered with special substrates of natural origin and planted with greenery that are able to absorb, retain, store and filter large amounts of water in short time. The specifically developed soil substrates are layered in a way as to combine high water permeability with high storage capacities.

The initial idea was made by the city office and the gardener, the idea stemmed from the need to plant more trees on the sides of the road. The project offered a huge opportunity to reduce the concrete environment throughout the municipality and introduce more green landscapes.

Key factors driving the success of the activity

The project involved multiple stakeholders which was seen as one of the successes of the action. The main stakeholders involved were the mayors as well as the leaders and members of local working groups in each of the seven pilot municipalities. The work groups set up in each municipality were composed of a group of citizens of different ages, sexes, education and profession. The inter-municipal workshops and public events were highly appreciated by participants for facilitating the exchange of experiences and social learning among workgroups of all municipalities. Preparation of adaptation knowledge, as well as information transfer, was supported by external climate change experts, who delivered expert lectures at the workshops on the specific topics chosen by each municipality.

The ecosystem-based adaptation measure that responds to several climate change impacts at the same time and delivers multiple environmental co-benefits, the measure can be considered a good practice example of sustainable adaptation.

The measure performs very well as regards cost-effectiveness, and it has comparative cost advantages against conventional solutions. It thus saves public money and disburdens the municipal household.

Key factors of failure or hindering success

The main difficulty was that at the time of implementing the process a regional adaptation strategy at provincial level was still missing. The adaptation options set out in the National Action Plan on Adaptation to Climate Change proved to be ill-suited for the local level, i.e. they were perceived as too abstract, strategic and distant. Thus, considerable efforts had to be invested in "translating" and "down-scaling" adaptation options from the national to the local level.

Lastly, an important thing to note would be the lessons learned within the project which are:

- the support for local adaptation processes needs to be responsive to the specificities of each municipality and to take into account the preferences of individual stakeholders; there is no "one-size-fits-all" approach that works equally well in each municipality;
- in order to be well-performing, the participation process required intense preparation, careful planning, professional process management and sufficient resources (financing, time), while at the same time leaving sufficient room for flexibility;
- preparation and communication of knowledge needs to be target group-oriented; internal communication trainings with a didactic expert helped to professionalise the communication approaches

Interview 6, 4th of November 2022

Background on the activity

The project was a national one, done in Italy, and it centred around providing adequate climate risk prevention and management tools available to small and medium-sized enterprises (SMEs). The project was a public-private partnership between the private insurance company,

municipalities, public administration, businesses, and insurers to reduce risks caused by exceptional climatic events. The goal was to provide tools and knowledge to SMEs to prevent, manage and improve the capacity to adapt to climate change.

The action is a completed action, and it ran from 2015 until 2018.

The model developed by the project was to support SMEs in increasing the knowledge and evaluation capacity of climate-related hazards, what kind of interventions are needed for risk prevention and risk management to decrease the possible damages and limit business interruptions. The project analysed the possible financial instruments available to local entities to adapt to climate change while assessing their expediency and critical nature in the national context and conducted an in-depth study of possible incentive schemes (including tax incentives) that can create incentives for SMEs to implement interventions to reduce climate risks and increase their resilience.

The crucial aspect of the project was the collaboration with multiple stakeholders: the collaboration with municipalities was important to plan climate adaptation to support the efforts of SMEs, and the inclusion of private companies and insurance companies played an important role in transferring residual risks, all while raising the awareness and knowledge of SMEs of the risk levels.

The project wasn't a part of the legislation, but the involvement of municipalities was important, specifically to take into account the specific needs of businesses while building their adaptation strategies, especially as far as industrial districts are concerned.

The main focus of the activity was climate change adaptation, and the main climate hazards the activity tried to tackle were: floods, rains, wind, landslides, hail, temperature and lightning. The hazards listed were tackled since they were most impactful for that specific area and existing data was available to build the hazard maps.

The project was involved in the draft of the national climate adaptation plan as an example of how to support SMEs in increasing their knowledge about the necessity to adapt to climate change.

Planned impacts and outcomes

One of the key planned impacts was that SMEs fully understand that adaptation to climate change is a way to limit business interruptions

It was much more difficult to involve the SMEs than originally foreseen, the project members had to find new strategies for their successful involvement and to get their attention on the importance of those actions. To solve this issue, the partners increased the collaboration with the municipalities to help involve SMEs in their territories but also worked with business associations and organisations at the local level. This also showed to be a useful method of increasing the capacity of the project to replicate itself, as the local organisations got the first-hand knowledge transfer from the project partners, which they can use for the future and transfer to their members as well.

The level of collaboration with many actors and stakeholders needed to be significantly increased in the local territories. Collaboration between public authorities, private companies, experts and end-users (in this case SMEs) is crucial. The method that was used to involve the SMEs was the

training sessions and field visits which were ad hoc support to build an understanding of what the risks were and how can SMEs prevent them.

It is worth underlying that in many cases the interventions aren't costly and were based on reviewing the existing procedures and processes and integrating and improving those existing processes.

Key factors driving the success of the activity

The involvement of municipalities was really impactful to the project since they managed to engage different players on their territory and highlight the benefits of the project, especially since many businesses are expecting the municipalities to be acting on climate adaptation, and intervene to decrease the levels of risk. It's important to work in synergy together with different stakeholders.

Another success factor was the role of intermediate players which they didn't originally foresee, such as trade organisations, business organisations, and local branches to make the knowledge transfer more efficient and to share the benefits of the project in a clearer way, even after the end of the project.

Training sessions were also used as a motivating factor for the involvement of SMEs, to get hands-on experience.

The pilot phase of the project was successful to acquire useful skills and contributed to the development and testing of the functions and content of the tool developed later within the project.

Key factors of failure or hindering success

The main failure was engaging fewer SMEs than originally foreseen, and much of the effort was used to find new ways to engage the SMEs, which in the end confirmed one of the project's initial assumptions, which was that there is a lack of awareness about this issue.

In the end, two interesting ways of approaching SMEs were found:

- One was that big companies pay more attention to the capacity of their suppliers to avoid business interruptions, and the SMEs had to comply, for which the project provided the solution: a user-friendly tool for climate-related risks
- The second was that the trainings provided offered certifications which were used by the SMEs involved

Initially, physical meetings were planned. However, after the need was created to diversify the channels to approach the SMEs, more meetings were held online and the tools were promoted on social media.

Lastly, an important thing to note would be to focus on having more impactful communication and to focus more on the psychological issue of transferring the information and awareness of the impacts of the risks and thus inducing behavioural change.

Interview 7, 4th of November 2022

Background on the activity

The Riba-Roja de Túria municipality leads the GUARDIAN project, aimed to increase the Spanish municipalities' resilience against the risk of forest fires through the implementation of green urban actions. The area within the project has an extension of 35 hectares and is populated by about 15,000 inhabitants that are potentially affected by fires. The agricultural land is close to the forests, with the municipalities being overwhelmed by the population growth, overbuilding and expansion of lands close to the forests with abandoned agricultural fields and with a serious lack of water, which created a potential exposure of structures and citizens in case of wildfire, that may entail tremendous consequences. The project focuses on building a buffer zone between the residencies and the wildlife to improve the ability to cope with forest fires. Water used for the fires is coming from a wastewater treatment plant. In this context, a hydraulic infrastructure for an advanced treatment of wastewater is under development, with the aim to offer a defensive tool against forest fire risk and build forest fire resilience. Riba-Roja de Túria is also building green firebreaks (i.e. low flammability strips of vegetation) to increase the area's resilience against the forest fires, with management and control of the planted trees in the buffer zone with irrigation.

Planned impacts and outcomes

The main goal was to increase fire resilience and fire security in the area of Túria Natural Park, by applying sustainable water management principles and without changing the environment. More than 35 hectares of "strategic nature" (i.e. green firebreaks and plant species with characteristics allowing to reduce fire risk) are planned to be managed in order to prevent fires at the urban-rural interface, protecting natural areas, biodiversity, agricultural land and the potentially affected population. The use of recycled water for fire extinction helps in preserving water resources, and the irrigation led to improvement in a local lake quality and the reduction of water pollution. In addition, it is recognized that the protection against fires at the interface with urban areas (Wildland Urban Interface, WUI) is not only a fire-fighters' responsibility. Both decision-makers and practitioners, must learn to use integrated fire-resilient strategies, such as implementing irrigation solutions and considering a sustainable water cycle, adjusting the water demand to the actual water availability. Therefore, the project achieved a change in legislation.

Key factors driving the success of the activity

The good management plan was the key to success of the activity in the planning phase of the project, with which key risks were explored, the key project impacts and outcomes and the possible project risks were explored. Effectively managing the project based on a good management plan contributes to having all stakeholders aware of the project details and future planning. Stakeholders have been mainly engaged in awareness-raising campaigns on fire prevention. Training sessions and workshops have been organised to train both residents and schoolchildren on climate change risks for the area, damages from fires, and prevention actions. In addition, specific sessions have been dedicated to presenting and demonstrating the hydraulic infrastructure and its benefits with the objective of increasing its acceptance by the local community and avoiding any conflicts related to potential risks associated with wastewater reuse.

Key factors of failure or hindering success

The restrictions and regulations were difficult, as well as the administration. In the beginning of the project there were 3 partners involved, but one of the project partners was released from the project, due to the slow response rates. The mobilisation of resources and the decision-making process in the institutional environment was a barrier in the process. The financing protocol was a continuous problem, especially if the government doesn't recognise the work as important.

Interview 8, 19th of November 2022

Background on the activity

The consequences of anthropogenic activity in 2022 further raise the spectre of a succession of violent climate crises on the planet, which will unfortunately become the norm in the decades to come. In the face of this major concentric threat, the Interreg program offers sustainable incentive measures which the MICCA project (Mosan Initiative for Climate Change) is taking on board. This is an ambitious scheme to preserve the water resources of the Meuse catchment area, and thus enable the economic, social and environmental adaptation of the territory to climate change.

The project is the expression of a global vision of the circular economy allowing for sustainable environmental management and the implementation of an integrated water policy at the interregional level.It is a European program named INTERREG NWE (North West Europe) and was initiated by local institutions. The activity is focused on adaptation, resilience and innovation

The project aims to fight against water scarcity and low flow in the Meuse catchment area

At this stage, the strategy is under progress. It is complicated to determine the right one because of the multifactorial issues

Planned impacts and outcomes

We are hoping to make a fruitful transnational cooperation among the stakeholders, and the results are that we work on creating cohesion and a dynamic synergy

Key factors driving the success of the activity

At the beginning it is interesting to federate actors around a major issue. The topic itself may lead to the success of this project but until the end, nothing is won

It is important to have all partners on the same page. Any kind of misunderstanding may trigger a negative impact. It is important to maintain a good communication and to provide explanation each time it is necessary

What would you have done differently if you had the chance to start the activity again?

I would probably have checked the feasibility of meeting face to face all the partners before launching the project.

Key factors of failure or hindering success

When managing an international project, it is complicated to make everyone happy. In other words, some people may feel frustrated because they cannot do everything they want

A lack or a bad communication is probably the most important factor that may lead to a failure. The key issues in the planning phase were to assess the resources available during the entire project period. The key issues in the execution phase were to ensure that there is the possibility of adapting to unforeseen circumstances that may arise along the way

Annex III: Regional workshop minutes

REGILIENCE
Regional Pathways to Climate Resilience

REGILIENCE T4.1: Regional Workshop: "Climate-resilient pathways: barriers and opportunities"

JUNE, 2022.

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"Climate-resilient pathways: barriers and opportunities"

Picture 1 The workshop poster

On 8 June, REGILIENCE "traveled" to Spain for a workshop on "Climate-resilient pathways: barriers and opportunities". Together with the Climate Change Office (Spanish Ministry for Ecological Transition and Demographic Challenge) and six representatives from Spanish regions, several challenges and opportunities facing the implementation of climate-resilient action, including bottom-up approaches, were actively discussed.

All participants agreed that there is far insufficient citizen awareness about the need for climate adaptation and resilience action. Citizen surveys could provide a better understanding of perception and acceptance of adaptation measures, but they are not the norm, although in Catalonia's bi-yearly survey climate change ranks as one of the top concerns. It was also mentioned that the interest in adaptation, mitigation and climate-resilience in general is growing among economic sector representatives; however, they shall demand rather sector-benefiting solutions without considering possible negative effects of (mal)adaptation on other sectors or geographic areas, e.g. by demanding more freshwater supply.

Several good practice examples of climate adaptation and resilience and lessons learned were highlighted:

- A working group on impact and adaptation (Grupo de Trabajo de Impactos y Adaptación) was established by the Ministry for Ecological Transition and Demographic Challenge (MITERD) and brings together national and regional actors and other stakeholders, facilitating exchanges on a regular basis and ensuring vertical exchange. It also addresses coordination for the engagement with the "EU Adaptation Mission" with those Spanish regions involved in the EU Mission on Adaptation.
- The adoption of national/regional climate change related laws, as for example the 2017 Catalonian law requirement to include climate change as a component of Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA) procedures, as

consequent action of justice can halt the development of non-climate-resilient investments, e.g. in large infrastructural projects (as a coastal highway).

- The Spanish Citizens Climate Assembly, which just recently published its final recommendations, is an interesting experience to replicate at the regional levels. It has actively addressed adaptation as well as mitigation.
- Working with platforms such as the Covenant of Mayors (e.g. on the Balearic Islands) brings on board almost all municipalities, leading to the adoption of climate-energy plans, while fostering valuable exchanges between the regional and local levels.

During the meeting, the following constraints or problems in fostering cooperation for climate adaptation were mentioned:

- Lack of horizontal cooperation at the regional level, with climate offices not being involved in the adaptation measures carried out under the scope of different departments.
- Lack of vertical cooperation between the local, regional and national scales that prevent the setup of a governance structure to properly manage coastal areas under risk.

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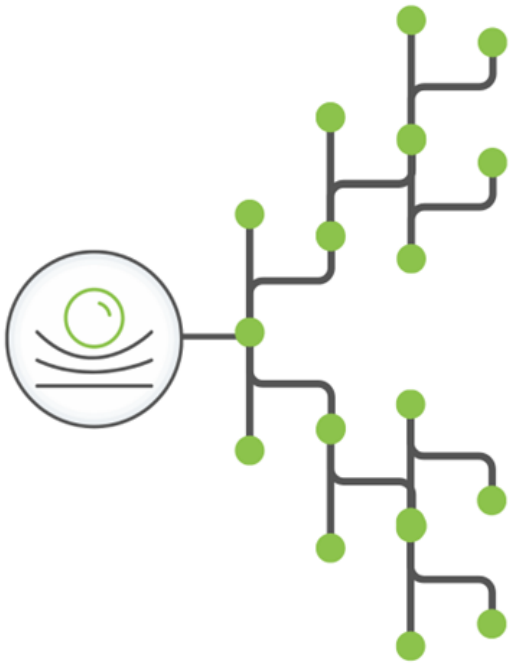


REGILIENCE T4.1: Regional Workshop: Climate adaptation and resilience on the local and regional level – Croatian perspective

JUNE, 2022.

www.regilience.eu

Climate adaptation and resilience on the local and regional level – Croatian perspective

On the 30th of June 2022, the REGILIENCE team has brought together 26 key Croatian stakeholders, including representatives of the local and regional governments, national utility companies and ministries, to discuss climate change adaptation and resilience. The room was unanimous on several points including that we are witnesses to the effects of climate change on a daily basis and that if we wait with adaptation measures until disasters strike it will be too late. The time to act is now, and the key actors in this process are the local and regional governments and their stakeholders and communities. The impacts of climate change will be felt on all levels and will require the cooperation and coordination both vertically (across different levels of governance) and horizontally (across different sectors), however the implementation of the necessary actions will fall on the shoulders of our municipalities, cities and regions. We must all support them in this process, the climate emergency we are facing can't be solved with top-down measures alone.

On a positive note, climate change as well as climate change adaptation and resilience are slowly but surely becoming a relevant topic of conversation across Croatia. Considerations of adaptation to climate impacts are a mandatory section of new projects funded by public money and more and more funds are being made available to adaptation and resilience project and not only for climate change mitigation. We do have a long way ahead of us, but we are at least moving in the right direction.

The general conclusions of the workshop can be summarised as:

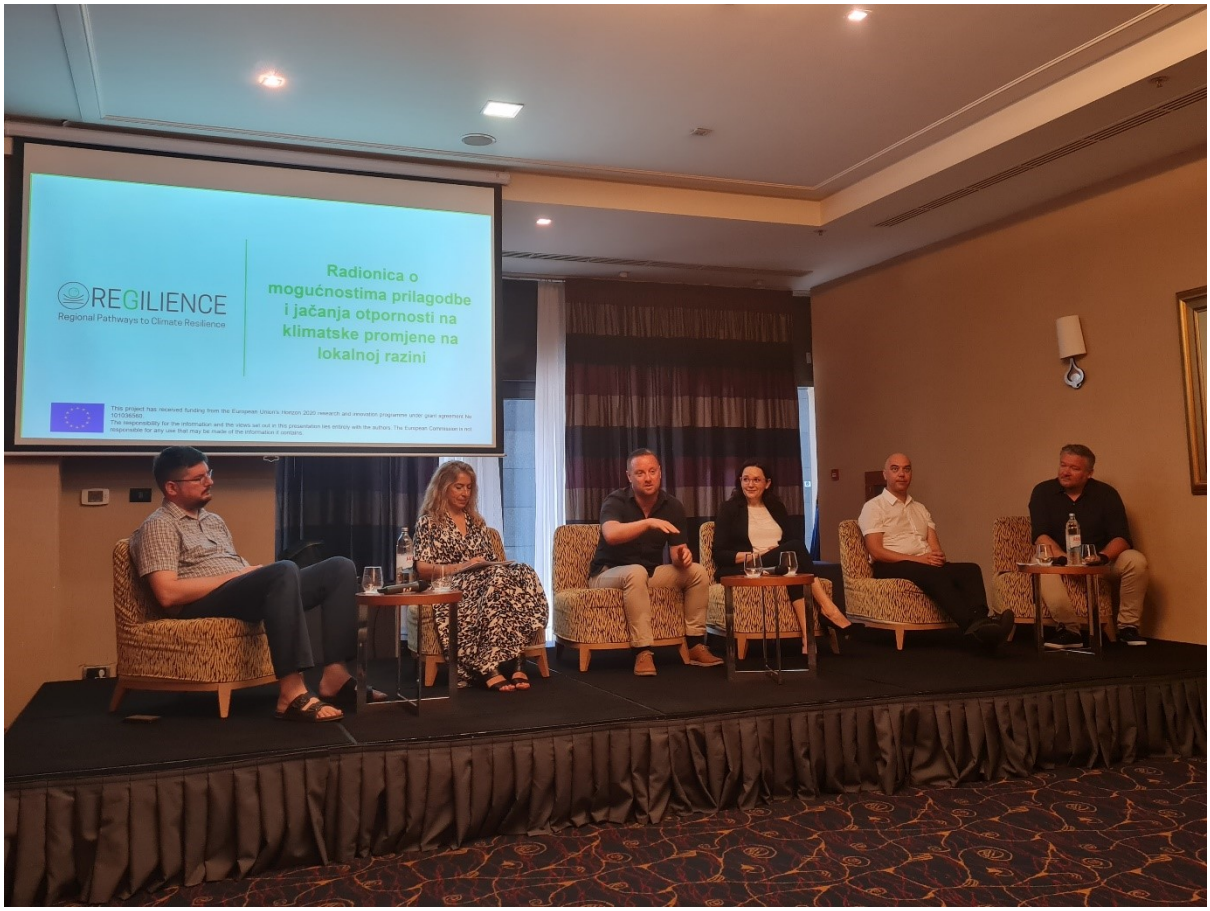
- Climate change is happening, and we need to adapt to it now if we want to be resilient in the future.
- Funding is available and we must use it. It is necessary to support both project development as well as prepared actions to act short and long term.
- Climate change adaptation and resilience actions must be systemic and not just reactionary. We must prepare for and not just react to climate disasters.
- It is vital to act in a coordinated manor, funding, plans and actions need to be aligned and harmonised horizontally and vertically to maximise the impact of the utilized resources.
- We still need more capacity in terms of education and additional experts in key positions across the local, regional and national levels to achieve the targets we have set for ourselves.
- Municipalities, cities and regions as well as their supporting institutions such as energy, climate and/or development agencies are key for achieving success.

The workshop has been organised on the 30th of June 2022 in Zagreb, Croatia in the framework of the REGILIENCE project by REGEA and IEECP and supported by the REGILIENCE consortium. The workshop has been held in Croatian with the following agenda:

Workshop agenda	
10.30 – 11.00	Registration
11.00 – 11.10	Opening and introduction Dr.sc. Julije Domac, REGEA
11.10 – 11.20	Climate change resilience and adaptation – why and how? Ivana Rogulj, IEECP
11.20 – 11.40	How is the Croatian strategic and regulatory framework adapted to the implementation of climate change adaptation and residence measures? Dr.sc. Branka Pivčević Novak, Ministry of Economy and Sustainable Development
11.40 – 12.00	How to finance climate change adaptation and resilience projects on a local and regional level?

	Damir Tomasović, Ministry of Regional Development and EU funds
12.00 – 13.00	**Panel discussion: Planning, funding and implementation of climate change adaptation and resilience projects – experiences of Croatian local and regional governments** Dr.sc. Branka Pivčević Novak, Ministry of Economy and Sustainable Development Damir Tomasović, Ministry of Regional Development and EU funds Ivan Ivanković, City of Zagreb Gordana Lalić, City of Poreč Dr.sc. Ivan Sekovski, UNEP/MAP Priority Actions Programme Moderator: Miljenko Sedlar, REGEA

Picture 2 Workshop presentations



Picture 3 Workshop panel discussion

Annex IV: EU workshop minutes

REGILIENCE
Regional Pathways to Climate Resilience

REGILIENCE T4.1: European Workshop: Climate Adaptation – European Approach and Success Stories

JUNE, 2022.

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Climate Adaptation – European Approach and Success Stories

On the 15th of June, REGILIENCE organized a workshop titled "Climate Adaptation – European Approach and Success Stories" as an event during the General Assembly of FEDARENE in León, Spain.

Regions and energy agencies from across Europe were invited to reflect on the implementation of climate adaptation and resilience measures and be inspired by best practices and experiences from their colleagues. During the first part of the workshop, the REGILIENCE team introduced the mission on Climate Adaptation followed by an in-depth presentation by Johannes Klumpers, Head of Secretariat for Climate Adaptation Mission at DG CLIMA. He shed light on the Green Deal missions, addressing the EU Adaptation strategy and the objective of supporting at least 150 EU regions and communities towards climate resilience by 2030 as an initial step to achieve a climate resilient society by 2050.

Highlighting the focus on regions, the Mission aims to include all regions regardless of their past progress in climate adaptation actions and provide knowledge and support to facilitate the climate adaptation process. EU regulations require member states to provide national adaptation strategies (NAS) and plans (NAP) which can include further support for regional actions. The CLIMATE-ADAPT platform provides all current and past National adaptation strategy (NAS) and National adaptation plan (NAP) documents as well as a lot of helpful information.

Finally, Johannes Klumpers shared the fact that 248 applications have been received to become a signatory of the Mission Charter, whereas 118 signatories have been announced during the first mission to adaptation forum this June.

Picture 4 Presentation of the integration of climate and energy actions into the spatial plans of the city of Karlovac

Picture 5 Presentations of the projects

Picture 6 Introduction to the discussion

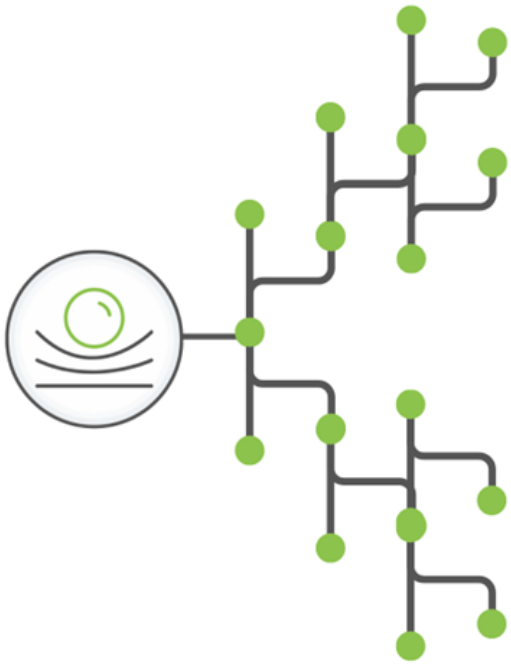
Picture 7 Second part of the workshop

The second part of the workshop focused on the presentation and discussion of successes and failures in resilience pathways. Some good practices and project examples of climate adaptation and resilience were highlighted:

- The integration of climate and energy actions into the spatial plans of the city of Karlovac. Based on the city's plans within the Covenant of Mayors Strategic Energy and Climate Action plans, REGEA supported the inclusion of energy and climate measures into the cities spatial plan. Together, they developed Croatia's first green spatial plan with measures such as ban on the use of fossil fuels for heating, limitation of personal car use in certain areas or the requirement of car parks with green spaces and rainwater management. This process has empowered the City of Karlovac to take the first steps towards the implementation of an integrated and enforceable pathway towards both climate neutrality and resilience. This success already piqued interest in other Croatian cities which are following this process.
- ClimaStory is a pedagogical support for collective reflection on climate change adaptation designed as a serious game. Based on a topographical map of a fictitious territory different stakeholders from a community play together to increase climate resilience. This raises awareness on the impact of climate change and illustrates the interconnections between different sectoral actions. The participants are able to make decisions regarding different sectors (Agriculture and forestry, Industry; Tourism, trade and crafts; Safety and health; Planning, management of resources and biodiversity; commerce, security, health, tourism) and try to find solutions together. For the moment, the game is only available in France but AURA EE aims to develop maps for each of the territories that want to participate and bring discussions that would help regions develop their Climate Adaptation pathways.
- To contrast the negative effects that suppose artificially enclosing the land by dams in the Netherlands, the energy agency of Fryslân Province proposed and implemented the idea of creating small holes in dikes allowing irrigation and the natural flow of water and fish. This helped to restore the natural habitats of fish.

- In lower Austria 23 dedicated Climate Managers are employed by the communities. To ensure that the climate adaptation is coordinated the Energy and Environment Agency of Lower Austria, eNu, employed 4 coordinators. They are supporting the local Climate Managers in their daily work and function as contact points. Additionally, the coordinators help with planning and implementing local climate measures with a better adaptation approach as well as being a first contact point for support.
- Remarkable project is working on the development of a training material on climate plans with the aim to create a map with specific measures towards climate neutrality. The project includes several regions in Europe.

REGILIENCE
Regional Pathways to Climate Resilience



REGILIENCE T4.1: European Workshop: National Adaptation Plans and Strategies in the Theory and Practice – Role of the National and Regional Governments

JUNE, 2022.

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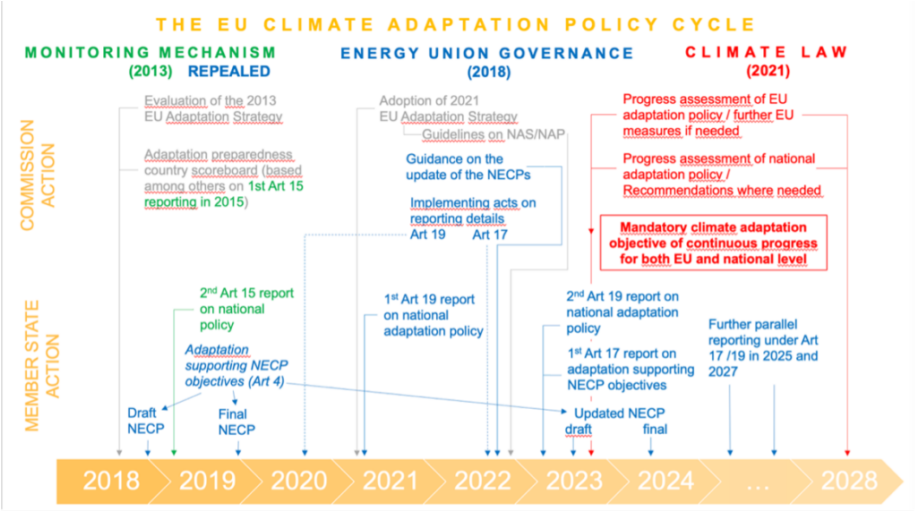
National Adaptation Plans and Strategies in the Theory and Practice – Role of the National and Regional Governments

On the 28th of June, REGILIENCE organised a workshop titled "**National Adaptation Plans and Strategies in the Theory and Practice – Role of the National and Regional Governments**" to discussed how present and future EU policies drive the necessary changes on the ground as well as lessons learnt from the processes of the drafting, implementation, and monitoring of the National Adaptation Strategies from several EU Member States.

Picture 8 Screenshot of the online workshop

To kickstart the workshop **Johannes Klumpers** – Head of Secretariat for Climate Adaptation Mission at DG CLIMA – introduced the work done by the European Commission through the Mission on Adaptation to Climate Change, a new initiative bringing together efforts both financially and policy-wise to help regions and municipalities become climate-resilient. After a thorough explanation of the European policy framework (see picture below), Mr. Klumpers moved on to describe the Mission on adaptation to climate change.



Picture 9 European policy framework

The mission specifically targets regions and cities, the main responsible actors of the many actions that need to be undertaken to reach climate neutrality. The mission has three main objectives on top of gathering a better understanding of climate risks:

- Equip all EU regions with necessary knowledge;
- Help them develop their adaptation plan, aiming to support about 150 regions;
- Upscaling solutions to trigger transformation and develop enabling conditions aiming to support about 75 regions.

More concretely, the Mission will support the regions in two ways:

1. by encouraging them to participate in Horizon Europe (and other research programmes) which can be reached through the Mission innovation platform, the first entry point to access guidance and funding.
2. by engaging them through the Mission Charter, thought to provide some support to regions which are not yet using (or do not have capacity to use) EU funds.

A practical example was offered by **Tom Lamers**, EU Affairs Adviser of the of the Green Metropolitan Region Arnhem-Nijmegen. Tom presented how the Climate Planning is structured in the Netherlands with a strong multi-level governance approach. The Green Metropolitan Region of Arnhem-Nijmegen is a region located in eastern Netherlands and is a cooperation of 18 municipalities, with an economic board representing the knowledge institutions. Its regional strategy has five focusing points: **circularity, productivity, connectivity, green growth and leisure** (climate adaptation is overarching in all five topics).

The main policy instrument at national level is the DELTA PROGRAMME (which was started as a response to the dramatic sea floods of 1953). A commission was installed to prevent such natural disasters in the future. Its work resulted in a world-known infrastructure preventing floods in the north shore, and in one long term strategy on flood risk management, freshwater supply and spatial adaptation. The programme is structured into decisions (6 years periods), which are themselves translated into plans, which are concrete measures for implementation. DELTA is not a top-down but a cooperation between the national government, the provinces, the water authority, municipalities and knowledge institutions and enterprises.

Spatial adaptation is a special sub-programme of DELTA. This is the context where the region sets up the planning measures for the built environment and rural areas (extreme heat, droughts, etc.). The sub-programme is also translated into a delta decision (2015) which includes plans and policies to make the Netherlands water resilient and climate proof by 2050. A DELTA plan on spatial adaptation was adopted in 2018 to set out goals ensuring compliance with the decision.

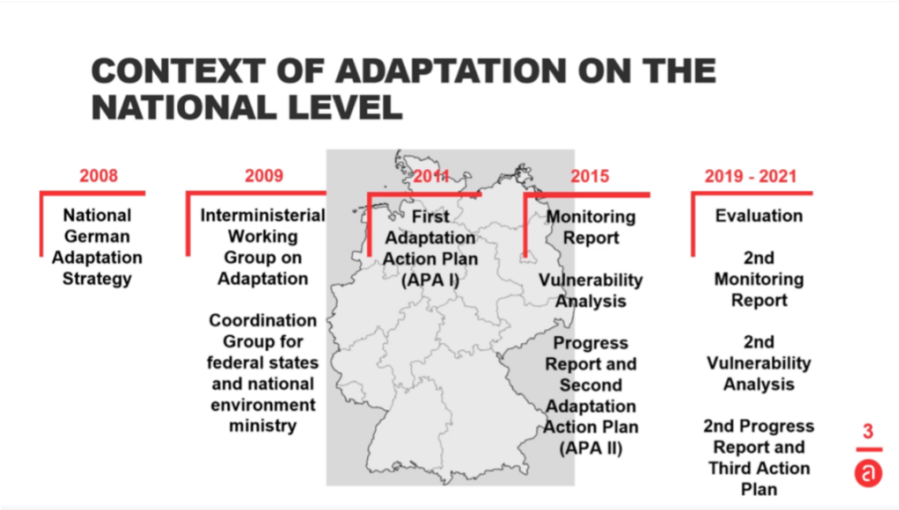
The DELTA programme is structured by 40 work regions in the Netherlands. These actors can identify vulnerabilities to weather extremes, act as pilots for stress tests, and set out ambitions and policies to take necessary measures. They also work together with other supra-regions. The 40 work regions are mostly based on a structure based on water basins and rivers. For example, the Arnhem-Nijmegen region has 7 work regions active (making it a very complex structure). One of the first work region is the one around the city of Nijmegen. This work region started working in 2016 and drafted its adaptation plan in 2019 and action plan in 2020. Some big projects are already implemented (e.g. island 4 km long and 200 m wide in the river).

In the Netherlands the adaptation strategy needs to be viewed as a whole – as an important interlink amongst all the levels. However, although multilevel governance seems to work quite well in the Netherlands, there are still some sectors which are difficult to engage (e.g. agriculture with the ban on pesticides).

Branka Pivčević Novak, Head of Service for general Climate protection policy, Ministry of Economy and Sustainable Development of Croatia presented the national perspective. The national level has the role to create the right framework to allow changes on the ground, which is not always an easy task.

Croatia used a co-creation process for reaching a consensus for the national adaptation strategy: the role of the ministry was drafting the adaptation strategy based on the SEA process (2016-20) with the participation of scientists and experts from universities, media, civil servants, general public, etc. However, it is not always easy to reach a consensus when drafting complex documents which are meant to deal with issues where a lot of scepticism exists. In order to overcome this, the Croatian government involved experts from the meteorologic service, who elaborated scenarios able to show what could happen in the different areas of the country and sectors of the economy in the future if no action was taken. That data was used in workshops all over Croatia, this made people much more involved and interested. Unfortunately, due to economic constraints, this is not easily replicable. More and more work on the ground is done, and policy tools such as Environmental Impact Assessment are a good way to gather data and continue showing the adverse effects of climate change.

Finally, Christian Kind, Head of Programme Adaptation at Adelphi gave an overview on the "Monitoring and evaluation of the German climate change adaptation and resilience efforts". Christian explained the German National Adaptation Process and showcased a detailed timeline of the National German Adaptation Strategy, first published in 2008 and being built upon ever since in a cyclic manner and with the help of the local level. In fact, municipal and regional levels are essential for adaptation however the design of plans saw a very limited active role for cities and regions. Needs are formulated and listened to, however only bit by bit. Barriers are the federal system (which has some advantages, but not in seeing the whole picture) and the fact that adaptation is competing with other important topics (e.g. poverty). It is very important for the national government to fund staff in municipalities in order to increase capacity (not for 1 or 2 years but permanently), funding investments (e.g. infrastructure), providing data (municipalities cannot do it by themselves + economies of scale) and supporting exchange and collaboration.



Picture 10 The overview of the "Monitoring and evaluation of the German climate change adaptation and resilience efforts"

The workshop ended with the Panel discussion "**Lessons learnt of the Climate change adaptation and resilience planning, implementation and monitoring process**", moderated by Vasileios Latinos, Coordinator of Sustainable Resources, Climate and Resilience at ICLEI Europe, where attendees were able to feed the discussion by asking their questions to the speakers.

It was concluded that there is more work to be done, but the geopolitical and economic situation is really rowing against us. The biggest effort should be on capacity building, as we are still lagging as a society. Priorities are not there, and actions that are planned are not efficient enough – what the EC is doing is good, but we really need to invest in capacity building and stop seeing this as an expense but rather as a need.

You can view the full workshop recording at the following link: https://www.youtube.com/watch?v=bRqwLJFtR50.