FutuResilience
Building sustainable futures together

Grant Agreement number: 101094455
Project acronym: FUTURESILIENCE
Project title: Creating future societal resilience through innovative, science-based co-creation labs
Type of action: Coordination and Support Action (CSA)

D2.5 Consolidated report of pilot cases

Deliverable leader	Fraunhofer ISI
Authors	Charlotte Freudenberg, Philine Warnke, Burak Can, Mohsen Pourpouneh, Serdar Türkeli, Bahar Gümüş, Matias Barberis
Due date	30 June 2025
Actual submission date	17 July 2025
Dissemination Level	Public

Abstract: This report presents the results from ten pilot cases under the FUTURESILIENCE project, which aimed to enhance societal resilience through co-creative, science-based experimentation. The pilots—FutuResilience Labs—operated across diverse European settings and followed a shared foresight framework comprising five phases: diagnosing challenges, developing scenarios, prototyping solutions, co-implementing actions, and evaluating outcomes. The labs combined participatory foresight with agent-based modelling (ABM). Foresight tools supported collective anticipation and scenario exploration, while ABM simulated policy impacts in varying socio-economic contexts. Stakeholders participated in structured experimentation linking local knowledge with evidence-based policymaking. Key outcomes include context-sensitive policy recommendations and strengthened cross-sector collaboration. Despite addressing different challenges, common findings highlight the importance of inclusivity, shared ownership, and institutional learning. The project shows that embedding foresight and co-creation in governance processes enhances the capacity of regions to navigate uncertainty and collaboratively shape adaptive, equitable futures.

EFISCENTRE · Fraunhofer ISI · NTNU | Samfunnsforskning
Università degli Studi di Ferrara · Mittuniversitetet Mid Sweden University · Universidad Politécnica de Cartagena · Copenhagen Institute for Futures Studies
Foresight Centre — An independent think tank at the Riigikogu · Maastricht University · Regional Development Institute of Panteion University
1506 Università degli Studi di Urbino Carlo Bo · Bulgarian Association for Personalized Medicine — Each patient matters · Ayuntamiento de Murcia · Δημος Χιου

Document Revision History

Date	Version	Author/Editor/Contributor	Summary of main changes / Status
30-04-2025	0.1	Charlotte Freudenberg, Philine Warnke (Fraunhofer ISI)	Structure of the report
25-06-2025	0.2	Burak Can, Mohsen Pourpouneh, Serdar Türkeli, Bahar Gümüş (UM)	First draft ABM section
30-06-2025	0.3	Charlotte Freudenberg, Philine Warnke (Fraunhofer ISI)	First draft Foresight section and compilation of labs reports
02-07-2025	0.4	Matias Barberis (EFIS)	Quality review
03-07-2025	0.5	Charlotte Freudenberg, Philine Warnke (Fraunhofer ISI)	Second draft Foresight section
16-07-2025	0.6	Philine Warnke (Fraunhofer ISI), Burak Can (UM) and Matias Barberis (EFIS)	Final draft
17-07-2025	0.7	Philine Warnke (Fraunhofer ISI), Matias Barberis (EFIS)	Editing
17-07-2025	1.0	Matias Barberis (EFIS)	Final Submission

Disclaimer
Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

Contents

Executive summary

The FUTURESILIENCE project, initiated under the European Commission's knowledge valorisation policy area, seeks to build societal resilience by bridging research, innovation, and local policymaking. Centred on ten co-creation labs across Europe, the project addresses the pressing need to design responsive and anticipatory policies in the face of increasingly complex and uncertain global challenges, from climate crises and demographic shifts to health system stress and the consequences of geopolitical instability.

The project's foundation rests on the conviction that resilience is not merely a technical or institutional matter but a deeply social process. In this light, FUTURESILIENCE champions participatory foresight as a primary approach—engaging policymakers, civil society actors, researchers, and citizens in exploring future scenarios and co-developing solutions that are locally anchored and broadly legitimate. Across all labs, foresight served not only as a tool to envision alternative futures but also to test and refine policy ideas in a collaborative, evidence-informed manner. The labs worked with multiple tools for policy testing within Foresight and also including Agent-Based modelling supporting evidence-based decision making and simulations (reported under D1.4 Report on Validation Phase)

The **ten FutuResilience Labs**—located in diverse locations ranging from Chios, Murcia, and Cesena to Hamburg, Porto, Ljubljana, Sofia, Tarragona, Kehl-Strasbourg and Tartu —targeted challenges as varied as housing insecurity, healthcare transformation, migration, digital vulnerability, climate adaptation, and rural decline. Each lab adopted a tailored, yet methodologically consistent approach grounded in five key phases: diagnosing issues, developing scenarios, prototyping policies, co-implementing solutions, and evaluating outcomes. This flexible framework allowed local teams to embed co-creation in meaningful ways, while drawing on shared tools such as the FUTURESILIENCE Knowledge Base and Toolbox—both of which were iteratively tested and improved during the labs. Crucially, the labs were **spaces of real experimentation**, where solutions were not just imagined but enacted, tested, and, in some cases, embedded into local governance structures.

A significant achievement of the project lies in its ability to surface both local specificity and broader insights. Despite the diverse themes, several cross-cutting lessons emerged: resilience-building must be inclusive and rooted in lived experience; policy innovation requires trust and co-ownership; and future-oriented thinking must move from abstract scenarios to actionable strategy. Furthermore, the labs highlighted the importance of integrating foresight into institutional routines, rather than treating it as a one-off engagement.

Ultimately, FUTURESILIENCE has demonstrated the power of structured anticipation and collaborative design in supporting more adaptive, equitable, and resilient societies. By turning abstract policy objectives into place-based actions, the project not only advanced methodological innovation but also provided practical pathways for other regions aiming to navigate complexity with confidence and care.

1 Introduction

1.1 Project overview

The FUTURESILIENCE project is part of the European Commission's knowledge valorisation policy and aims to create resilience at local and regional levels by facilitating the fast and effective development and application of evidence-based policies designed in co-creation labs. It is anchored in an action that calls for engaging research communities and citizens in 'experimentation spaces' for creating innovative solutions stemming from existing evidence and policy recommendations. The ultimate goal of the project is to contribute to creating social and economic value from the 10 FUTURESILIENCE labs (Figure 1), working with existing evidence (both scientific and co-developed by citizens or relevant stakeholders) at more local and regional levels, and develop sustainable policies for enhancing societal resilience and increased preparedness given uncertain futures.

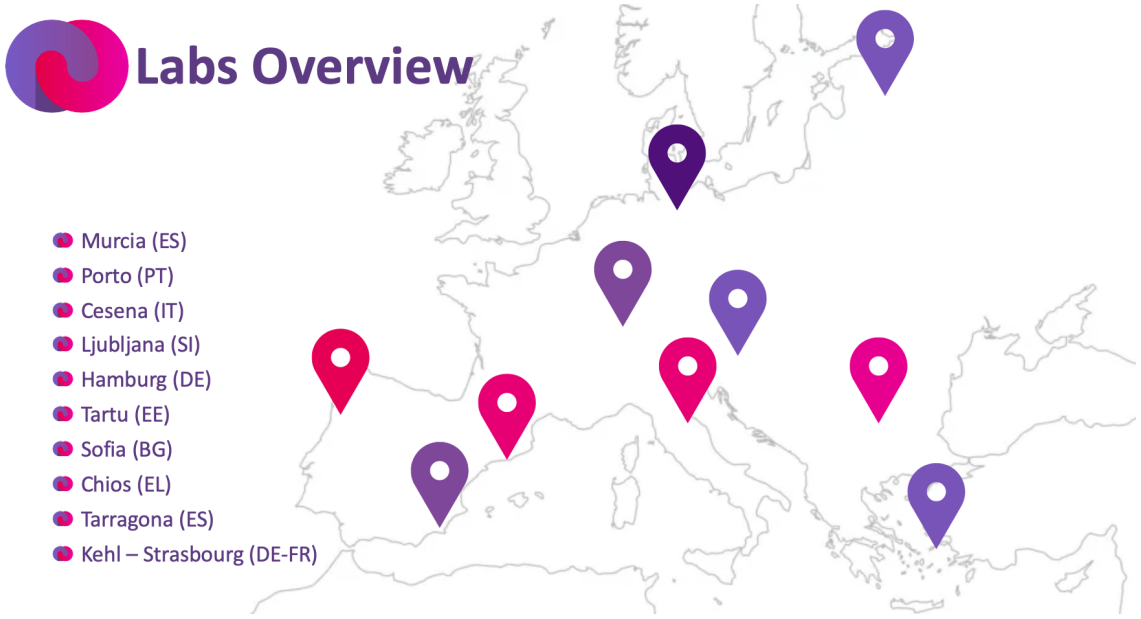


Figure 1: FUTURESILIENCE Labs Overview

The project focuses on developing key policy-relevant outputs that could increase confidence and trust for policymakers and citizens in responding to new challenges. During the first year of the project implementation, the project created a knowledge base with policy actions for building and strengthening societal resilience in multiple key areas such as labour market, housing, education, climate change, mobility, health, finance, etc. Moreover, the project set up a toolbox with multiple tools for policy testing for resilience, including foresight techniques, agent-based modelling, policy tools and multiple thematic tools (also related to thematic areas as pre-identified for the knowledge base).

At the core of the experimentation, the project funded 10 FUTURESILIENCE labs, whose priority were to match the needs at the local, regional or national level with existing policy-

relevant R&I findings ensuring that these findings are translated into policy and new societal solutions.

The project designed detailed Guidelines to facilitate the implementation of the FUTURESILIENCE labs that co-created and tested policy solutions in different fields associated to societal resilience. While three pilots were already part of the consortium (MURCIA, CHIOS and BAPEMED), the consortium launched an open call and selected seven additional pilots using a cascade-funding mechanism.

This report is structured as follows: the next section presents the rationale for societal resilience and the Lab approach; this is followed by an overview of the foresight methodology, including scenario development and agent-based modelling; subsequent sections provide insights into stakeholder engagement, scenario strategies, and use of evidence in policy design across the ten Labs; the final chapters reflect on methodological conclusions, present modelling results, and offer Lab-specific summaries and technical annexes for further detail.

1.2 Rationale for societal resilience and the Lab approach

Building societal resilience through innovation

The FUTURESILIENCE project was launched in response to a world increasingly defined by crises, including pandemics, climate disruptions, migration, energy shocks, and financial instabilities. These challenges have tested the strength and flexibility of institutions and communities across Europe, revealing a critical need for societal resilience. This need goes beyond simply withstanding shocks; it encompasses the ability to adapt to changing circumstances and to transform in ways that prepare societies for future uncertainties.

The project embraced a comprehensive understanding of societal resilience, structured around three fundamental capacities. The first, absorptive capacity, enables systems to endure and withstand immediate disruptions. The second, adaptive capacity, refers to the ability to adjust to new conditions and reorganise accordingly. The third, transformative capacity, empowers societies to rethink structures and innovate in response to systemic challenges.

FUTURESILIENCE sought to enhance all three capacities by promoting the effective use of research and innovation outcomes in both policy development and practical implementation. Crucially, the project acknowledged that resilience is not merely a technical concern—it is inherently societal. Addressing it requires inclusive, collaborative, and context-sensitive approaches that draw on diverse perspectives and local knowledge to build solutions that are both robust and equitable.

The FUTURESILIENCE labs: experimentation in action

To achieve its goals, the project established 10 FutuResilience Labs across Europe. These labs served as real-life experimentation spaces where diverse stakeholders—including policymakers, researchers, civil society actors, SMEs, and citizens—came together to test, co-create, and apply science-based strategies for resilience.

The labs addressed a wide variety of thematic challenges—ranging from urban climate adaptation and personalised healthcare models to migration, social inclusion, and regional

preparedness for cascading crises. All labs operated under the same overarching methodology but were tailored to local realities, needs, and governance structures. Each lab was structured in three key phases (Figure 2):

1. Diagnose and Framing: Describing the problem and identifying the stakeholders.
2. Scenario Development: Understanding how frameworks conditions may evolve.
3. Policy Testing: Selecting policy options and testing their robustness against the scenarios.

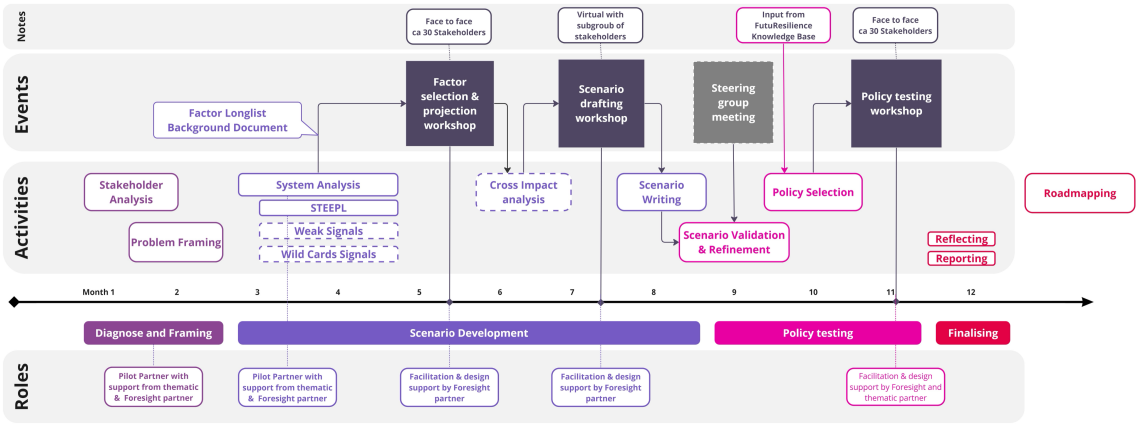


Figure 2: Indicative FUTURESILIENCE Labs Timeline

The FUTURESILIENCE approach brought together evidence-based policymaking and social innovation, creating a science-based yet stakeholder-driven process. It employed a diverse and multi-methodological toolkit designed to navigate complexity and uncertainty. Scenario-based foresight enabled stakeholders to envision and prepare for a range of possible futures, while agent-based modelling provided a means to simulate behavioural responses and the diffusion of innovation under different conditions. Complementing these, design thinking was used to co-create interventions that were human-centred and sensitive to specific contexts.

Co-creation was not treated as an optional add-on but rather as a core element throughout the process. In the project's labs, citizens, public authorities, businesses, and researchers all engaged actively from beginning to end. This inclusive participation ensured that the resulting solutions were deeply rooted in local realities, socially inclusive, and underpinned by robust technical insight.

Translating research into practice: Knowledge Base and Toolbox

The labs were supported by two key resources developed throughout the project. The first was a Knowledge Base, which brought together more than 600 research and innovation findings relevant to resilience in areas such as health, climate, migration, and socio-economic transformation. These findings were carefully selected, filtered, and translated into actionable formats to meet the needs of a wide range of users (See D1.1 Report on mapping policy relevant R&I finding). The second resource was a Toolbox, which provided tested methodologies and practical guidance for activities such as scenario planning, participatory policy design, and evaluation. This Toolbox enabled the labs to identify, assess, and implement research-based interventions tailored to their specific crisis contexts.

Both the Knowledge Base and the Toolbox were rigorously validated through field experiments and cross-lab learning sessions. This process ensured their relevance and usability across different European regions and levels of governance, reinforcing their value as practical instruments for building resilience.

1.3 Methodological approach for Foresight

A core methodological pillar of the FUTURESILIENCE project was the use of foresight techniques to strengthen the ability of stakeholders and systems to anticipate, prepare for, and respond to complex future crises. Foresight, in this context, was not used merely as a predictive tool but to create shared visions, uncover uncertainties, and enable strategic thinking in participatory and systemic ways.

Within the project, foresight served two main functions. First, it supported the development of tailored resilience strategies by offering structured processes to explore possible and plausible futures. Second, it tested the applicability and robustness of research and innovation findings across a range of potential crisis scenarios. This dual role enabled the labs not only to address current challenges, but also to build long-term capacities for adaptation and transformation in the face of unexpected developments.

Scenario development method

The primary foresight method applied across the project was scenario development. Scenarios took the form of consistent, plausible narratives describing alternative future environments shaped by local or regional uncertainties. These narratives provided the foundation for experimentation within the FutuResilience Labs. Each lab created several forward-looking scenarios, tailored to its context, that addressed possible disruptive events such as pandemics, energy shortages, climate shocks, or migration. Research and innovation findings from the Knowledge Base were then tested within these scenarios to evaluate their relevance and adaptability across different conditions, their usability in policy design and community planning, and their potential to support systemic resilience.

Through this stress-testing process, the labs were able to determine which innovations were robust, which required modification, and where additional knowledge or collaboration might be necessary. This approach ensured that resilience-building efforts were not only grounded in evidence but also flexible enough to meet the demands of an uncertain future.

Foresight as a participatory dialogue

Foresight activities were designed as interactive processes involving local authorities, researchers, businesses, civil society actors, and citizens. This ensured that scenario development and exploration reflected diverse perspectives and contextual knowledge**.** By engaging a wide range of actors, the process built collective intelligence**,** fostered mutual understanding, and supported inclusive decision-making.

Dialogue and co-creation within the foresight sessions played a key role in uncovering blind spots and challenging hidden assumptions embedded in current policies. It also helped to align stakeholders around shared challenges and potential opportunities, while enhancing the legitimacy and ownership of the resulting proposed solutions.

The use of foresight proved essential in enabling stakeholders to move from reactive crisis management to proactive resilience building**.** It enhanced long-term thinking, uncovered strategic options, and made it possible to design solutions that were both robust across multiple futures and sensitive to local realities**.**

1.4 Methodological approach for Agent Based Modelling

In addition to foresight methods, agent-based modelling (ABM) has been applied in the FUTURESILIENCE project to understand and simulate complex systems. Two primary modelling paradigms were utilised: top-down and bottom-up approaches.

The top-down approach begins with overarching system characteristics or a collection of behaviours from which it derives rules or explanations. This approach is appropriate when the system is well understood, has centralised control, and is clearly defined in its interactions and other properties. It aligns closely with classic scientific methods focusing on isolation, prediction, and repetition. A well-known top-down approach is system dynamics (SD) modelling, which is used to simulate and understand complex systems by focusing on high-level factors and their interactions. Sy et al. (2021) showcase how SD modelling can be used in pandemic response by simulating how infection rates, healthcare capacity, and economic effects are interconnected.[1] SD models depend on feedback loops and time delays to predict system outcomes. Their research showed that simulation can help policymakers evaluate strategies such as lockdowns or vaccination initiatives.

On the other hand, a bottom-up approach is well suited when the system to be modelled is poorly understood, open with vague components, has partial or decentralised control, or has undefined interactions. This approach, on which ABM is based, focuses on individual agents and their interactions to then observe emerging collaborative behaviour. Contrary to top-down methods, bottom-up problems do not assume reducibility, linearity, time/context independence, or simplicity. Additionally, the classic scientific method (top-down) is less applicable. Such systems are best understood by re-creating them in simulations. ABMs fit particularly well in systems where decentralised control and emergent properties are important, making them ideal for dynamic and complex systems with multiple interacting entities or agents.

Agent-based modelling, also referred to as agent-based systems or simulations (ABS), individual-based modelling (IBM), or agent-based modelling and simulation (ABMS), will be referred to as ABM throughout the remainder of this report for consistency (Macal & North, 2009)[2]. It is a computational simulation framework used to simulate behaviours and interactions of so-called agents within a previously defined environment. By doing so, it captures interactions, emerging behaviours, and complex collective dynamics that arise from individual and autonomous agents interacting with each other and/or the environment.

---

[1] Sy, Charlle, et al. “Systems Dynamics Modeling of Pandemic Influenza for Strategic Policy Development: A Simulation-Based Analysis of the COVID-19 Case.” *Process Integration and Optimisation for Sustainability*, vol. 5, no. 3, 2021, pp. 461–474.

[2] Macal, Charles M., and Michael J. North. “Tutorial on Agent-Based Modelling and Simulation.” *Journal of Simulation*

This methodology is used for studying complex systems because of its ability to provide a bottom-up approach that visualises macro-level outcomes using local (agent) interactions (Macal & North, 2009; Railsback & Grimm, 2012).[3] By focusing on agent interactions and bottom-up dynamics, ABM provides insights that are often inaccessible through traditional modelling approaches. Its accessibility, versatility, and representational fidelity make ABM a powerful tool for researchers and practitioners seeking to understand and address the complexities of the natural and social worlds (Wilensky & Rand, 2015).[4]

In ABM, there are multiple components, such as agents, the environment, interactions, rules, and the interface:

- **Agents** are entities with unique characteristics and behaviours that represent individuals, organisations, or elements such as animals, humans, or other entities. Each agent has states, follows defined rules, and can interact with other agents and the environment. Depending on their properties and status, agents behave differently. These states are dynamic and may change depending on the agent's previous or future state.
- The **environment** sets the context in which agents exist and interact. It may be physical (e.g., a geographic grid or map) or abstract (e.g., a network). As agents can interact with the environment, it can influence their behaviour through, for instance, barriers or network topology.
- **Interactions** are one of the mechanisms through which the state of agents may change. This occurs when agents interact with the environment or other agents, either directly (e.g., two agents communicate or make contact) or indirectly (e.g., by sharing the same environment). These interactions are fundamental to the emergence of complex behaviours observed in ABMs.

To control how states change and decisions are made, rules and schedules are defined during development. These may be based on model-generated data, the modeller's choices, or randomness. Depending on the objectives of the model and the system's complexity, the rules may be either simple or intricate. In some cases, a large number of simple, interwoven rules can result in a highly complex system. While ABM is the theoretical foundation of this research for the creation of the models, it uses NetLogo (Version 6.4) as a development environment and observer interface.[5]

[3] *North, Michael J., and Charles M. Macal. "Agent Based Modeling and Computer Languages." Encyclopedia of Complexity and Systems Science, edited by Robert A. Meyers, Springer, 2009.*

[4] Wilensky, Uri, and William Rand. *An Introduction to Agent-Based Modeling: Modeling Natural, Social, and Engineered Complex Systems with NetLogo*. MIT Press, 2015.

[5] NetLogo was developed in 1999 by Uri Wilensky and is widely used by students, teachers, and researchers for multi-agent programming (NetLogo, 2023). On its website, it offers various guides, additional resources, a forum to connect with other users, and a model library.

2 The FUTURESILIENCE Labs Foresight Activities

2.1 Overview

Table 1 below provides a very brief overview of each FUTURESILIENCE Lab, summarising their societal challenge, methodological approach and key outcomes. For a comprehensive documentation and in-depth insights, please see Appendix 1 containing the summarised FUTURESILIENCE lab reports.

Table 1: Overview FutuResilience Labs

Name & Location	*Challenge*	*Approach*	*Results*
BAPEMED Lab (Bulgaria)	Unsustainable healthcare, systemic inefficiencies	Participatory foresight, scenario-building, backcasting	3 policy proposals: improved data systems, workforce resilience, early detection
CHIOS Lab (Chios, Greece)	Climate change and migration pressures	Foresight, intercultural dialogue	Enhanced mutual understanding, cross-community initiatives, resilience networks
COSIGHT Lab (Hamburg, Germany)	Urban social polarisation and fragmentation	Co-created scenarios, inclusive dialogue workshops	Trust-building, strategic insights for vulnerable groups (refugee women, youth)
FICTIONS Lab (Porto, Portugal)	Labour shortages, tech impact on wellbeing	Speculative Design, worker training	9 policy proposals; replicable participatory method recognised
IMMER Lab (Strasbourg–Kehl, FR/DE)	Mobility and energy resilience in cross-border cities	Narrative foresight, science-fiction	Cross-border cooperation, dynamic planning tool introduced (portulan chart)
LIQUIDHOUSING Lab (Tarragona, Spain)	Insecure, informal housing conditions	Strategic foresight, Tetralemma	20 policy proposals; fostered institutional dialogue and awareness
MULTILOCAL Lab (Tartu County, Estonia)	Multilocal living, spatial planning strain	Scenario planning, digital forecasting tool	Tool to simulate demographic trends; new governance strategies
MURCIA Lab (Murcia, Spain)	Urban climate resilience	3-step participatory foresight process	6 scenarios, 30+ policies; boosted cross-sector collaboration
SCRL (Slovenia)	Cybersecurity risks for start-ups	Scenario planning, training, stakeholder engagement	Policy guidance for cyber resilience; awareness in innovation ecosystem
TIMES Lab (Cesena, Italy)	Civil protection gaps in volunteer coordination	Storytelling, co-creation, scenario development	Civic training plan, digital volunteer platform, updated GIS & plans

2.2 Stakeholder involvement

The following table provides an overview of stakeholder involvement across the different labs, including the number and types of stakeholders engaged, as well as insights into recruitment experiences and strategies used to ensure participation. Further information can be found in the Appendix 1.

Table 2: FutuResilience Labs Stakeholder Involvement

Lab	*Number of Stakeholders involved*	*Key stakeholder groups*	*Recruitment experience*
BAPEMED	30–40	Ministry of Health, National Patients' Organisation (NPO), Ministry of Electronic Governance, Health & Life Sciences Cluster Bulgaria, Bulgarian Pharmaceutical Union, startups, hospitals, public health institutions	Recruitment benefited from BAPEMED's strong local networks and credibility. Despite political instability and public distrust, stakeholder interest was high. Challenges included maintaining participation across workshops, especially with high-level actors.
CHIOS	30-35	Public Health Directorate, Regional Hospital of Chios, Municipality of Chios, Migration and NGO representatives, healthcare professionals, academics, Ministry of Migration and Asylum, the Ministry of Maritime Affairs and Island Policy, representatives from primary and secondary education, UNHCR, UN Refugee Agency.	Recruitment was facilitated by existing local networks and strong institutional collaboration. Some effort was needed to ensure inclusion of marginalised groups and migrant voices.
COSIGHT	100+	Academia, politics, NGOs, social entrepreneurship, business sector, media, integration practitioners, local authorities	Recruitment was challenging due to COSIGHT being a relatively new actor. Stakeholder engagement improved over time through networking, visibility, and demonstrated added value.

Lab	*Number of Stakeholders involved*	*Key stakeholder groups*	*Recruitment experience*
FICTIONS	34 manufacturing operators taking part in the Lab, circa 10 of which were Lead Users. In addition, 14 external experts joining the workshops.	Manufacturing workers (dst group), design researchers, digital tech researchers, external specialists	Workers were recruited via employer; motivated and consistent participation aided by training and relevance. External experts involved early and at end; more continuity would be beneficial.
IMMER	~40	Civil society organisations, think tanks, public sector representatives, academia, engaged citizens	Recruitment benefited from the existing network of IMMER.
LIQUIDHOUSING	40+	Municipal representatives, housing cooperatives, local residents (incl. migrants and youth), architects, NGOs; professional bodies	Recruitment benefited from established trust and local presence. Focus on housing attracted high engagement.
MULTILOCAL	~15-20	Local and national authorities: municipalities (in Tartu County), municipal associations, regional development organisations, ministries (Regional Affairs and Agriculture, Digital and Justice)	Successful: stakeholders were identified early and remained engaged throughout; low dropout rate; strong co-creation and collaboration experience.
MURCIA	~20-25	Municipal staff, regional authorities, educators, NGOs, local experts	low level of citizen participation in response to the calls to join the workshops, which led to adjustments in the design of the sessions. To address this, the organising team made a greater effort to involve citizens in the process.

Lab	Number of Stakeholders involved	Key stakeholder groups	Recruitment experience
SCRL	~50	Local governance actors, rural entrepreneurs, innovation experts, academics, NGOs	Recruitment leveraged prior project relationships; participation benefited from regional relevance.
TIMES	~40 (+ 142 questionnaire respondents and 800+ students)	Municipality departments, Civil Protection, spontaneous volunteers, associations, schools, local residents	Recruitment faced initial challenges despite relevance of topic. Required adaptation, informal outreach, and strong institutional support to ensure wide community involvement

2.3 Foresight process outlined in the Toolbox and Guidelines

The following table outlines the scenario approaches used by each lab, the number of scenarios developed, and how the strategy development phases were implemented in alignment with the project's foresight Guidelines. Further information can be found in the Appendix 1.

Table 3: FutuResilience Labs Scenario Building Approaches

Lab	Scenario Approach	Number of scenarios developed	Approach to strategy phases
BAPEMED	Factor-based framework for diverse and plausible scenarios, not the traditional 2x2 matrix; used 4 future-oriented scenarios (Business-as-usual, Private Sector Dominance, Climate-centric Governance, AI-driven Healthcare)	4	All five phases and steps of the Guidelines were conducted: 1. Problem definition & stakeholder analysis, 2. Factor assessment & scenario development, 3. Policy identification & scenario validation, 4. Policy testing, 5. Assessment & reporting
CHIOS	Explorative, participatory scenario building using trend analysis and local stakeholder input	3	All five phases and steps of the Guidelines were conducted: 1. Problem definition & stakeholder analysis, 2. Factor assessment & scenario development, 3. Policy identification & scenario

Lab	*Scenario Approach*	*Number of scenarios developed*	*Approach to strategy phases*
			validation, 4. Policy testing, 5. Assessment & reporting
COSIGHT	Iterative foresight through civic dialogue events ("CoSaturday") - with mixed methods (Tetralemma, Future Headlines, Backcasting & Roadmapping)	4	All phases applied: trend/conflict analysis, scenario building, backcasting, roadmapping, and policy transfer steps.
FICTIONS	Participatory speculative design; integrated digital and future-of-work focus	4	Full process conducted: issue framing, factor selection, scenario building, prototyping, reflection, and policy formulation.
IMMER	Narrative-based foresight using immersive and dystopian story worlds - Combined qualitative and quantitative foresight (e.g. visioning, windtunneling, policy stress testing); context-driven and iterative	3	All key foresight strategy phases conducted: problem framing, visioning, scenario testing, policy design, stress-testing.
LIQUIDHOUSING	Urban speculative design exploring future housing insecurity	4	All phases conducted: problem framing, trend analysis, scenario development, backcasting, strategy formulation, validation.
MULTILOCAL	Data-driven scenario co-creation with local administrations	3	Main three phase structure: Diagnosing & Framing → Scenario Building & Prototyping → Scenario Assessment & Policy Design.
MURCIA	Participatory scenario building using local data and creative sessions.	6	All five phases and steps of the Guidelines were conducted: 1. Problem definition & stakeholder analysis, 2. Factor assessment & scenario development, 3. Policy identification & scenario validation, 4. Policy testing, 5. Assessment & reporting.
SCRL	Cybersecurity foresight using STEEPL-based factor analysis	4	All five phases and steps of the Guidelines were conducted: 1. Problem definition & stakeholder analysis, 2. Factor assessment & scenario development, 3. Policy identification & scenario

Lab	*Scenario Approach*	*Number of scenarios developed*	*Approach to strategy phases*
			validation, 4. Policy testing, 5. Assessment & reporting.
TIMES	Foresight-based co-design using participatory storytelling and future visioning (e.g., "Newspaper of Tomorrow")	4	All five phases and steps of the Guidelines were conducted.

2.4 Use of evidence in the policy design

Several labs made use of the Knowledge Base to select and adapt policy-related recommendations, particularly in areas such as health, housing, digital transformation, and cybersecurity. While it provided a valuable foundation, it often needed to be contextualised to local circumstances, including political structures, regional particularities, or specific target groups. Some labs used the Knowledge Base primarily for orientation and inspiration, while others integrated it into scenario analyses or policy design processes. More information in the type of evidence used by the labs is provided directly in the Annexes as well as in detail in D1.4 Report on Validation Phase.

2.5 Methodological conclusions on the lab's foresight processes

An analysis of the ten FutuResilience Labs reveals a shared commitment to scenario-based foresight as a core methodology, yet with considerable variation in interpretation, application, and depth. While all labs adhered to the foundational Guidelines laid out by the FUTURESILIENCE project, they operationalised the foresight process in ways that reflected their thematic focus, stakeholder capacities, and local governance contexts. The Guidelines provided a flexible yet structured pathway—diagnosis, scenario development, policy prototyping, co-implementation, and evaluation—but labs adapted these phases pragmatically to address practical constraints or leverage local assets.

Some labs (e.g., BAPEMED, SCRL, and MURCIA) followed the full cycle of the Guidelines closely, embedding foresight across all five strategic phases and integrating structured tools such as windtunnelling, backcasting, and STEEPLE factor analysis. Others, such as the FICTIONS, TIMES and IMMER Labs, adopted more experimental and creative foresight formats—emphasising narrative design, artistic prototyping, or speculative world-building. These variations enriched the overall methodological spectrum of the project and showed that foresight, when properly contextualised, can support both systemic policy development and grassroots civic engagement.

A key methodological insight is that foresight should not be treated as a rigid, one-size-fits-all framework. Rather, its value lies in enabling reflection, anticipation, and transformation through participatory processes tailored to each setting. In this regard, flexibility proved to be an asset: where highly structured foresight was appropriate for systemic challenges (e.g., cyber resilience or health governance), more open-ended, imaginative formats were more effective for building social cohesion or democratic imagination.

From a resilience perspective, the labs collectively affirmed that foresight plays a critical role in identifying systemic vulnerabilities, stress-testing existing assumptions, and surfacing opportunities for innovation. It fosters long-term thinking in environments often dominated by short-term pressures, and—when participatory—builds ownership and legitimacy around contested decisions. Moreover, the labs illustrated that resilience is not merely about absorbing shocks but about shaping transformative trajectories that align with community values and social equity.

Opportunities for future foresight work include stronger integration with digital tools (as seen in the MULTILOCAL Lab), greater emphasis on engagement methodologies tailored to marginalised or underrepresented groups, and closer alignment with policy cycles to maximise impact. At the same time, pitfalls to avoid include overly technocratic approaches that exclude lived experience, and foresight activities that remain disconnected from institutional follow-up or budgetary frameworks.

In conclusion, the FutuResilience labs demonstrated that foresight, when combined with co-creation and local anchoring, can significantly enhance resilience strategies across diverse domains. The FUTURESILIENCE project will present the developed policy options in the form of a consolidated roadmap.

3 Results from the Agent Based Modelling

3.1 BAPEMED Lab

For this Lab, an ABM was developed to explore future scenarios in order to identify effective solutions by analysing demographic trends, the burden of chronic diseases, and the role of technology. Using the model, BAPEMED aimed to test and develop policy recommendations. In doing so, it addressed systemic issues such as workforce shortages, the emigration of healthcare professionals, and rising costs associated with demographic shifts and chronic diseases. As part of the wider project, the developed ABM constitutes one component of the research intended to strengthen Bulgaria's ability to respond to future health crises, improve health outcomes for citizens, and potentially set a benchmark for other nations facing similar challenges in transitioning to personalised and technology-driven healthcare systems.

The simulation model was designed to represent and explore the dynamics of healthcare accessibility and outcomes within the geographic and socio-economic context of Bulgaria. The model integrates key elements of health system functioning—including public and private hospital infrastructure, patient demographics, financial disparities, and insurance coverage—to evaluate how these factors interact to shape individual and systemic health outcomes.

At its core, the model investigates how effectively patients can access medical treatment in a dual-tier healthcare system, and what barriers—such as cost, capacity limitations, and insurance restrictions—may prevent equitable treatment. Patients in the model are characterised by differing levels of wealth and insurance coverage, and must choose among hospitals with varying availability, cost structures, and acceptance policies. Hospitals, in turn, face constraints on capacity and may become overloaded, leading to negative outcomes for patients who cannot secure timely care.

The primary goals of the simulation include:

- Analysing the performance of healthcare infrastructure under different conditions (e.g., increased demand, limited public capacity).
- Examining the effects of insurance status and wealth inequality on treatment access and health outcomes.
- Comparing the performance of public versus private healthcare institutions in terms of patient throughput, overload frequency, and mortality.
- Testing hypothetical scenarios or policy interventions, such as expanding insurance access or subsidising private care, and evaluating their impact on overall healthcare efficiency and equity.

By visualising these interactions and outcomes over time, the model supports informed discussion on healthcare reforms, resource allocation, and the potential consequences of healthcare privatisation or universal insurance initiatives. It also serves as a learning tool for policymakers, researchers, and students interested in health economics, system modelling, or social policy planning.

Agents and Variables

The simulation defines two primary agent types—patients and hospitals—and several global variables that track the overall performance of the healthcare system during the simulation. These agents interact in a dynamic environment governed by resource constraints, individual needs, and institutional policies.

Global Variables

These are system-level indicators that help evaluate the aggregate results of the simulation. They are crucial for analysing trends and measuring outcomes across time steps (ticks):

- tick-counter: Measures the simulation's progression in discrete time units ("ticks"), used to track temporal patterns.
- total-treated: Cumulative number of patients successfully treated.
- total-deaths: Total count of patients who died, likely due to being untreated, delayed, or mismanaged.
- total-overload: Number of times hospitals exceeded their maximum capacity, highlighting system pressure points.
- total-stranded: Number of patients who failed to receive treatment due to a lack of access or affordability.
- total-treated-attempts: The number of attempts patients made to receive treatment, which may include multiple retries due to hospital refusal or overload.

These variables are essential for tracking the effectiveness, equity, and efficiency of the healthcare system over time.

Agent Types

Patients

Patients represent individual citizens within the healthcare system who may fall ill and seek treatment. Each patient agent is defined with several properties that influence their healthcare-seeking behaviour and outcomes:

- health-status: Describes the current state of the patient’s health. Its likely changes over time and is influenced by whether they receive timely and adequate care.
- wealth: Indicates the patient’s financial resources. Wealth levels may determine whether a patient can afford private care, particularly if uninsured.
- illness-duration: Reflects how long a patient has been sick. A growing duration without treatment might increase the risk of death or complications.
- in-treatment: Boolean (true/false) flag that marks whether the patient is currently being treated.
- treatment-time: The expected number of ticks a patient needs to remain in treatment before recovery.
- insurance-status: A Boolean attribute indicating whether the patient holds health insurance, affecting their access to specific hospitals (especially private ones).

Patient behaviour:

In the simulation, each patient (agent) acts autonomously based on their current health condition, financial resources, and the constraints imposed by the healthcare system. Their behaviour reflects decision-making under uncertainty and limited resources, which closely mirrors real-life scenarios faced by individuals seeking medical care in mixed public-private healthcare environments.

Decision-Making Process

Each patient must determine whether, when, and where to seek treatment. This decision-making process is influenced by several key factors:

- Health urgency: As the illness-duration increases, the patient's condition worsens, likely increasing the probability of death if left untreated. This incentivises early treatment-seeking behaviour.
- Proximity to hospitals: Patients likely consider hospitals within a reachable distance. If no hospitals are nearby or accessible (e.g., due to geography or system constraints), the patient may become stranded.
- Insurance status: A major determinant in whether the patient can access private hospitals, which may restrict admission to insured individuals only.
- Wealth level: If a hospital's daily cost exceeds the patient's wealth, treatment may be unaffordable, particularly in private hospitals with higher fees.

Treatment Attempt

Once a patient decides to seek care, the following likely occurs:

The patient scans nearby hospitals to find one that:

- Is not at full capacity (workload < capacity),
- Accepts his/her/their insurance status, and
- Charges a cost that is within their financial means.

If a suitable hospital is found:

- The patient is marked as in-treatment = true.
- The hospital's workload is incremented.
- A treatment-time counter is initiated, after which the patient is discharged and counted as total-treated.

If no hospital satisfies all conditions:

- The patient remains untreated.
- The simulation increments total-stranded, and illness continues to progress.

Consequences of Untreated Illness

Patients who fail to receive care are subjected to worsening health, simulated by increasing illness-duration. If a critical threshold is exceeded (likely coded in the death logic), the patient dies, contributing to total-deaths.

Reattempts

If treatment was not successful or unavailable, the patient may try again in subsequent ticks, depending on their persistence logic. Each reattempt:

- May update the total-treated-attempts metric.
- May lead to successful care if a hospital becomes available or if the patient's financial/insurance status changes.

Recovery and Discharge

Once a patient completes their treatment time, they exit the treatment state (in-treatment is set to false) and are no longer counted in the hospital's workload. Additionally, they are added to the total-treated statistic.

Hospital

In the simulation, hospitals serve as service-providing agents that accept, treat, or reject patients based on a set of operational and policy-driven constraints. Each hospital represents either a public or private healthcare facility, with distinct characteristics that impact accessibility, capacity, and affordability.

Hospital Types and Admission Policy

Public Hospitals typically have larger capacity and lower daily treatment costs. They are expected to be more inclusive, often accepting all patients regardless of insurance status or wealth. Public hospitals represent the state-funded healthcare system.

Private Hospitals, on the other hand, tend to have smaller capacity and higher treatment costs according to BAPEMED experts. They may impose stricter admission criteria, such as only accepting insured patients or those with higher incomes. These hospitals represent profit-driven medical institutions.

Hospitals apply these rules when evaluating patient admission requests.

Capacity and Workload Management

Each hospital maintains a dynamic variable:

- Capacity: Maximum number of patients the hospital can treat concurrently.
- Workload: Current number of patients undergoing treatment.
- Accept patients only if their workload is below capacity.
- Reject or turn away patients if they are full, contributing to the total-overload count.
- Discharge patients after treatment, reducing the workload and freeing up space.

This system simulates bottlenecks and triage pressure experienced during healthcare crises (e.g., pandemics or resource shortages).

Cost Structures and Profitability

Each hospital has a daily cost representing the cost of a single day of care. This cost:

- Is lower in public hospitals (state-subsidised).
- Is higher in private hospitals, which seek to generate profit and may demand upfront payment or proof of insurance.
- Patients unable to afford the cost are not admitted, unless policy overrides allow otherwise (e.g., emergency treatment in public hospitals).

Insurance Policy Enforcement

Hospitals also take insurance status into account when admitting patients. Depending on their policies, some hospitals may accept uninsured patients, while others, particularly private hospitals, might only treat those with insurance coverage and may deny treatment to uninsured individuals.

Patient Discharge

Upon completion of a patient's treatment, the patient is removed from the hospital's workload and considered successfully treated, which updates the global statistics. Following this, the hospital becomes available to admit new patients in the subsequent ticks.

Initialisation Procedures

The setup procedure clears previous simulation data and initialises the environment. It also imports a background image of Bulgaria, which is assumed to map real-world geography. After this, it calls a series of functions including setup-public-hospitals, setup-private-hospitals, and setup-patients. Additionally, global tracking variables are initialised to zero.

Hospital Placement

Valid-hospital-locations define the patches or areas suitable for placing hospitals, identified by a specific colour code in the map image (pcolor = 28.1). The function setup-public-hospitals randomly places public hospitals on these valid patches, while setup-private-hospitals similarly places private hospitals.

Simulation Dynamics

The simulation operates in discrete time steps called ticks, during which agents (patients and hospitals) evaluate their conditions and interact according to defined behavioural rules. Each tick simulates a "day" in the healthcare ecosystem.

1. Initialisation (Setup)

- The environment is cleared and reset.
- A map of Bulgaria is loaded as a spatial background to represent valid geographic locations.
- Hospitals (both public and private) are randomly placed on valid land areas using pcolor = 28.1 (likely land terrain).
- Patients are distributed across the map with randomly initialised attributes (e.g., wealth, health, insurance).

2. Time-Step Operations

During each tick in the simulation, a sequence of operations was carried out to reflect the ongoing dynamics within the healthcare system. First, patients in need of treatment assessed nearby hospitals based on factors such as accessibility, insurance status, and affordability. Hospitals then evaluated these patients for admission, accepting or rejecting them according to their current capacity and institutional policies.

For patients already undergoing treatment, their remaining treatment time was reduced accordingly. Once a patient's treatment was completed, they were discharged, thereby freeing up hospital capacity. Meanwhile, patients who were not receiving treatment could experience a deterioration in their health status and an increase in the duration of their illness. If certain thresholds were exceeded, the patient might die.

At the end of each tick, global statistics—such as the total number of patients treated, the number stranded without care, and other key indicators—were updated to reflect the current state of the system.

3. Key Interactions

- Overload Events: Hospitals that are full reject patients, which increases the total-overload count.
- Stranded Patients: Patients unable to find any suitable hospital (due to location, affordability, or insurance) remain untreated, raising the total-stranded count.
- Mortality: When a patient exceeds a predefined illness threshold without receiving care, they die, contributing to total-deaths.

4. End Conditions

The simulation may either:

- Run for a fixed number of ticks, to observe system behaviour over time.
- Or stop when a specific event occurs, such as when all patients are treated or dead

The following figure shows the ABM interface in NetLogo, for the case of BAPEMED in Bulgaria, before the simulation is executed. The parameters are set by the user, for demonstration purposes. To test the effect of different policy interventions, the user can change the values of the parameters of the model to reflect the impact of varying intervention choices.

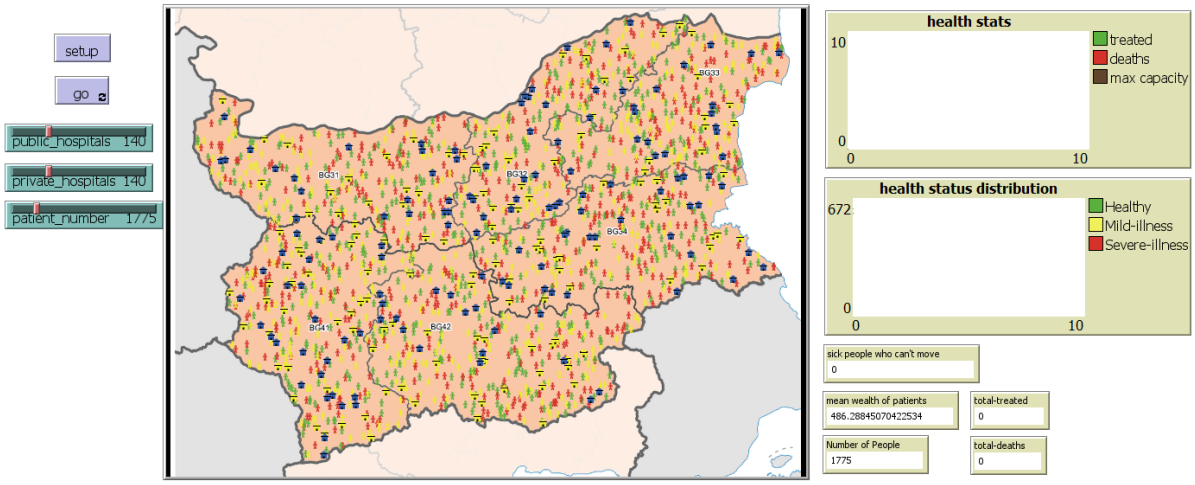


Figure 3: BAPEMED ABM initial setup

Results

Key global variables include the total number of patients successfully treated (*total-treated*), the total number of deaths due to untreated or delayed care (*total-deaths*), and the number of patients who failed to receive treatment due to access or affordability issues (*total-stranded*). Other variables, such as *total-overload* and *total-treated-attempts*, highlight system bottlenecks and the frequency with which patients are forced to reattempt access to care. These metrics provide insight into the operational strain on hospitals and the overall accessibility of healthcare under different scenarios.

Over the course of the simulation, patients with differing wealth and insurance statuses interact with public and private hospitals, each characterised by distinct cost structures and capacity constraints. Public hospitals typically offer lower daily costs and broader admission policies, whereas private hospitals charge more and may only admit insured patients. As the simulation progresses, hospitals frequently reach capacity, leading to increased *total-overload* events and higher *total-stranded* and *total-deaths* counts. These outcomes illustrate the consequences of systemic inequalities and limited healthcare infrastructure, especially under stress conditions such as increased patient demand. The model thus enables the visualisation of access disparities and supports evaluation of potential policy interventions, such as expanding insurance coverage or subsidising private care.

The following figure shows an example of the execution of the simulation.

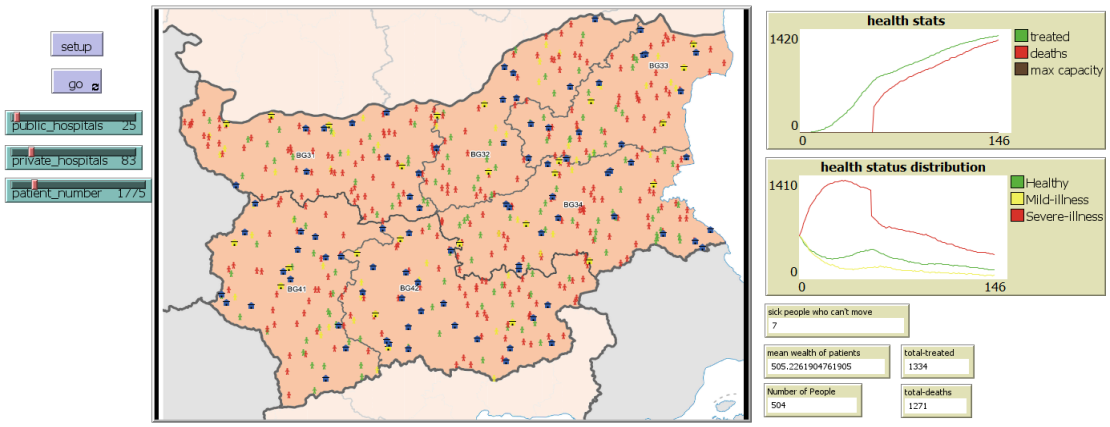


Figure 4: Simulation results for BAPEMED for the given parameters

3.2 CHIOS Lab

The Chios lab aimed to support the island of Chios in navigating the intertwined challenges of **climate change and migration**, both of which had significant and growing impacts on local society. In particular, these issues put intense pressure on **waste management systems**, strained community cohesion, and affected local economic activities such as agriculture.

Considering the challenges and pressures faced in the Chios lab, it became clear that there was a need for policies promoting both social and environmental resilience. Waste management, as one of the most critical pressure points, emerged as a priority. With more people arriving on the island and its limited resources and infrastructure, Chios faced an increasing level of solid waste. This rise in waste affected daily life, public health, and had long-term consequences on tourism, agriculture, and local ecosystems, which were all essential for the island's sustainability.

As part of the FutuResilience project, the Chios Lab was created to address these needs. It focused on social protection, healthcare, community engagement, and sustainability with the objective of strengthening the island's resilience to these interconnected challenges.

In ABM, there were multiple components: agents, environment, interactions, rules, and the interface. Agents acted as entities with unique characteristics and behaviours, representing individuals, organizations, or even objects such as trash cans. Each agent had states, followed defined rules, and could interact with other agents and their environment. Depending on their properties and status, agents behaved differently, and these states were dynamic, changing over time.

The environment set the context in which agents existed and interacted. It could be physical (e.g., a geographic grid or map of Chios) or abstract (e.g., a network). Because agents could interact with the environment, this context could directly influence their behaviours through elements like barriers or spatial layouts.

Interactions changed agents' states, occurring when agents engaged with the environment or each other, directly (e.g., physical contact or communication) or indirectly (e.g., shared environmental conditions). These interactions were fundamental to creating the emergent properties observed in ABMs.

Scenario Development

The chosen scenario focused on understanding how climate change and ongoing migration flows interacted to shape daily life and long-term development on Chios:

- Climate Change Impacts
  - Rising temperatures and irregular rainfall affected local agriculture, including critical products like Mastika and citrus.
  - Increased extreme weather events damaged infrastructure and intensified environmental vulnerabilities.
- Migration Pressures
  - Continuous arrivals of refugees who were housed in reception centres (up to ~2 years) before transitioning to temporary or semi-permanent housing.
  - Additional demands were placed on limited resources, including jobs, housing, and municipal services.
  - Social tensions and potential competition with local workers emerged.
- Combined Impact on Waste Management
  - Waste overflowed in and around refugee camps and neighbourhoods.
  - Lack of waste awareness and inadequate collection capacity exacerbated environmental and health risks.
  - A need arose for community-wide behavioural change and improved infrastructure.

Agents and Variables

The simulation defined three primary agent types—**humans**, **trashcans**, and **litter-items**—and several global variables that tracked the state of waste management and human behaviour dynamics on Chios during the simulation. These agents interacted in a spatial environment based on realistic urban and rural settings from Chios.

Global Variables

These variables helped evaluate the simulation outcomes over time steps (ticks) and allowed for analysis of system-level dynamics:

- **tick-counter**: Measured the progression of the simulation in discrete time units ("ticks").
- **sum-trash**: Counted the accumulated trash inside each trashcan.
- **cap**: Defined the maximum capacity of each trashcan before it overflowed.
- **full-trash**: Reported the number of trashcans that were full at each tick.

These global indicators provided insights into the effectiveness and capacity of the waste management system as it adapted to different human behaviours.

Agent Types

Humans

Humans represented individual agents moving through the urban or rural environment of Chios. Their behaviours reflected different attitudes toward waste disposal and environmental responsibility. Each human agent had the following properties:

- **speed**: Movement speed of the agent.
- **trash**: Boolean (true/false) flag indicating whether the human was currently carrying trash.
- **done**: Indicator flag for task completion (not fully implemented).
- **angle-of-vision**: Defines the angle of the agent's field of view for pathfinding.
- **depth-of-vision**: Defines how far ahead the agent could see.
- **target-trashcan**: Reference to a specific trashcan chosen as a disposal target.
- **cautious-level**: Degree of environmental consciousness, which influenced the decision to drop trash or seek a trashcan ("not," "somewhat," or "very" cautious).

Human Behaviour

Humans moved through the environment, generating trash at random intervals. When carrying trash, they evaluated whether to deposit it in a trashcan or drop it on the ground as litter, depending on:

- **Proximity to trashcans**: If a trashcan was nearby and not full, they moved toward it.
- **Cautious-level**: Determined how easily an agent would resort to littering if no trashcan was within a certain distance.

Humans also adjusted their paths dynamically, choosing alternate routes or turning when they encountered obstacles or full trashcans.

Trashcans

Trashcans acted as passive agents serving as waste collection points throughout Chios. Each trashcan had the following properties:

- **cap**: Maximum capacity before becoming full.
- **current**: Current amount of trash inside (implicitly tracked through sum-trash).
- **radius**: Visual or spatial influence radius.
- **sum-trash**: Total trash collected over time.

Trashcans changed colour when full (e.g., turning brown), signalling reduced availability to human agents. Emptying trashcans reset their capacity and colour, allowing reuse and testing different policy interventions (e.g., increased cleaning frequency).

Litter-Items

Litter-items represented trash dropped on the ground. They visually signaled environmental neglect and were important for illustrating accumulation hotspots in the simulation. Each litter-item had properties such as:

- **colour**: Orange, to stand out on the map.
- **size**: Adjusted for visibility.

These items could be periodically cleaned from the environment to simulate street cleaning efforts.

Simulation Dynamics

Initialization (Setup)

The setup procedure cleared all existing data, imported a background map of Chios ("chios no labels.png"), and initialized humans and trashcans. Agents were placed on patches with suitable characteristics (e.g., white pcolor, representing walkable areas).

Trashcans were created with customizable sizes and capacities (small, medium, large). Humans were assigned random cautious levels, which defined their littering behaviour.

Time-Step Operations

During each tick, the following sequence of operations occurred:

1. **Movement and Trash Production**:
   Humans moved according to their speed and pathfinding logic. They randomly generated trash, becoming "active carriers.
2. **Trash Disposal Decision**
   When carrying trash, humans evaluated the environment:
   (a) If a trashcan was within reach and had space, they moved toward it and deposited the trash.
   (b) If no suitable trashcan was found, they decided whether to drop the trash based on their cautious-level.
3. **Trashcan State Update**:
   Trashcans incremented their **sum-trash** when trash was deposited. When reaching capacity, they visually changed to indicate they were full.
4. **Environmental Maintenance**:
   Street cleaning (via *clean-streets*) and trashcan emptying (via *empty-trashcans*) allowed for periodic resetting and exploration of policy strategies.
5. **Statistics Update**:
   Variables tracking full trashcans and litter accumulation were updated, providing insights into system pressures.

Key Interactions

- **Overflow Events**:
  Full trashcans forced humans to either change their target or drop trash as litter, demonstrating infrastructure bottlenecks.
- **Behavioural Variation**:
  Differences in cautious-level among agents illustrated the social dimension of environmental responsibility.
- **Policy Testing**:
  Buttons such as *clean-streets* and *empty-trashcans* allowed simulation of municipal interventions (e.g., increased cleaning frequency, additional bins).

End Conditions

The simulation could run indefinitely to observe long-term trends or be stopped manually to analyse intermediate outcomes. Users could adjust agent numbers, trashcan capacity, and behavioural parameters to simulate different policy and social scenarios.

Figure 2 shows the ABM interface in NetLogo, for the case of Chios, before the simulation is executed. The parameters are set by the user, for demonstration purposes. To test the effect of different policy interventions, the user can change the values of the parameters of the model to reflect the impact of varying intervention choices.

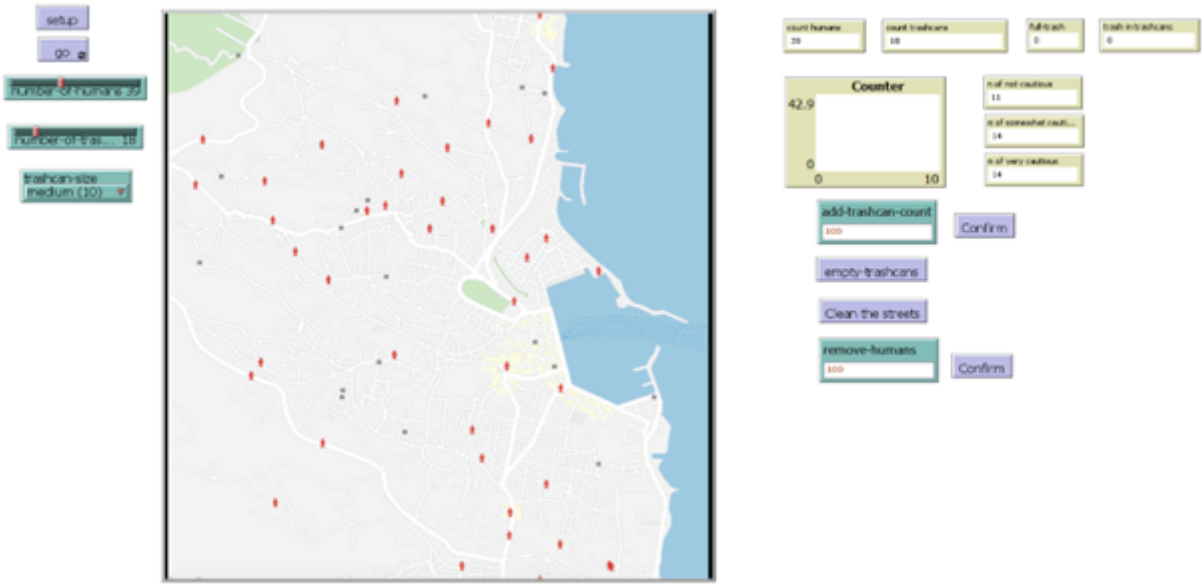


Figure 5: The initial setup for the case of Chios

Results

After gathering and analysing information from the Maastricht University researchers, the team started brainstorming how the model could be implemented. While analysing, it became apparent that there was limited information provided and that, although some rough objectives existed, much needed to be conceptualized and interpreted by the team.

In the case of Chios, the overarching objective was to model the solid waste behaviour of the inhabitants, integrating the additional pressures from climate change and migration. The conceptualized idea and model aimed to visualize a map of Chios and let the people — the agents — walk around the streets on the map. After a certain time, agents would then create trash and dispose of it either in designated trash cans or as litter on the street. Trash cans were also designed as agents, with attributes such as capacity and colour.

Upon initializing the model, a map of Chios displayed streets in white, where human agents moved according to behaviours set in the code, and trash cans were placed throughout. As the simulation ran, humans produced trash, deposited it in trash cans if available, or dropped it as litter. Reporting elements, such as the number of humans, number of trash cans, and a time series graph tracking trash accumulation, provided real-time insights into model dynamics.

A key observation was that as agents walked the streets, their decision to litter or properly dispose of trash was influenced by their assigned “cautious-level” and proximity to a trash can. When trash cans reached maximum capacity, agents increasingly used the streets to drop trash, resulting in more litter. This behaviour illustrated how uneven trash can distribution or

limited capacity could negatively impact the environment. The “Clean the streets” and “empty-trashcans” buttons allowed users to experiment with different waste management strategies.

While these results reflected first insights into waste management in Chios, it was important to understand that the model remained in a developmental stage. It was not complete and would benefit from additional feedback loops with local authorities and researchers to replace current random placeholders with real-world data. The model provided a solid foundation for exploring human behaviour and infrastructure placement in waste management. In the future, collaborative efforts with municipalities and researchers would be crucial in shaping model parameters and aligning them more closely with empirical data. With these improvements, the simulation had the potential to become a powerful tool for depicting and testing solid waste management strategies in Chios and potentially other urban environments. Figure 6 shows an example of the execution of the simulation.

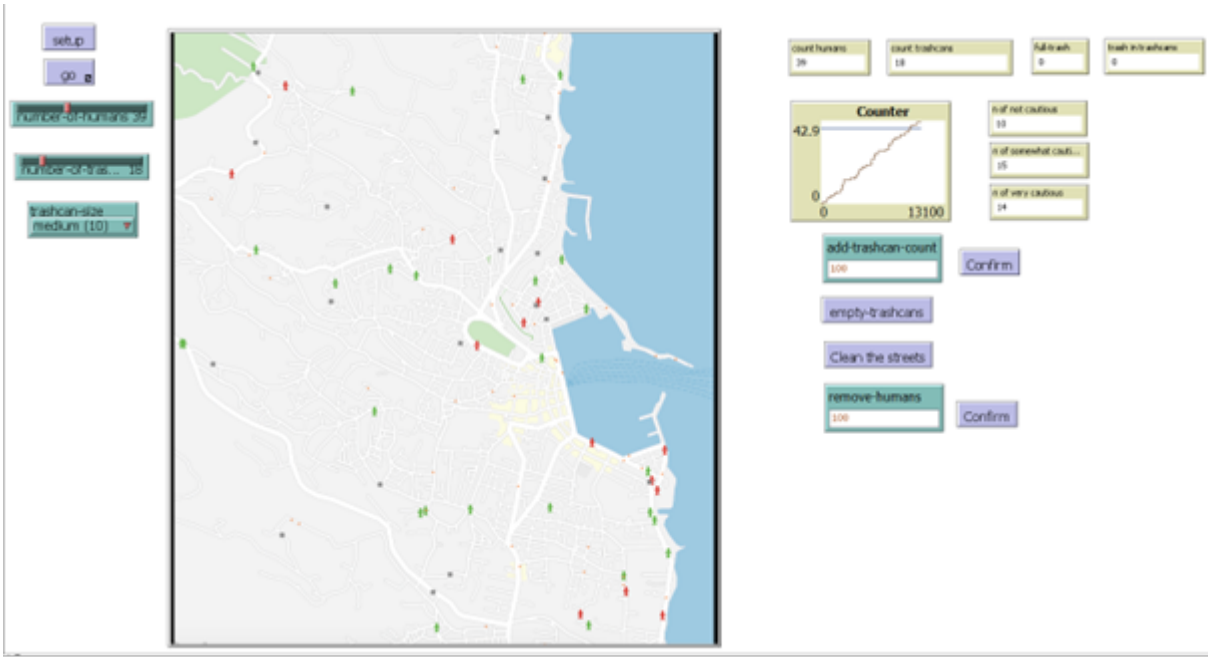


Figure 6: Simulation execution of the Chios for the given parameters

3.3 MURCIA Lab

A simulation model was developed for the Murcia pilot case to explore urban mobility behaviour under different infrastructure and policy conditions.

This agent-based simulation represents a synthetic urban environment where residents (agents) choose their daily commuting modes—car, bicycle, walking, or public transport—based on individual preferences, environmental infrastructure, and policy interventions. The model simulates long-term behaviour change under varying urban planning strategies such as bike-lane construction, tram stop installation, and pedestrian zone creation. It allows for testing the impact of infrastructure investments and behavioural nudges on transportation patterns, sustainability outcomes, and commute efficiency.

Core Research Questions

- How do different types and levels of urban transport policies affect mode share among residents?
- What is the role of eco-inclination in shaping transport decisions?
- How does infrastructure saturation influence modal shift?
- What combinations of policy levers lead to optimal commute times and sustainability gains?

Model Structure

Each resident in the simulation represents a commuter with a designated home location and a workplace within a defined radius. The agent is assigned a transport mode—either car, bike, walk, or public transport—and an eco-inclination score between 0.0 and 1.0, which reflects their sustainability preference. This score evolves over time, reflecting growing awareness and cultural change.

The environment is a 2D grid of patches, each of which may contain infrastructure such as bike lanes, tram stops, and pedestrian zones. During initialisation, the environment is cleared and recoloured, agents are placed randomly, and eco-inclination and initial transport modes are assigned.

Time Dynamics

The simulation runs on a daily tick system, where one tick equals one day. A full year consists of 365 ticks, and the model progresses until the defined simulation period is reached.

Behaviour and Decision Logic

Each day, agents commute to and from work and decide whether to switch transport modes. This decision is based on factors such as the distance to work, available infrastructure nearby (depending on whether the use-in-radius? setting is enabled), and the agent's eco-inclination. A small random factor (5%) is included to simulate irregular behaviour, such as a fallback to car use regardless of conditions.

Transport decisions follow a logic based on distance and infrastructure: agents are likely to walk if the commute is short and there are pedestrian zones or if their eco-inclination exceeds 0.3. They choose biking for medium distances when bike lanes are present and eco-inclination is above 0.2, and opt for public transport for longer commutes if tram stops exist and eco-

inclination is above 0.5. Otherwise, agents default to using a car, with a 5% chance of choosing it at random.

Policy Interventions

Policy levers are implemented either annually or every three years. Each year, new bike lanes and pedestrian zones are added to underserved patches, with respective caps at 60% and 50% coverage. Every three years, tram stops are introduced, with a cap at 20% of patches. These interventions help simulate the gradual improvement of urban infrastructure.

Eco-Inclination Growth

Each day, agents' eco-inclination values increase slightly (by 0.0005), modelling the gradual shift in public attitudes due to education, policy, and cultural influence.

Movement

Residents symbolically move between home and work each day. Their movement is not constrained by road networks or real-world geography but is instead determined by the Euclidean distance between locations.

Interface Controls

The model includes several parameters that can be adjusted by the user.

Table 4: Interface Controls

Control	*Description*
Number of residents	Number of agents created.
Bike lane investment	Annual number of new bike lanes.
Pedestrian zone investment	Annual number of pedestrian zones.
Tram stop investment	Tram stops added every 3 years.
Simulation years	Number of years to simulate.
Use in radius	Toggle for whether infrastructure is checked locally or in a radius.
Walk distance max	Maximum commuting distance (in patches) where walking is considered.
Bike distance max	Maximum commuting distance (in patches) where biking is considered.
Walk speed, bike speed, car speed, pt speed	Speeds (in km/h) used to compute commute time by mode.
Work radius	Determines how far from home the work location can be selected during setup.

The following figure shows the ABM interface in NetLogo, for the case of Murcia, before the simulation is executed. The parameters are set by the user, for demonstration purposes. To

test the effect of different policy interventions, the user can change the values of the parameters of the model to reflect the impact of varying intervention choices.

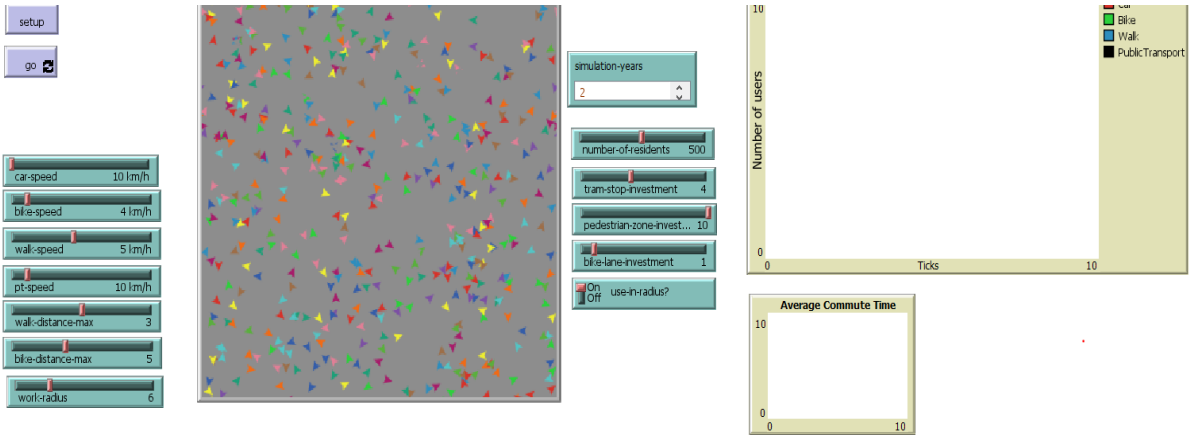


Figure 7: Murcia ABM initial setup

Results

The agent-based simulation for the Murcia pilot produced a range of results illustrating how different transport policies and infrastructure investments influence commuting behaviours over time. The model tracked the number of agents using each transport mode—car, bike, walk, or public transport—as well as the average commute time. These indicators allowed for assessing the overall efficiency and sustainability of the urban transport system under various conditions.

The results demonstrated that sustainable modes of transport (walking, cycling, and public transport) became more prominent over time when supportive infrastructure and eco-inclination growth were present. For example, a significant mode shift was observed once bike lane coverage approached the 60% threshold. Pedestrian zones and increasing eco-inclination also led to greater adoption of walking, especially for short distances.

Public transport usage showed strong gains when combined with a higher eco-inclination threshold (above 0.5) and the presence of tram stops. However, since tram stop investments occurred less frequently and were capped at 20% of patches, the adoption rate for this model remained more limited compared to biking and walking. The use of private cars declined steadily in all scenarios where active investments in sustainable infrastructure were maintained.

Average commute time, calculated using Euclidean distance and predefined speed settings for each transport mode, decreased over the course of the simulation. This improvement was particularly notable in scenarios where pedestrian and cycling infrastructure was prioritised, as these modes replaced longer and slower car commutes with more efficient and direct routes.

Overall, the simulation results support the idea that infrastructure investment, behavioural nudges, and a gradual increase in sustainability preferences can collectively lead to a more resilient, efficient, and eco-friendly urban mobility system.

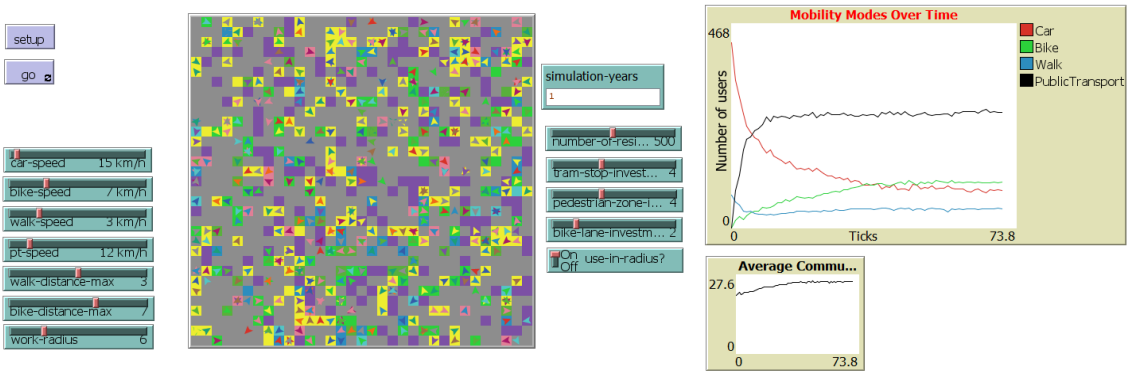


Figure 8: The simulation results for the Murcia mobility are shown for the given parameters.

3.4 Agent Based Modelling Conclusions

Methodological Conclusions

The agent-based models (ABMs) developed for BAPEMED, Chios, and Murcia demonstrate that bottom-up modelling approaches are highly effective in capturing the dynamic, decentralised nature of complex societal challenges. ABM enabled the simulation of heterogeneous agent behaviour, emergent phenomena, and system-level vulnerabilities that are difficult to identify using traditional top-down approaches.

In the case of Chios, ABM helped visualise the impact of infrastructure placement and human behaviour on waste accumulation, emphasising the importance of environmental consciousness and accessibility in building resilient solutions in migration-based, multicultural contexts. The model used in the BAPEMED Lab revealed how socioeconomic inequality and hospital capacity interact, leading to unequal healthcare outcomes – for instance, with disparities impacting in the healthcare costs models. Meanwhile, the Murcia case applied ABM to explore urban mobility behaviour under different infrastructure and policy scenarios, simulating how residents adapt their commuting choices in response to interventions like bike-lane construction, tram stop installation, and pedestrian zones. Within the lab activities, mobility was identified as a key area of strategic intervention for resilience building in compact cities.

Across all three cases, ABM proved valuable for experimenting with policy interventions before real-world implementation. The flexibility to simulate different rules, agent properties, and system conditions provides a robust framework for foresight and participatory policy design.

Content Conclusions

The agent-based models (ABMs) implemented in the CHIOS, BAPEMED, and MURCIA labs uncovered key thematic insights into the dynamics of societal resilience under different sectoral challenges; waste management, healthcare, and urban mobility, respectively.

In the CHIOS lab, the ABM simulation highlighted how environmental outcomes are deeply influenced by individual behaviour and infrastructure design. Agents responded to their proximity to trash bins and their internal "cautiousness level," revealing that even well-placed infrastructure becomes ineffective if not supported by behavioural incentives or capacity management. Overloaded trash bins led to increased littering, showing how small constraints in infrastructure can trigger cascading environmental consequences. This emphasised the importance of both spatial planning and behaviour-based policy levers in waste management strategies.

In Bulgaria's BAPEMED lab, the model underscored the structural inequalities embedded in dual-tiered healthcare systems. Wealth and insurance status heavily determined treatment access and survival outcomes. Public hospitals often became overloaded, whereas private institutions remained underutilised due to access barriers. The simulation allowed testing of interventions such as insurance expansion or subsidy schemes, providing insight into how policy changes could mitigate systemic inefficiencies and reduce mortality and healthcare inaccessibility. The model also captured dynamic interactions such as treatment delays, hospital capacity thresholds, and resource misallocation.

In the MURCIA lab, the ABM focused on mobility decisions in a synthetic urban grid. Results showed that investments in cycling, pedestrian, and public transport infrastructure, combined with behavioural nudges like eco-inclination, drove significant modal shifts away from car usage. The findings suggested that infrastructure coverage thresholds (e.g., 60% bike lanes) served as tipping points for widespread behaviour change. Notably, commute efficiency improved over time when sustainable infrastructure was prioritised. The model demonstrated how small-scale, iterative interventions could shape more efficient and sustainable urban systems.

Together, these case studies confirm that ABMs are effective in illuminating critical pressure points within complex societal systems. Across all pilots, accessibility, whether to infrastructure, care, or mobility, emerged as a recurring factor affecting resilience outcomes. Moreover, the simulations revealed how compounding limitations (e.g., wealth, proximity, capacity) can exacerbate inequality and reduce system performance. The use of ABMs provided a safe, controlled environment to test policy levers and visualise long-term impacts, supporting more adaptive and equitable resilience planning across domains.

4 Appendix I Detailed labs foresight-based activities

4.1 BAPEMED Lab

Abstract
The BAPEMED Lab addresses the escalating and unsustainable cost of healthcare in Europe by applying strategic foresight to build long-term resilience. The Lab explores how anticipatory governance and science-based co-creation can shift healthcare systems from reactive to preventive models, with focus on Bulgarian context. Amid structural challenges, including political instability, workforce shortages, and fragmented health data systems, the project established a foresight-driven, collaborative policy space that engaged key national stakeholders. The project demonstrates how futures thinking can inform robust, adaptable healthcare strategies and contribute to a broader European knowledge base aimed at improving societal resilience.

- Local Partner: Bulgarian Association for Personalised Medicine
- Mentor: Copenhagen Institute for Futures Studies

4.1.1 Description of the lab

Foresight is a critical tool for strengthening policymakers' capacity to anticipate and address future challenges effectively. By embracing long-term strategic thinking, governments can move beyond reactive decision-making and implement proactive measures that enhance resilience. This shift is particularly vital in today's fast-changing global landscape, where economic fluctuations, social transformations, and technological advancements demand agile, forward-thinking policies.
The BAPEMED Lab aimed to strengthen Bulgaria's healthcare system, making it more resilient and better equipped to handle future challenges and crises. By enhancing the ability to anticipate trends and emerging issues, the lab facilitated proactive measures and a forward-looking approach to healthcare.
Designed as a co-creation space, the lab brought together multiple stakeholders to foster collaboration and innovation in healthcare. Through a holistic approach, its primary objective was to create an environment where solutions could be designed, tested, and effectively implemented.
The BAPAMED Lab sought to create a collaborative space that brought together experts, policymakers, and stakeholders such as the Ministry of Health, the Personalised Medicine Coalition (PMC), the National Patients' Organisation Bulgaria (NPO), the Ministry of Electronic Governance and startups and more to engage in structured foresight exercises and scenario planning. By identifying emerging trends and potential crises in healthcare before they materialise, governments can design strategic interventions that mitigate risks and seize new opportunities.

4.1.2 Initial needs and challenges

As illustrated by the figure below, many countries are witnessing increasing cost of healthcare measured as a share of GDP.

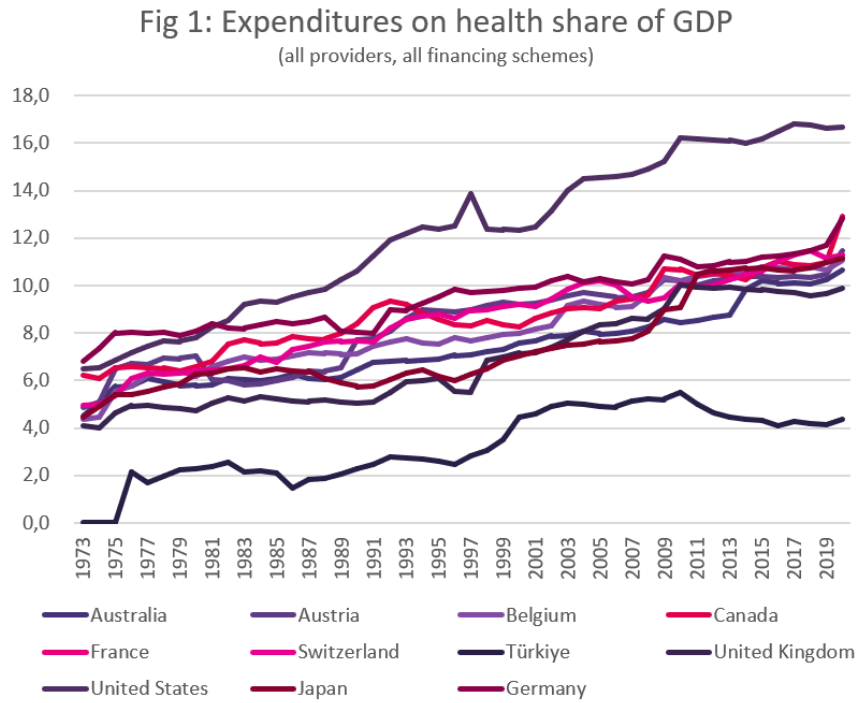


Figure 9 Expenditures on health share of GDP (Source: OECD database)

This will -if continued- increasingly displace other areas in government budgets such as defence spending, education, and effort to mitigate and adapt to climate change. This is unsustainable in the long run. The rising cost of healthcare is a consequence of an increase in non-communicable diseases and the overall effect of having more elderly that need more care. Tackling this slow-moving crisis that is common for many countries in the EU and beyond, requires considering the specific local challenges for each individual country.

The Bulgarian healthcare system currently faces significant challenges, including insufficient emphasis on preventive care, the absence of a unified health data collection system, and a regulatory framework that does not fully support the treatment-diagnostic process. These inefficiencies negatively impact the overall quality and effectiveness of healthcare services. Keeping these challenges in mind the Bulgarian healthcare system needs to become more resilient. Bulgaria must transition from a reactive healthcare system to one focused on prevention. This shift demands a fundamental change in mindset, infrastructure, and policy. Currently, the system rewards treatment over prevention, making it inefficient and costly. To unlock the full potential of preventive healthcare, Bulgaria needs to rethink incentives, promote value-based care, and integrate personalised medicine, big data, and wearable technology. Empowering citizens with actionable insights is key. This transformation requires cross-sector collaboration, involving government, education, urban planning, and food systems etc. Without bold action, Bulgaria risks rising healthcare costs and worsening public health outcomes.

4.1.3 Work done in the lab

4.1.3.1 The approach

The lab adopted a methodological approach centred on exploring future scenarios to identify resilient policy responses to challenges facing the Bulgarian healthcare system.
The process began by pinpointing critical issues likely to impact the system in the coming years. Central to this was the question: What are the underlying barriers and enabling factors driving these challenges? Through this diagnostic analysis, a series of future scenarios were developed to serve as strategic testing grounds.
While several scenario development methods exist, including the widely used 2x2 matrix, this approach was deemed too constraining for the complexity of Bulgaria's healthcare landscape. Instead, a factor-based framework was selected for its flexibility and capacity to accommodate a broader range of potential futures. This allowed for a more nuanced exploration of how different trajectories could shape the policy environment.
By generating diverse and plausible scenarios, the lab created varied contextual landscapes in which future solutions could emerge. The objective was not to prepare solely for a "business-as-usual" (BAU) future, but to account for transformative dynamics, such as the rise of AI, climate change impacts, and increasing privatisation, shaping the sector.
To identify robust policy options, the lab employed windtunneling: a technique that stress-tests policy ideas across multiple scenarios to assess their resilience under different conditions. This process enabled the formulation of adaptive, forward-looking strategies that remain effective amidst significant uncertainty. Trends and structural drivers were carefully analysed, factor projections applied, and candidate policies iteratively tested to ensure alignment with a range of plausible future contexts.
The BAPEMED Lab placed significant emphasis on participative foresight, leveraging a robust stakeholder engagement strategy. It served as a co-creation space, bringing together key actors to develop solutions for the diverse challenges within the healthcare system. In line with the FUTURESILIENCE guidelines the process followed a 5-stage model of 1: Problem definition and stakeholder analysis. 2: Factor assessment and scenario development. 3: Policy identification and scenario validation. 4: Policy testing. 5. Assessment and reporting.

Figure 10 BAPEMED Lab approach

At the initial kick off meeting CIFS presented the initial thoughts about the toolbox and knowledge data base. The purpose was to provide CIFS's insights as to what tools could be

used from the toolbox and how they might apply to the problems facing Bulgarian healthcare system.
As part of the project, it was agreed that there would be two physical meetings, whereas under normal circumstances, four of such meetings would typically be held. One of the main areas of focus was ensuring sustained engagement from participants. In the scenario planning processes, it is crucial that individuals involved at the outset also participate in the concluding phases to maintain continuity and coherence throughout the project.
However, maintaining consistent participation can be challenging, particularly when working with politicians, senior officials, CEOs, or other high-level stakeholders, who may join or exit the process due to changing priorities or schedules. Having a local partner with strong contact with stakeholders ensured continued support and engagement. However, it was also clear that the workshops needed to be handled very effectively so to not overburden participants.
BAPEMED delivered a description of the Bulgarian healthcare system and the different stakeholders that could be involved. Based on this description CIFS had an internal workshop focusing on the driving forces effecting Bulgarian healthcare system. Following these discussions BAPEMED and CIFS in internal meetings addressed the identified driving forces. Then, the stakeholder workshops were organised.

Workshop 1
BAPEMED introduced CIFS, which in turn provided an overview of both CIFS and the field of foresight. CIFS highlighted its engagement with the UN Summit for the Future 2024, the Pact for the Future, and Future Literacy, where it holds a UNESCO Chair. As part of the introduction, CIFS also presented the work of the EU Foresight Unit and the Foresight Ministers, emphasising the importance of these initiatives in shaping forward-looking policymaking.
This introduction was crucial for securing buy-in, as CIFS has observed that those unfamiliar with foresight often perceive it as speculative. Many government entities, accustomed to traditional planning, may be hesitant to engage with foresight due to its perceived uncertainty. This challenge is further compounded by the tendency of participants to focus on immediate crises, leaving little room for long-term strategic alignment.
CIFS then introduced the project's core purpose: To strengthen European economic and social resilience by enhancing the capacity to respond swiftly to future crises. This would be achieved through the rapid and effective use of policy-relevant Research & Innovation (R&I) results at national, regional, and local levels.
Additionally, 13 key driving forces and developments within the health sector were presented, offering a structured view of the factors shaping the future landscape. The list of the 13 key drivers was created by CIFS from its experience with working with healthcare systems in over 20 countries around the world, such as Lebanon, Columbia, Chile, Brazil, Canada, Mexico and The Nordics. This was used as a starting point for a high-level factor analysis of uncertainties (see figure below).

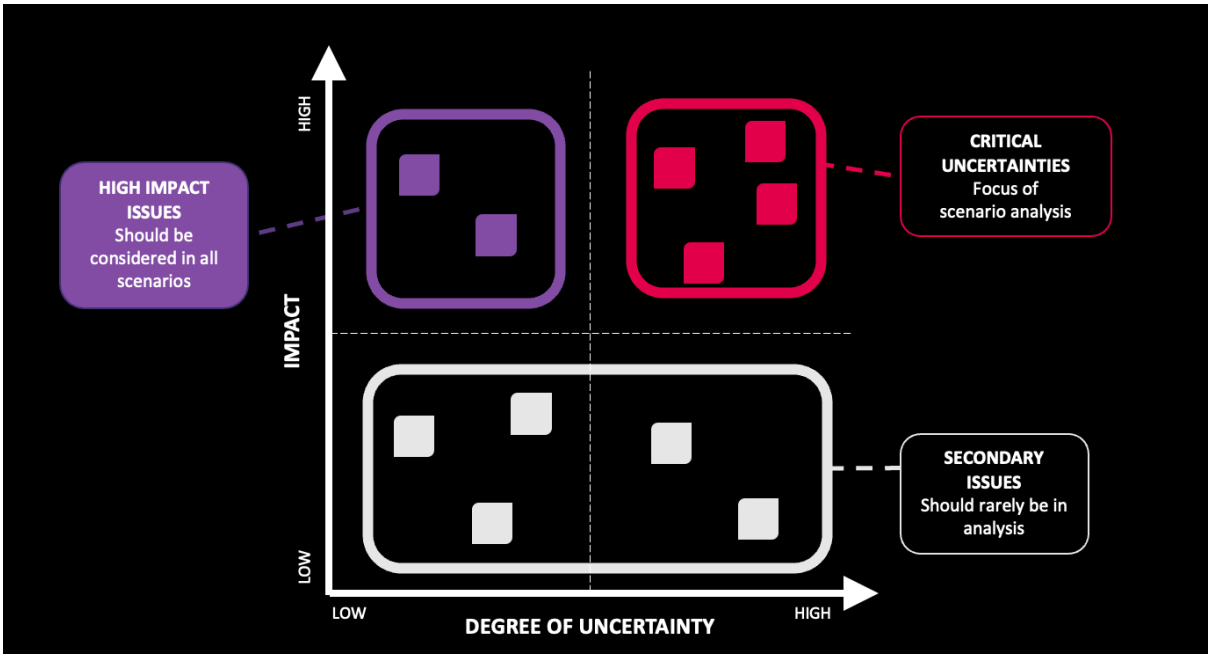


Figure 11: Matrix of analysis for uncertainties

Example list of factors:

- **Digital Integration:** Adoption of electronic health records, telemedicine, and AI to streamline patient care and improve outcomes.
- **Precision Health:** Utilising genetic information, lifestyle, and environmental factors for tailored health plans.
- **Sustainable Healthcare:** Minimising environmental impact with eco-friendly practices in medical facilities.
- **Approach to** Health**:** Shifting focus from treatment to preventive measures and addressing social determinants of health.
- **Health** Workforce **Development:** Continuous education and skill adaptation for healthcare professionals.

Based on these identified trends the Enablers & Blockers framework was used. The Enabler and Blockers framework is demonstrated in Figure 12. The way future change occurs, depends on the outcome of the power struggle between enabling and limiting forces. Forecasting methods typically derive trends from past data and extrapolate these trends forward without much consideration of the forces that nurture the trend and may eventually alter it. By utilising the Enablers & Blockers framework, we can get a better understanding of the dynamics of change of a given trend development. This understanding is gained by identifying underlying dynamics in favouring forces (enablers) that create, sustain and catalyse a trend, and limiting forces (blockers) that stand in the way of a trend and slow it down, possibly even diverting it. In the case of Bulgaria there are many trends seen in healthcare internationally that for various reasons are blocked in Bulgaria.

After identifying the blockers and enablers for each trend, the workshop continued with an assessment of the impact in the future of the various trends keeping in mind the perceived development of the identified blockers and enablers. The workshop continued with an

assessment of the degree of uncertainty that participants estimated for each of the topics resulting in an (Uncertainty, Impact Matrix) as shown in Figure 11.

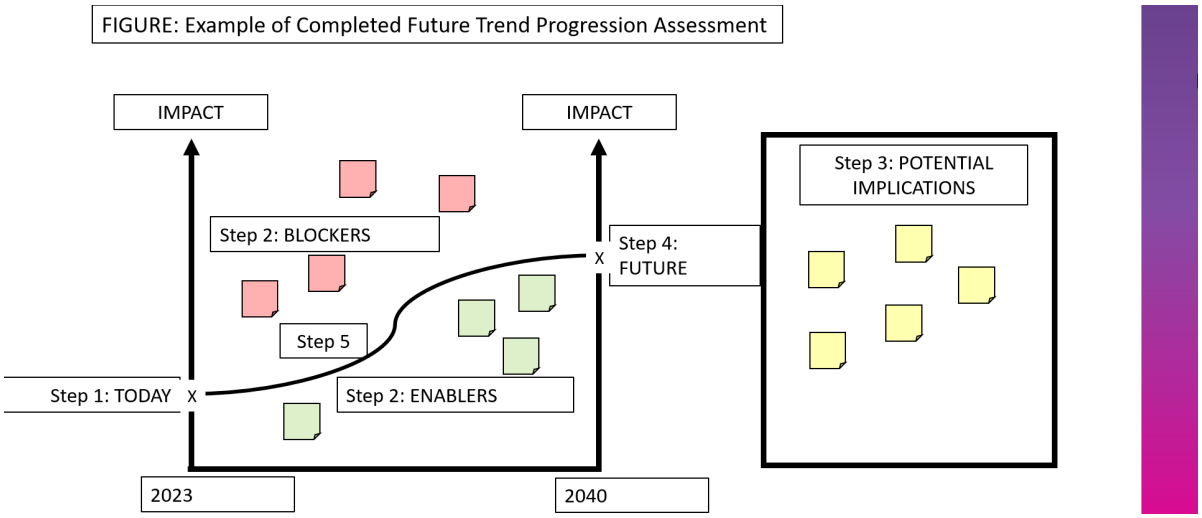


Figure 12: Example of completed future trend progression assessment

Based on the workshop CIFS developed a set of scenarios about the future challenges for the Bulgarian healthcare system. One scenario in particular proved problematic: The impact of climate change. The physical impact of climate change is already witnessed in Bulgaria with examples of floods and extreme heat. The EU's focus on carbon neutrality also demands healthcare systems to adopt new measures. Currently however climate change is not a key priority in Bulgarian politics, according to participants in the workshop. This means that the short-term focus and the long-term focus clashed. CIFS wanted to maintain the focus on the long-term challenges yet understood the reservations that were raised.

Detailed outputs:

Covered trends/factors in health care

1. Digital Integration: Adoption of electronic health records, telemedicine, and AI to streamline patient care and improve outcomes.
2. Precision Health: Utilising genetic information, lifestyle, and environmental factors for tailored health plans.
3. Sustainable Healthcare: Minimising environmental impact with eco-friendly practices in medical facilities.
4. Approach to Health: Shifting focus from treatment to preventive measures and addressing social determinants of health.
5. Health Workforce Development: Continuous education and skill adaptation for healthcare professionals.
6. Mental Health Integration: Combining mental health services with primary care and expanding digital solutions.
7. Chronic Disease Management Innovation: Developing new models and technologies for managing non-communicable diseases.

8. Equity in Access to Care: Implementing solutions like telemedicine to improve access for underserved areas.
9. Aging Solutions: Developing targeted programs for the healthcare and social needs of the aging population.
10. Pandemic Resilience: Enhancing preparedness and response capacities for pandemics.
11. Regenerative Medicine: Advancing the repair or replacement of tissues and organs through stem cell research and tissue engineering.
12. Digital Health Literacy: Educating about digital tools to improve health decision-making and promote holistic health perspectives.
13. Collaborative Health Ecosystems: Fostering partnerships across sectors to address health challenges and improve care delivery.

Results of enablers and blockers analysis

Digital Integration

- Barriers
  - Lack of transparency of data, political barriers, lack of transparency enable power holders to maintain power and a privileged position
  - People at power have no incentive to changing health care
  - Lack of integration of systems and data. There is no unique patient identifier, every hospital has their own system. There is no integration of data.
  - Private actors are creating value for patients and will play a larger role
- Enablers
  - Greater ecosystem convergence especially coming from the private sector,
  - Main uncertainty element

Precision Health

- Barriers same as under Digital integration
  - Lack of structed data, lack of transparency
  - Political instability, new health ministers, no tradition for continuation in policy like in Scandinavia,
  - No political will
- Enablers
  - No regulation could make it easier for private companies to come in offer solutions they would not be able to in Scandinavia due to privacy concerns etc.
  - More digital integration happening
  - There is a culture of living for the moment that came after the liberation from Soviet rule, this culture does not think long term. Wearables and new IT solutions that monitor health could help people make more healthy decisions

Sustainable Healthcare

- Barriers:
  - Current generation not focused on climate change, we need a generational shift
  - Lack of restrictions and environmental laws

- Enablers
  - More educated people
  - Entrepreneurs start changing the systems find places in the value chain where they can make a difference and create
  - Main uncertainty element

Workshop 2

Workshop 2 was a virtual workshop. Four scenarios were presented by the facilitators: Martin Kruse, Patrick H Gallen, Joe Max Wakim, and Aron Szpisjak from CIFS. Each member facilitated a group discussion about the impact each of the scenarios would have on healthcare (See scenarios in the section below). The purpose was to get engagement with the scenarios as well as to reveal any local considerations that were not adequately presented in the scenarios. Participants were asked to provide feedback and to evaluate whether these scenarios described concrete future risks to the Bulgarian healthcare system. Participants were engaged and provided good feedback based on which the scenarios could be revised to better fit the local context. As part of the scenario exercise a SWOT-TOWS analysis was performed to assess strengths in relation to opportunities (SO) and weaknesses in relation to threats (WT) (Figure 13 and Figure 14). Based on this analysis policy suggestions could be created.

Figure 13: SWOT – TOWS model

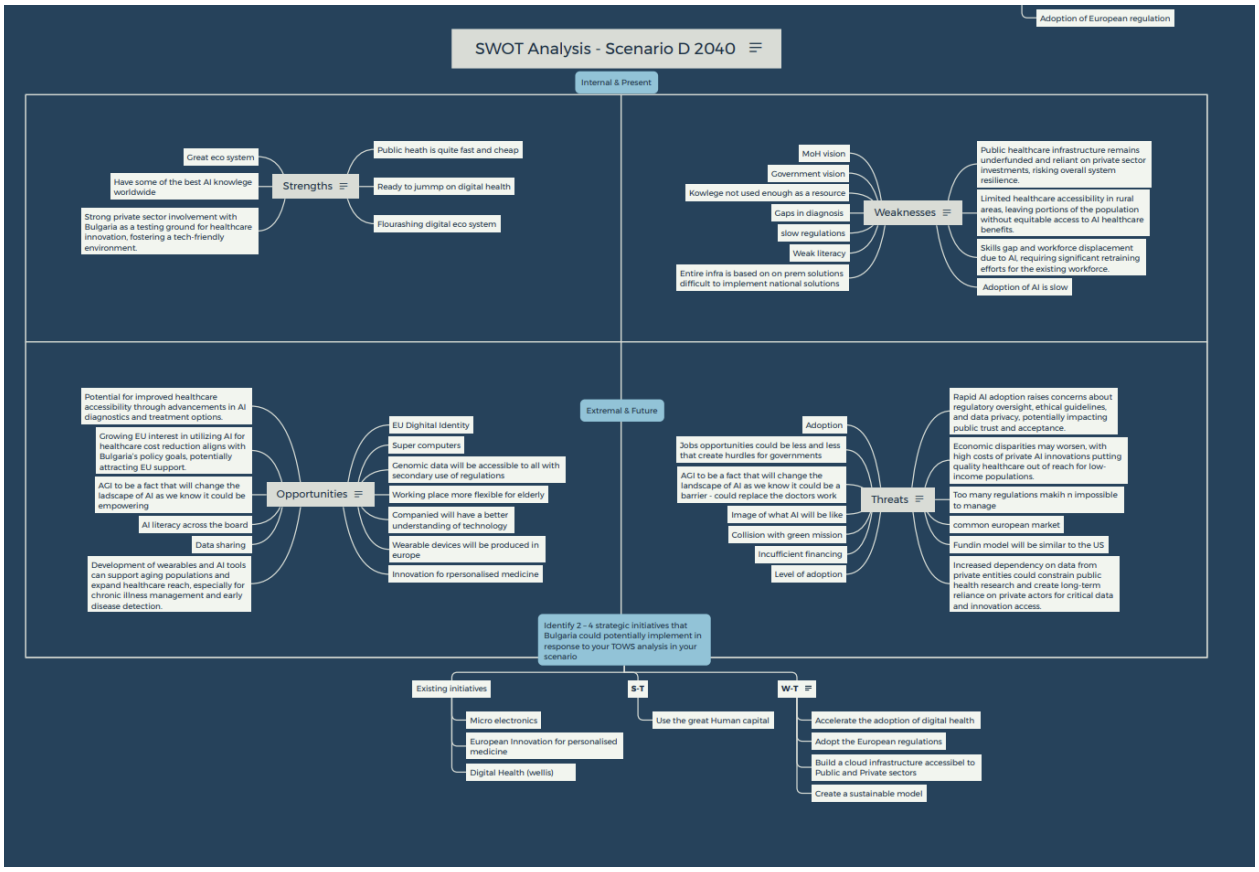


Figure 14: SWOT – TOWS filled out

4.1.3.2 Detailed Output

Adjusted scenarios for future health care crisis preparation

Scenario A: Same old same old (Business as Usual)

In this scenario, the Bulgarian healthcare system continues along its current trajectory without significant political or policy shifts, this is largely due to lack of political stability. Technologies progress quickly, but efforts to integrate digital health technologies, such as electronic health records and telemedicine, progress slowly due to bureaucratic inertia and frequent changes in the Ministry of Health leadership. Workforce development struggles with the emigration of skilled professionals and a lack of investment in continuous education, exacerbating the shortage of nurses and healthcare providers for the aging population. Digital tools are used primarily for administrative control and reimbursement, not for improving care quality. Medical specialists often lack access to patient data. The focus remains on service quantity over quality, reinforcing a reactive, transactional care model. Non-communicable diseases (NCDs) dominate the disease burden. The lack of prevention has created a growing, slow-moving health crisis. Chronic disease management and aging solutions see incremental improvements but are hindered by the system's limited capacity to adopt innovative practices and technologies. Pandemic resilience remains a concern, with the healthcare system poorly prepared for future health crises due to inadequate investment in infrastructure and emergency planning.

Preventive health measures and mental health services continue to be neglected, with little to no integration into primary care. The private sector fills some gaps where demand outpaces public provision, but reforms remain elusive. Without systemic changes, digitalisation reinforces inefficiencies instead of transforming care.

Scenario A: Grid Components

Zeitgeist

- General acceptance of the status quo, with scepticism towards rapid changes or reforms.
- Prevailing distrust in the political system, contributing to a passive approach to healthcare improvements.
- Resilience and adaptability in the face of systemic inefficiencies, with reliance on informal networks for healthcare access and support.

Political

- Frequent changes in the Ministry of Health and a lack of stable leadership hinder long-term planning and implementation of reforms.
- Political discussions around healthcare focus on short-term fixes rather than systemic overhauls, with limited consensus on major changes.
- Investments in healthcare infrastructure and technology are subject to political cycles, leading to inconsistent progress.

Economic

- Limited public funding for healthcare, with expenditures constrained by broader fiscal policies and priorities.
- Economic disparities contribute to unequal access to healthcare services, with a significant portion of the population unable to afford private care.
- The healthcare system faces financial pressures from an aging population and the rising cost of chronic disease management.

Societal

- An aging society places increasing demands on healthcare and social services, with a growing proportion of the population dependent on state support.
- Emigration of young and skilled workers, including healthcare professionals, exacerbates workforce shortages and strains the system.
- Public scepticism towards vaccinations and preventive measures, influenced by misinformation and historical mistrust in authorities.

Technology

- Slow adoption of digital health technologies due to bureaucratic hurdles, infrastructure gaps, and most importantly lack of transparency and mindset for change.

- Technology is used for the purpose of control, but medical specialist does not see the use for their everyday job as they don't have access to patient records
- Incremental progress in electronic health records limited by funding, lack of awareness and health literacy
- Health data are present in the system but not put to use. There are a lot of strategies for e- health, but implementation is lacking behind.
- The private sector leads innovation in healthcare technology, but its benefits are not widely accessible to the general population due to restrictive regulations.

Scenario B: Private Sector Dominance

In Scenario B, the private sector (a broad mix of startups, pharma, MedTech, and digital health companies) becomes the primary driver of innovation and service delivery in the Bulgarian healthcare system. Many of these players bring process maturity and technological innovation, but operate independently, contributing to a fragmented and siloed ecosystem. Bulgaria's relaxed regulatory enforcement, especially around data privacy, has made it an attractive testing ground for new digital health solutions. However, the lack of synergy, networking frameworks, and public-private collaboration structures limits the ability to scale or integrate these innovations into a cohesive national strategy. This leads to advancements in technology and efficiency, it also results in significant disparities in access and quality, driven by economic status and the ability to pay. The public healthcare system struggles to keep pace, highlighting the challenges of a predominantly market-driven approach to health. Local players have become vital in bridging the gap between tech innovation and local populations, especially where big international providers lack context-specific understanding. Yet digital and health literacy remains low, hindering adoption. Access to innovation remains highly inequitable, with OOP (out-of-pocket) costs, already among the highest in Europe, acting as a major barrier. Preventive care and digital services are largely available only to those who can afford them, leading to a deepening two-tier system.

Scenario B: Grid Components

Zeitgeist

- Growing acceptance of private sector solutions to public problems, with a pragmatic view towards healthcare improvements driven by business interests.
- Increased individual responsibility for health, where access to high-quality care depends significantly on personal financial means.
- A dichotomy in public opinion about healthcare quality and access, with growing concerns about inequalities in the system.
- As the physical impact of climate change becomes apparent public sentiment shifts from scepticism to climate science to a concern over the escalating impact of climate change.
- Climate-related disasters are at times straining resources. The healthcare system’s ability to adapt is severely tested, with citizens and healthcare workers facing burnout and resource shortages.

- There is growing public awareness of the connection between climate change and health, but this awareness comes with frustration as the healthcare system struggles to respond effectively to climate-induced health crises.

Political

- Regulatory barriers are reduced or circumvented, allowing private companies to play a larger role in healthcare provision and innovation.
- Political reluctance to invest in public healthcare leads to a dependency on private solutions, weakening the public system's infrastructure.
- Limited government intervention in healthcare pricing and policies, leading to a market-driven approach that favours those who can afford premium services.
- The absence of strong PPP models and trusted data governance also means Bulgaria faces a growing "data deficit", limiting its ability to develop or benefit from emerging AI applications in health.
- Cross border collaboration and EU integration is threatened by uncoordinated, aggressive competition and Bulgaria's relatively weak role in regional digital health policymaking.

Economic

- Significant growth in the private healthcare sector, attracting both domestic and international investment.
- Economic inequalities are exacerbated by a healthcare system where high-quality services are clustered in private facilities.
- Public healthcare facilities face financial difficulties and resource constraints as funds and focus shift towards more profitable private entities.

Societal

- Societal divisions deepen between those who can afford private healthcare and those reliant on the underfunded public system.
- An increase in health tourism as Bulgaria's private healthcare providers offer competitive services to foreigners, neglecting local needs.
- Public dissatisfaction grows due to disparities in healthcare access and outcomes, sparking debates about the role of government in healthcare.

Technology

- Private companies lead the way in adopting and implementing cutting-edge technologies, including AI, telemedicine, and personalised medicine.
- Innovations in healthcare are primarily available through private channels, creating a two-tier system based on technological access.
- While private healthcare providers rapidly deploy digital health solutions, the public system lags significantly behind, further widening the gap in service quality.

- Digital convergence accelerates in private healthcare, yet interoperability is lacking. Patients risk "lock in effect" on specific platforms or apps

Scenario C: Climate- centric governance

In Scenario C Bulgaria's healthcare system is increasingly affected by the urgent need to address climate change. More instances of extreme weather is happening between 2025 and 2040, resulting in more cases of extreme heat and flooding. Instances where flooding have prevented nurses to get to their job. Has accentuated the need for more nurses and better climate governance. Lack of parliamentary alignment has made Bulgaria miss out of support from the EU Green Deal As the physical effect of climate change has grown more apparent, the general mistrust in climate science is reduced. The lack of burning platform and lack of belief in science, has resulted in a lack of preparedness, with little planning and training to cope with disasters that proliferate through the system. Tele medicine however has been enacted into law early on in Bulgaria which is both a blessing and a curse. Tele medicine shifts risk from lack of personnel to infrastructure integrity, which can be vulnerable during flooding.
The EU is now openly calling climate change a climate emergency. Public health deteriorates as climate challenges take precedence over healthcare reforms, leading to a reactive and fragmented healthcare system. Economic constraints exacerbate disparities in healthcare access, and technological advancements are unevenly distributed. The dual pressures of an aging population with increasing prevalence of NCDs and the need to focus on climate change mitigation as well as adaptation strain the system, eroding public trust and reducing the capacity to maintain basic health services.

Scenario C: Grid Components

Zeitgeist:

- As the physical impact of climate change becomes apparent public sentiment shifts from scepticism to climate science to a concern over the escalating impact of climate change.
- Climate-related disasters are at times straining resources. The healthcare system's ability to adapt is severely tested, with citizens and healthcare workers facing burnout and resource shortages.
- There is growing public awareness of the connection between climate change and health, but this awareness comes with frustration as the healthcare system struggles to respond effectively to climate-induced health crises.

Political

- The EU prioritise climate and push member states for compliance. The Bulgarian government and private sector prioritise climate adaptation and disaster response, impacting how healthcare investments areas.
- Healthcare policies are still reactive with little attention to systemic reform or long-term health planning.

Economic

- The financial burden of climate adaptation and mitigation reduces healthcare budgets, with priority given to climate-related infrastructure over healthcare services.
- Deteriorating public healthcare services widen economic disparities, with the wealthy turning to expensive private care while the poor struggle to access basic healthcare.

Societal

- Healthcare professionals migrate from rural areas to urban centres or abroad exacerbate healthcare worker shortages, causing service collapses in the hardest-hit areas.
- Public trust in health authorities erodes as the government's ability to prioritises needed reform and introduce preventive health measures becomes evident.

Technological

- Bulgaria has early on enacted policies to push for telemedicine which help address health issues for vulnerable communities.
- Adoption of digital health technologies is slow and uneven, with some rural areas particularly disadvantaged.
- Private sector leads healthcare innovation focused on climate impacts, but high costs and restrictive regulations limit these advancements' accessibility to the general population.

Scenario D: AI-Driven Healthcare Transformation in Bulgaria

In Scenario D, Bulgaria's healthcare system experiences a profound transformation, with AI at the heart of healthcare delivery. Political leadership actively supports AI integration, aligning with growing EU interest in using AI to reduce healthcare costs, attracting EU investment and policy backing. Substantial AI investments reshape the health economy, creating both opportunities and financial pressures. AI diagnostics, wearables, and personalised health tools enhance chronic disease management and early detection, particularly benefiting aging populations. The increasing accessibility of genomics data fuels personalised care, promising more precise treatments. Despite technological gains, public healthcare infrastructure remains underfunded and increasingly reliant on the private sector, threatening overall system resilience. Healthcare access in rural areas lags, leaving some populations excluded from AI benefits. High out-of-pocket (OOP) costs and expensive private innovations exacerbate inequalities. The private sector's dominance in data raises concerns over data sovereignty and public research constraints, fostering long-term dependence on private actors. The lack of clear governance frameworks challenges safe and equitable AI deployment. The healthcare workforce is disrupted, create both opportunities and hurdles for governments. Digital and health literacy become critical for uptake. Building literacy emerges as a tool to nudge public behaviour and foster acceptance. While Bulgaria becomes a hub for AI health innovation, societal and institutional readiness remain uneven. Public-private collaboration, digital literacy initiatives, and inclusive policy strategies are essential to ensure AI drives equitable, sustainable healthcare transformation.

Scenario D: Grid Components

Zeitgeist:

- The advancement of AI happens rapidly. There is a strong emphasis on utilising AI for reducing health care cost in the EU.
- AI significantly reduce misdiagnosis and creates increased efficiency of operational processes.
- The Bulgarian health care system in many ways lack behind other EU countries, but on some areas where private players have more room to maneuverer Bulgaria is seen as a testing ground.

Political

- Political discussions revolve around the ethical, legal, and regulatory frameworks needed to govern AI in healthcare. While there is support for AI, the rapid pace of technological change creates challenges in developing and enforcing regulations.
- AI is progressing fast, but there is from the EU side a strong wish to contain the risk of technological unemployment resulting in a mixed tapestry across the healthcare sector.

Economic

- Political reluctance to invest in public healthcare leads to a dependency on private solutions, weakening the public system's infrastructure.
- The advancement of wearables creates an increased individual responsibility for health which is dependent on personal financial means, increasing health disparities.
- Significant private funding is directed towards AI development and implementation in healthcare, leading to rapid advancements in AI-driven diagnostics, treatment planning, and patient management.
- The integration of AI in healthcare exacerbates economic disparities. Wealthier populations benefit from cutting-edge AI healthcare services, while poorer segments struggle with access due to the high costs associated with these advanced technologies.
- AI technologies lead to cost savings in certain areas, such as predictive analytics for disease prevention and automation of administrative tasks. However more and more public research is dependent on data that is owned by private actors, especially the tech giants.

Societal

- AI plays a critical role in managing the healthcare needs of the aging population, offering personalised care plans, remote monitoring, and early detection of diseases. However, the elderly face challenges in adapting to AI-driven healthcare services.
- The healthcare workforce undergoes significant changes, with a shift towards roles that require AI expertise. Traditional roles are increasingly automated, leading to workforce displacement and the need for continuous upskilling.
- AI is better than doctors in performing diagnosis resulting in trust issues and a new role for MD's, who find their role as doctors radically challenged.

Technology

- AI technologies are rapidly adopted across the healthcare system, transforming diagnostics, treatment, and patient care. AI-driven tools become integral to managing chronic diseases, predicting health trends, and optimising resource allocation.
- While urban areas see significant advancements in AI healthcare technologies, rural regions struggle with infrastructure gaps, leading to uneven access to AI-driven care.
- The private sector plays a leading role in developing AI healthcare solutions, including advanced diagnostic tools and personalised medicine. However, these innovations are often inaccessible to the general population due to high costs and regulatory barriers.

Policies selected from knowledge base and based on workshop 2

1. Strengthen Early Detection Systems: Implement robust surveillance and diagnostic capabilities to identify emerging pathogens promptly.
2. Enhance Health Information Systems: Strengthen data governance. Develop robust data collection and shared cloud infrastructure to be accessed by public and private actors to facilitate real-time monitoring and informed decision-making. It will address challenges in transparency and interagency coordination, critical for responding to health crises as well as over-reliance on private sector investments.
3. Community Engagement Policy: Establish mechanisms for incorporating community input into health planning and response efforts.
4. Invest in Health Workforce Resilience: Provide training, fair compensation, and mental health resources for healthcare workers, and ensure cross-training for flexible deployment during crises.
5. Invests in health literacy and digital fluency as an enabler for behavioural change and system-wide uptake.
6. Amend the Health Act to address the reimbursement of medical devices.
7. Facilitate a shift to a climate friendly diet: According to the Lancet a shift to a climate friendly diet can significantly reduce public health expenditures. (Red meat, such as beef, lamb and pork, has been classified as a Group 2A carcinogen by the WHO). The Bulgarian government should incentivise the shift to a more vegan friendly diet, though labelling and public procurement practices.
8. Build framework for PPP collaboration.
9. Develop a National AI in Health Strategy: Align with EU goals to attract funding and guide safe, equitable AI adoption in healthcare.
10. Ensure Sustainable Health Financing: Allocate sufficient funds for health services and establish financial reserves to manage unexpected health crises.
11. Improve collaboration: Make a joint taskforce between Ministry of Defence and Ministry of Interior to with coordinate plans for emergency responses. Including the integration of digital health solutions into national emergency response plans.
12. Augment human resources There is lack of nurses in Bulgaria, AI and augmented reality could be used to support not formally trained nurses to provide assistance in case of emergencies.

Workshop 3

The third policy workshop focused on policy testing. It gathered participants from the National Patients' Organisation (NPO), the National Centre of Public Health and Analyses, the Health & Life Sciences Cluster Bulgaria, the Bulgarian Pharmaceutical Union, the Ministry of Electronic Governance, among other stakeholders.
Input from the knowledge base was used to test against the scenarios during this workshop. Between workshop 2 and 3 a list of suggestions for policy recommendations was prepared taking from the SWOT- TOWS analysis and a list of policy recommendations was taken from the knowledge base whose relevance was checked by the local partner BAPEMED. These was compiled into a list that was used in the third workshop (See section with details below).
Participants were asked to access each policy recommendation against their respective scenarios, using the template that has been provided by the project.
Each policy was assessed in relation to local circumstance, so the participants were asked to provide the strategic reasoning pursuing this particular policy or part of the policy. It might not be the entire policy, but part of it which worked, so they were asked to specify what part of the policy that would work for the challenge and write suggestions for changes to better fit local needs or a particular situation, as well as what would be required to implement the policy solution. They were asked to specify who would benefit from the policy solution and who would be potential losers. For each scenario this can be different. It is through this difference that both the robustness of the policy and its applicability is seen.

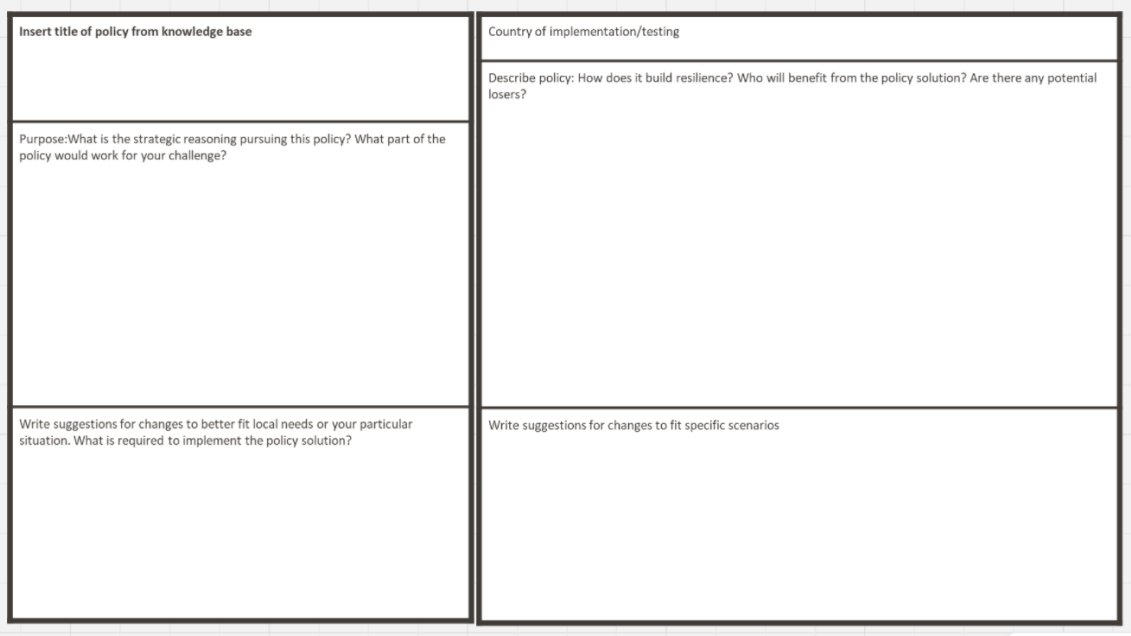


Figure 15: Policy solution canvas

The time Horizon of the project was 2040, so a backcasting exercise was performed. This created the basis for a 3-stage roadmap. Asking the questions what should be done:

- from 2025-2030
- from 2031-2035
- from 2036-2040

The focus of this exercise was to make the aim of 'future resilience' actionable today. Time constraint prevented a discussion about what other areas would benefit from these initiatives in the short term. This discussion is a good way to create the organisational buy in and get the resources needed to follow through with the proposed changes.

Detailed Output

The third policy workshop was focused on policy testing. The four groups that had previously worked in the scenarios were divided in the same way as in workshop 2, so that each scenario could be presented in the groups rather than in plenary. Four facilitators from CIFS presented the scenarios in the groups and tested the identified actions/ policies that had been identified earlier in the process or had come from the knowledge base.
To test the policies the windtunneling method was used (see Figure 16)

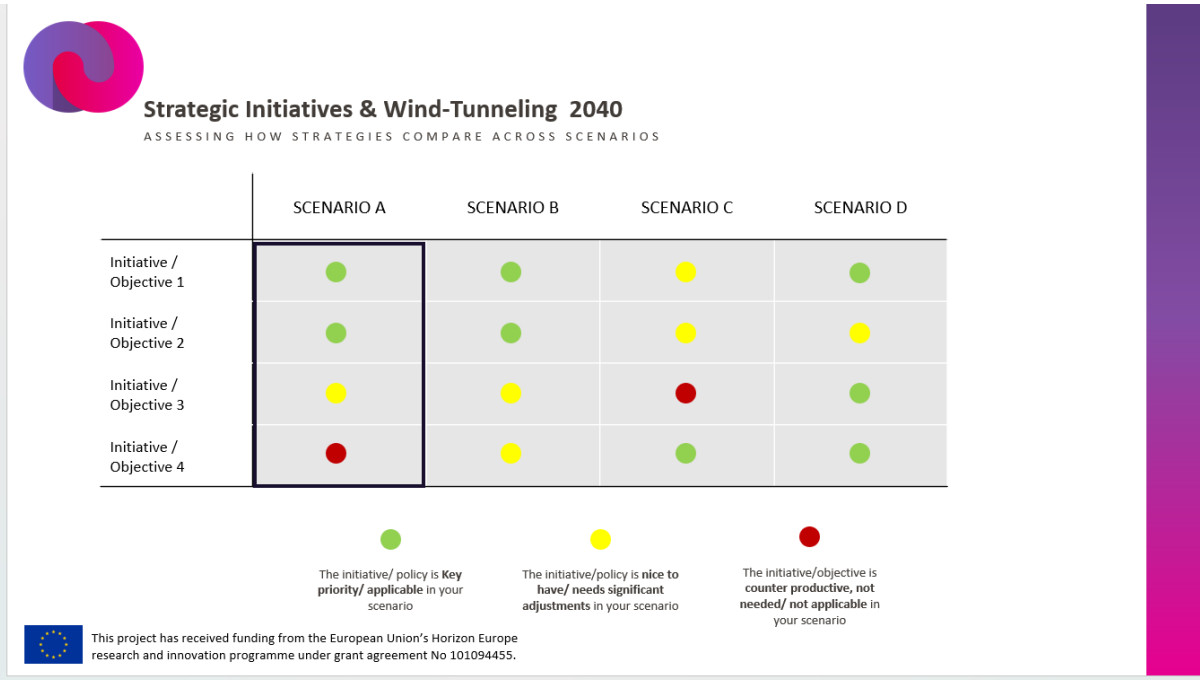


Figure 16: Windtunneling model

Using the windtunneling method policies was tested and adapted to a Bulgarian context. Three policy solutions were selected that complement the existing Bulgarian policies within the National Health Strategy 2030 (NHS 2030).
Especially POLICY 2.1 - Development of outpatient care capacity with a focus on primary care, POLICY 2.3 - Development of emergency response capacity, POLICY 2.7 - Better planning and motivating the workforce in the health sector. The three policy solutions are:

- Strengthen Early Detection Systems: Implement robust surveillance and diagnostic capabilities to identify emerging pathogens promptly: Effective outbreak detection enables timely crisis management and lead to a reduction in the healthcare costs by avoiding expensive or long-term treatments. Early detection plays a crucial role in managing diseases by helping to lessen the

impact on both individuals and society overall, it also benefits healthcare workers by reducing the severity and volume of cases they need to manage, allowing for more efficient use of resources, improving patient outcomes, and decreasing occupational stress and burnout.

- **Invest in Health Workforce Resilience**: A healthier, more stable healthcare workforce contributes to broader public health and national resilience. For society at large, investing in health workforce resilience means greater health security, inclusive development, and social protection. It's a foundational investment in the well-being, stability, and future of communities and nations. It supports job creation and economic inclusion, promotes equity and social justice, and enhances national resilience and security, enabling societies to better withstand and recover from crises like pandemics, climate change, and conflict. Moreover, it underpins sustainable development and advances global health commitments, particularly the Sustainable Development Goals (SDG 3: Good Health and Well-being), reinforcing a country's role in global health security.
- **Enhance Health Information Systems:** Patients will gain better quality and access to care through digital platforms, experience more personalised care, and benefit from faster, more informed and precise medical decisions. It reduces redundancies and costs and empowers individuals through improved access to their health information. Additionally, it enhances emergency response capabilities while ensuring greater privacy and data protection. More efficient healthcare delivery improves health outcomes and should decrease overall cost. It strengthened social resilience by using data to better withstand shocks, such as pandemics or disasters, contributing to societal stability and preparedness.

4.1.4 Achievements

Achievements should be understood in the context of the Bulgarian reality and how to deal with this reality. As part of the workshops the enablers and barriers framework was used to identify challenges.

4.1.4.1 Identification of challenges

A key issue is that today's healthcare systems are financially structured around treating illnesses, which means there is little financial motivation for prevention. Policymakers and healthcare providers need to rethink reimbursement models, shifting towards value-based care that rewards prevention rather than treatment.

- Political reality: The Bulgarian healthcare system is imbedded in a political reality with significant political turmoil and shifts in governments. There is no tradition for continuation in policy like in Scandinavia.
- Transparency: There is a significant lack of transparency of data in Bulgaria. There is a new national electronic health record system (e-health records) where citizens have access to their medical history through the National Health Information System, but the hospitals and medical institutions still use their own separate systems to collect and store patient data. As a result, when a patient visits different hospitals, doctors may not have automatic access to all previous medical records unless they specifically request them, or the patient provides them. The system is improving, but full integration is still a work in progress. This lack of transparency enables power holders to

maintain power and a privileged position. The people it power have no incentive to change the health care system, because it rewards them.

- Culture: There is great frustration with the established system and limited belief in change. People openly say that things will only change when the people in power are no longer in power. They are waiting for a generational shift to create a systems shift. Despite this underlying frustration participant have participated and shown great will for change.
- Climate policy: Current generation are not focused on climate change; there is a belief that a generational shift is needed.
- Misinformation: There are widespread misinformation campaigns taking place in Bulgaria and a part of the population are pro-Russian. This is affecting political decisions negatively. There is widespread scepticism towards science, something that is impacting climate governance and is creating a more and more populistic and non-science-based public discourse.
- Workforce: There is a significant workforce issue with a great lack of nurses.
- Pandemic resilience: remains a concern, with the healthcare system poorly prepared for future health crises due to inadequate investment in infrastructure and emergency planning.
- Preventive health measures and mental health services are neglected, with little to no integration into primary care. A comprehensive health reforms is needed

4.1.4.2 Achievements in the context of challenges

Strengthening Foresight capacity amidst systemic challenges

Foresight is fundamentally about capacity building, developing the ability to anticipate and prepare for different futures. However, when individuals and institutions are trapped in systemic gridlock, with little hope for meaningful change, their ability to think long-term is constrained by the urgency of immediate challenges. This is a critical obstacle that must be addressed to ensure that future preparedness does not become an afterthought in crisis-driven environments.

Fostering experimentation through an adaptive process

Engaging policymakers, researchers, and stakeholders in collaborative foresight spaces is an inherently experimental approach. Success depends on allowing for iterative adjustments based on real-world feedback, ensuring that both the process and resulting policy recommendations remain relevant and actionable.

Bridging the long term with the short-term

Given the pressing challenges Bulgaria faces, it is crucial not just to identify long-term risks but to connect them to the immediate struggles of today. Without this linkage, stakeholder participation is likely to be low, and the process may fail to generate real impact. Recognising this, CIFS adopted a backcasting approach, creating a structured roadmap that aligned long-term foresight with short-term priorities. This to ensure that stakeholders remained engaged and invested, as they could see direct, actionable benefits from their participation.

Leveraging synergies at the European Level

Denmark will assume the Presidency of the Council of the European Union in 2025, and CIFS's health team is actively involved in shaping its agenda. A major focus is on bridging the Danish and Polish presidencies, particularly in relation to the European AI Act and the European Health Data Space, both of which are areas that play a critical role in the FUTURESILIENCE scenarios as well as the policy solutions that came out of the process. A key priority for the

Danish presidency is to bridge the East-West divide in European healthcare and digital governance. Bulgaria is a prime example of this divide and offers an important case study. Bogi Eliasen who is part of the FUTURESILIENCE team presented on 17 January the importance of prevention and digital health as part of the inauguration of Poland's presidency of the Council of the EU in Warsaw. Organised by the National Institute of Oncology in collaboration with the Ministry of Health, "the conference brought together experts, scientists, and representatives of European oncology institutions, including participants from Denmark, which will take over the presidency from Poland. The discussion centred on joint strategies to reduce cancer rates and the future of preventive measures in Europe."

4.1.4.3 Policy impact

The BAPEMED Lab has manged to engage a wide range of stakeholders, who has shown interest in foresight. One of the pilot's most significant contributions is getting these stakeholders together with the aim of shifting governance from reactive crisis management to anticipatory policymaking. By integrating foresight methodologies into decision-making, the BAPEMED lab is equipping policymakers with the skills to balance short-term needs with long-term resilience strategies, an essential step toward sustainable governance.
Integrating foresight into policymaking presents challenges, as political decisions are often driven by short-term incentives and electoral pressures. Policymakers are frequently evaluated on their ability to deliver immediate results rather than their commitment to long-term strategic goals. This misalignment between political cycles and foresight methodologies can create resistance to future-oriented policies, something we have witnessed throughout the FUTURESILIENCE project. This is especially the case in Bulgaria which suffers from political instability.
Despite these obstacles, Bulgarian stakeholders' involvement in FUTURESILIENCE highlights an openness to embedding foresight and resilience into governance. We hope that by developing a co-creating lab Bulgarian policymakers are gaining the skills and methodologies needed to navigate complex uncertainties which can foster a culture of anticipatory thinking in and around government. This capacity building should lead to direct policy impact, which will create more forward-looking policymaking that prioritises long-term societal well-being over immediate political gains.
The most tangible outcomes of the BAPEMED Lab are three policy recommendations that have become part of the knowledge base:

Enhance health information systems

- Modernise core health information infrastructure with unified standards across all healthcare providers from primary to tertiary and specialised care (public and private).
- Implement interoperability with quality control mechanisms to ensure reliable data is captured, stored and used securely.
- Ensure health information systems are optimised to deliver the best health services and are capable of absorbing surge capacity during emergencies.
- Establish data governance frameworks ensuring appropriate access, privacy, and security controls.
- Build secure health data exchange capabilities to accelerate healthcare innovation and secondary use of data by academics and research institutions

- Enhance the National Health Information System by ensuring equitable access for healthcare providers, not just patients. Enable bidirectional data flows that allow both uploading and secure downloading of high-quality health data to support clinical decision-making and research.

Invest in health workforce

- Create reskilling programs for practicing healthcare professionals. Develop specialised educational tracks in health informatics and clinical informatics.
- Implement professional development programs for healthcare providers in collaboration with universities and schools.
- Augment human resources using AI and augmented reality. This can be used to support non-formally trained nurses also to provide assistance in case of emergencies.
- Invest in health workforce resilience providing training, fair compensation, and mental health resources for healthcare workers, and ensure cross-training for flexible deployment during crises.
- Build international partnerships for knowledge exchange and capacity development.

Strengthen early detection system

- Use standards in structured data so that it can be used to establish real-time alerting mechanisms integrating data from diverse sources such as meteorological data for extreme heat warning.
- Leverage AI to build integrated epidemic intelligence systems capable of detecting unusual disease patterns from diverse data sources.
- Strengthen communicable disease surveillance systems by leveraging existing infrastructures such as the Centre for Infectious Diseases to ensure dissemination of information for emerging infections like COVID-19.
- Establish clear communication channels and decision-making protocols for crisis situations.
- Create simulation-based training environments incorporating AI and digital health technologies for emergency scenarios.

These policy recommendations came from the knowledge base and were tested against the Bulgarian local context. Each helps to create a more resilient healthcare system in case of crisis, an each individually and seen in conjunction help create an adaptive, coping, and transformative capacity. Investing in a health workforce is an investment in a fundamental capacity without which the healthcare system will not function. Enhancing the health information system leveraging digital and AI technologies is anticipating the potential transformative change that AI might bring about, securing government shape the future of the underlying data system considered privacy issues and interoperability.
The three policy recommendations are directed at Bulgarian policymakers, whereas the policy brief is also targeting the many similar EU countries where rising healthcare costs are threatening government finances and where prevention and advancement of the health technology ecosystem can provide part of the solution.
As part of the workshop a roadmap to bridge the future was created. This was out of scope but was a means to bridge the long term 2040 aims to the short-term actions and a way to motivate and empower participants (see below).

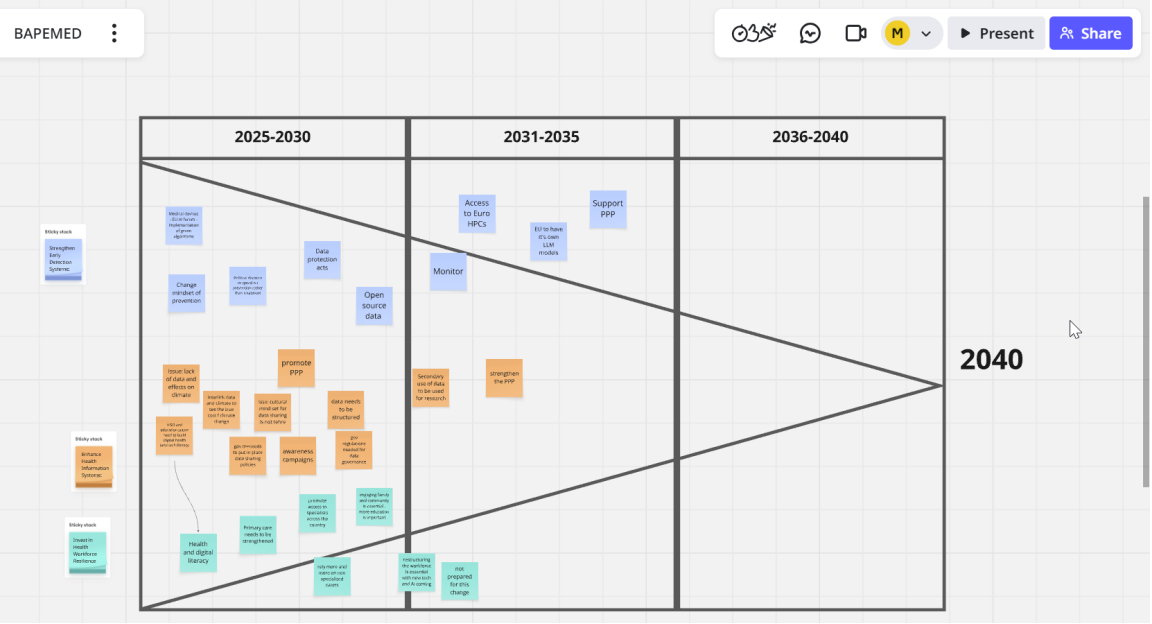


Figure 17: MIRO for Backcasting

4.1.5 Lessons learnt

The vision for the BAPEMED lab in Bulgaria was to reshape the policy landscape by shifting the focus from reactive crisis management in healthcare to proactive governance and decisive actions to prevent future crisis. However, identifying a future crisis is only the first step, ensuring that stakeholders take meaningful action is an entirely different challenge.

A common but flawed assumption is that once a crisis is identified, rational decision-making will naturally lead to its prevention. In reality, short-term priorities, political incentives, and the perception that future risks are someone else's problem often delay action. This phenomenon, known as future discounting, leads stakeholders to deprioritise long-term challenges in favour of immediate concerns. For others interested in launching similar initiatives identifying the barriers to uptake is very important task.

To counteract this tendency to focus on the short term, CIFS decided to develop a strategic roadmap that integrated backcasting from foresight scenarios. By starting with a vision of the desired future and working backward, we ensured that long-term objectives were aligned with short-term goals.

This approach bridges the gap between foresight and action, ensuring that healthcare policies remain both forward-looking and immediately actionable. By embedding this the BAPEMED Lab ensured that policies stay relevant and effective over decades while still addressing urgent priorities today, striking a balance between long-term resilience and short-term political and societal realities.

4.2 CHIOS Lab

Abstract
The CHIOS Lab focused on addressing the challenges and opportunities arising from migration on the Greek island of Chios, located in the North Aegean. The lab examined Chios resilience in the face of migration and overlapping crises, by employing innovative participatory foresight methods integrating stakeholder engagement, scenario planning, and policy testing. It held workshops, focus groups, interviews, and surveys with multiple stakeholders at various levels of governance and in multiple sectors to identify critical determinant factors, develop scenarios, and recommended strategies and policy solutions for building community resilience.

- Local Partner: Municipality of Chios
- Mentors: Regional Development Institute and Foresight Centre

4.2.1 Description of the Lab

As part of the FUTURESILIENCE project, 10 labs have been introduced to study the resilience and preparedness of specific regions in Europe. The FUTURESILIENCE project set up the CHIOS Lab to study the phenomenon of migration.

Migration constitutes one of the main societal challenges in Europe and worldwide. Since the turn of the new century, migration crises have imposed considerable challenges on the lives of local communities worldwide. In Europe, immigration continues to be one of the most prominent political issues. In 2023, of the 448.8 million inhabitants in the European Union (EU), 27.3 million are non-EU citizens (6% of the total population of the EU). In 2022, 5.1 million people from non-EU countries migrated to an EU Member State (Eurostat, 2024). Chios, a North Aegean Island with a rich cultural and economic history, became a focal point during the 2015 migration crisis, when a significant influx of refugees and migrants exerted immense pressure on local communities. By August 2016, “more than one million people seeking international protection, mostly from Syria, Afghanistan, Pakistan, and Iraq, have entered Greece through Turkey since January 2015” (Sakellis et al., 2016). This crisis compounded preexisting economic and social challenges, making Chios an ideal case study for examining resilience in the face of overlapping crises.

Chios is the fifth largest island in Greece, situated in the North and East Aegean. Together with the smaller islands of Psara, Antipsara, and Oinousses, Chios forms one of the Regional Units of the North Aegean Region. The island boasts a rich natural and built environment and offers a diverse range of agricultural products, including the famous and unique Chios mastic, as well as olive oil, figs, wine, and citrus fruits. Chios also has a longstanding tradition in shipping and ship ownership. The island's tourism sector is well-developed, supported by an international airport and connections to major Greek ports. Chios is known for its beautiful beaches, old stone-built mansions, Byzantine churches, and picturesque villages located both seaside and on the steep mountain slopes.

Chios represents an interesting case study due to the overlapping crises that impact its local communities. Chios has faced unique challenges, particularly due to the migration crisis of 2015. During this time, the island experienced a substantial influx of refugees and migrants attempting to enter Europe from nearby Turkey, leading to overcrowded refugee camps and humanitarian issues. Additionally, Chios's economy, which relies heavily on agriculture, tourism, and maritime trade, was further strained by the migration crisis and the economic recession in Greece.

The aim of the CHIOS Lab was to investigate the impact of the migration crisis and the island's resilience building process through an innovative participatory methodological approach. Specifically, the Lab examined how these external shocks have influenced various dimensions of daily life, including aspects related to climate change. Furthermore, the Lab looked to contribute to shaping European urban development policies by sharing successful practices and exploring synergies in a multilevel and multistakeholder environment.

The objectives of the CHIOS Lab included:

- Objective 1: Investigate the ways in which the recent economic and migration crisis have affected the island's resilience.
- Objective 2: Explore ways in which these external shocks have affected dimensions of everyday life, considering additional aspects related to climate change.
- Objective 3: Adopt a regional perspective including experiences that refer to neighbouring islands, looking to find similarities between them.

4.2.2 Initial needs and challenges

Chios became the centre of attention during the 2015 migration and refugee crisis when a large number of migrants, including children and women, arrived by sea, narrowly escaping drowning and completely without belongings. Greece, along with other countries such as Italy, received the largest influx of refugees. The number of arrivals by sea and land soared to extremely high levels.

This situation led to a humanitarian crisis that drew the attention of international and human rights organisations, the European Union, various governments, local authorities, non-profit organisations (NGOs), the Church, and concerned citizens. This crisis compounded an already unstable political and social environment in Greece, which had been grappling with a socioeconomic crisis since 2008. The ongoing state of crisis heightened the pressure on local communities to address these complex and multi-dimensional challenges. On the other hand, refugees faced numerous challenges related to living conditions and their need to move and settle in another country.

The CHIOS lab worked on three categories of challenges: environmental, technical and social, as presented in the subsections below:

4.2.2.1 Environmental challenges

Environmental and climate challenges have a direct link to or were intensified as consequence of the Greek economic crisis and migration flows to the islands, creating complex dynamics. The influx of people exerts significant strain on the environment, particularly in areas ill-prepared for such population surges. Several key concerns regarding the refugee crisis and its environmental impact will be examined:

1. Plastic pollution emerges as a prominent issue, with refugees leaving behind approximately 8 kilograms of waste per person, largely consisting of discarded life vests upon arrival.
2. The heightened population strain leads to overuse of natural resources, exacerbating water scarcity issues, particularly problematic for islands with limited water supplies.
3. Overcrowded camps on the islands compound these challenges, resulting in hygiene and waste management issues.

4.2.2.2 Technical challenges

Technical challenges involve the following:

1. Water supply remains a pressing issue on islands, exacerbated by overpopulation resulting from the refugee crisis.
2. Housing shortages persist despite the construction of camps to accommodate the enormous number of refugees.
3. Shortages in healthcare facilities have been amplified by the influx of refugees to islands already struggling with healthcare provision.
4. Education is a critical concern, as asylum-seeking children are mandated by law to attend public schools under conditions akin to Greek nationals.

4.2.2.3 Social challenges

Society and its behaviour exert significant influence on economic crises and migration. Factors such as social attitudes toward migrants, discrimination, social cohesion, community engagement, awareness of migrants' challenges, education, government policies, and healthcare services all contribute to shaping these issues. Negative perceptions of migrants can fuel discrimination, whereas promoting social cohesion and inclusivity can help mitigate migration challenges. Community engagement can offer crucial support, resources, and social networks for migrants.

In the initial stages of the refugee crisis, local communities played a pivotal role in addressing the challenges faced by refugees. They provided voluntary assistance, including food, clothing, accommodation, and employment opportunities. However, as the crisis persisted and NGOs and state assistance expanded, the voluntary contributions from residents diminished. This decline could be attributed partly to citizens observing significant funds

allocated to the refugee crisis, while the domestic situation, still reeling from the economic crisis, remained unresolved.

4.2.3 Work done in the lab

The CHIOS Lab aimed at strengthening the governance of migration by adopting an innovative participatory methodological approach (see, for instance, Kordel and Gruber, 2024; Kounani et al., 2020; Olcese et al., 2024). Furthermore, the lab looks to contribute to shaping European urban development policies by sharing successful practices and exploring synergies in a multi-level, multi-actor environment.

The Lab conducted workshops, focus groups, and interviews with multiple stakeholders, as well as a semi-structured questionnaire in the local language geared towards citizens. Through these activities local actors were called upon to actively, openly, and collectively contribute to resilience capacity building by sharing their experience of the 2015 migration crisis, by detecting determinant factors, and by shaping scenarios, strategies, and policies to deal with such crises in the future.

The CHIOS Lab implemented innovative participatory foresight methods to assess possible policy solutions for dealing with the challenges posed by migration on the island of Chios. Briefly, in accordance with the guidelines for pilot cases, through the course of the project the Lab evolved in 3 core phases:

- **Phase 1. Diagnose and Frame:** Describing the problem and identifying the stakeholders.
- **Phase 2. Scenario development:** Understanding how frameworks conditions may evolve.
- **Phase 3. Policy Testing:** Selecting policy options and testing their robustness against the scenarios.

Both online and onsite workshops were organised to implement the 3 phases of the study. The onsite workshops took place at the meeting room of the Municipality of Chios, a familiar location where stakeholders at all levels of governance gathered to tackle the extraordinary challenges posed by the huge migration influx. In the following section, we develop the details regarding the activities of the CHIOS Lab.

Phase 1

Approach

The problem framing in the CHIOS Lab was developed through a mixed-method approach. Primarily, it is based on the STEEP framework, which enables a holistic analysis of the crisis's multifaceted impact on the region. The Regional Development Institute (RDI), leading this task, applied its expertise in regional resilience and development, utilising a mix of desk research, analysis of publicly available statistical data, and insights drawn from workshops and collaborative engagements with local stakeholders. In particular, as an academic and research-based institution, RDI applied its established expertise in regional resilience and

development to define the key challenges faced by Chios in the context of the refugee crisis. The framing exercise also draws on official data from sources such as the Hellenic Republic Ministry of Migration and Asylum, UNHCR, and Eurostat. It was further complemented by evidence from prior workshops, policy discussions, and fieldwork involving local authorities, NGOs, and community stakeholders to ensure a more inclusive and participatory problem definition process. Therefore, elements of the problem framing methodology are grounded in published statistics and reports, while others reflect experiential knowledge and institutional memory from collaborative activities on the ground.

Problem Statement

This task involves the implementation of the pilot project in Chios, an island in the northern Aegean Sea. The pilot case examines how the migration crisis has impacted the island's resilience. Specifically, it explores how such external shocks have influenced various dimensions of daily life, including those related to climate change. Starting from a local perspective, the project will gradually broaden its scope to include the regional level, taking into account the experiences of neighbouring islands and identifying common patterns among them.

The refugee crisis that began in 2015 intensified in the following years. According to the EU, by August 2016, "more than one million people seeking international protection, mostly from Syria, Afghanistan, Pakistan, and Iraq, have entered Greece through Turkey since January 2015."

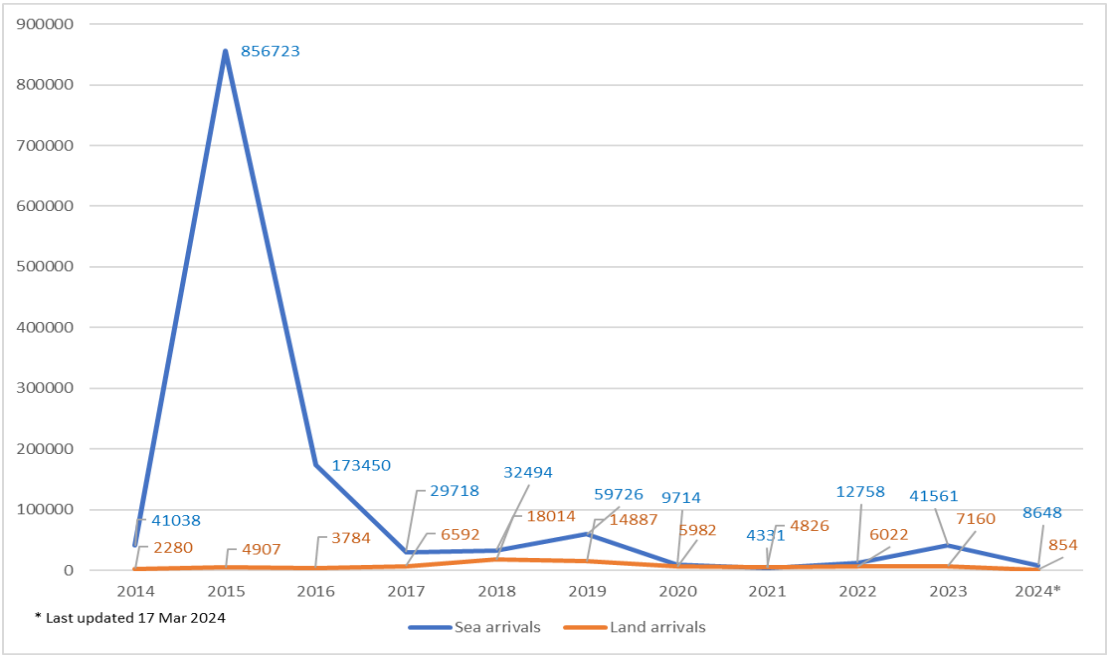


Figure 18: Sea and Land Arrivals in Greece

Source: United Nations High Commissioner for Refugees, Operational Data Portal

Greece, along with other countries such as Italy, received the largest influx of refugees. Arrivals by both sea and land intensified, reaching exceptionally high numbers. Although this flow had significantly declined over the past two years, a notable increase has been observed in recent months. Specifically, arrivals surged by 300% in October 2023 compared to the same month in 2022.

Focusing on the area under study, the island of Chios—along with other Northeastern Aegean islands, such as Lesvos and Samos—received a substantial share of these refugee flows. The data reflects refugee arrivals over the period from 2013 to 2023.

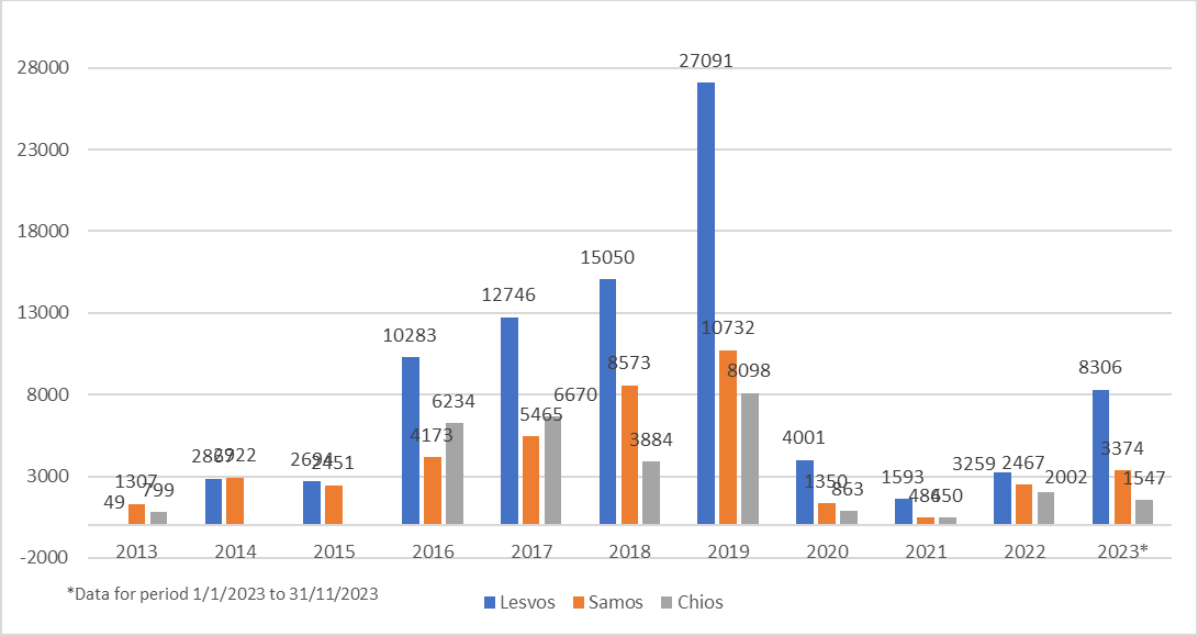


Figure 19: Arrivals in North Aegean Islands

Source: Hellenic Republic, Ministry of Migration and Asylum, General Secretariat for the Reception of Asylum Seekers.

The total percentage of refugees in relation to the overall population of the islands has generally remained below 10%, with the exception of the period between 2016 and 2019. Indicatively, in 2019, refugees on the island of Samos made up nearly one-quarter of the total population.

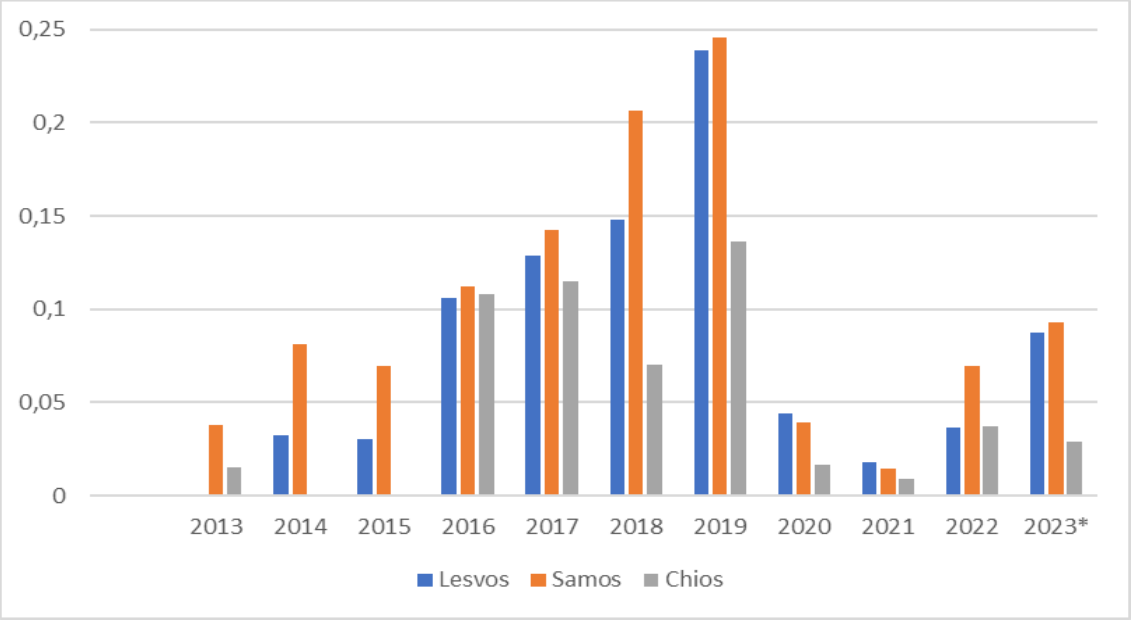


Figure 20: Percentage of refugees to permanent population in islands

*Source: Hellenic Republic, Ministry of Migration and Asylum, General Secretariat for the Reception of Asylum Seekers, Hellenic Statistical Authority *Data for period 1/1/2023 to 31/11/2023,Data of population are based on the Census Results of Population and Housing 2011 and 2021*

Regarding the island of Chios, several data points are presented below.

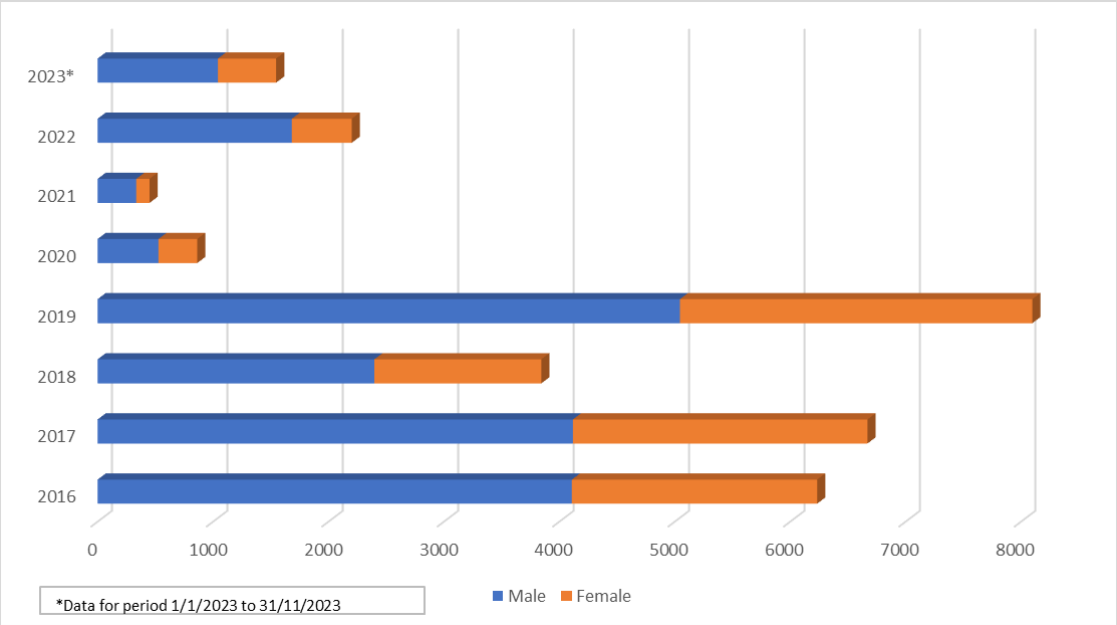


Figure 21: Arrivals at Chios by gender

Source: Hellenic Republic, Ministry of Migration and Asylum, General Secretariat for the Reception of Asylum Seekers

Among the refugees, a significant number are children traveling with their families, while some are unaccompanied minors. For instance, in 2022, a total of 333 unaccompanied children arrived on the island of Chios. The figure below presents selected data related to Chios.

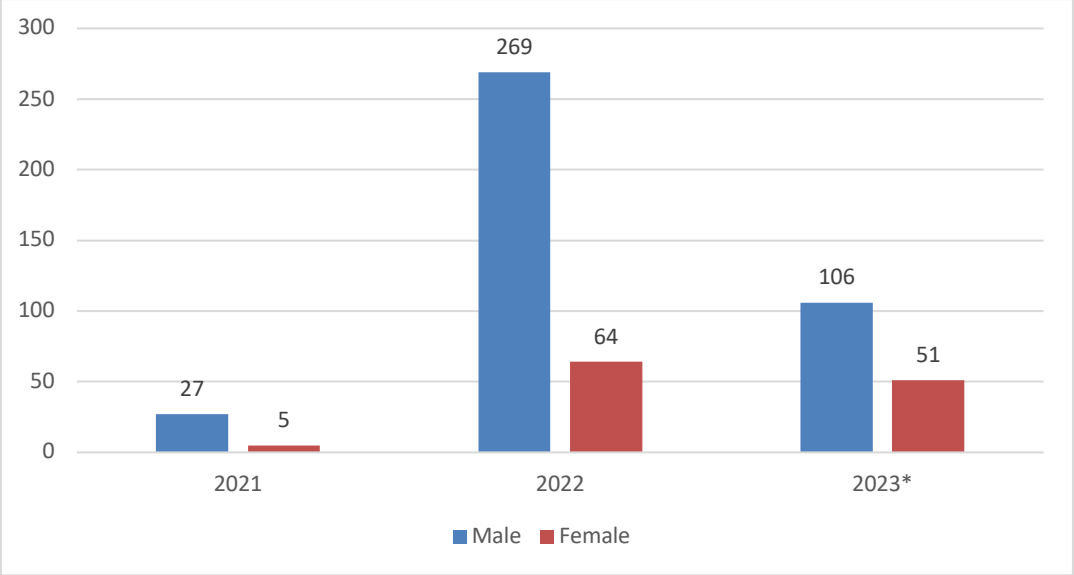


Figure 22: Unaccompanied Minors at Chios by gender

Source: Hellenic Republic, Ministry of Migration and Asylum, General Secretariat for the Reception of Asylum Seekers *Data for period 1/1/2023 to 31/11/2023

Unsurprisingly, the intense influx of refugees to the island of Chios disrupted its economic and social cohesion. Large numbers of people—many without resources, employment, or access to basic necessities—arrived on the island, and the local government was tasked with responding to this challenging situation. Supporting efforts were made by the central administration, international organisations, public and private sector entities, as well as NGOs. Nevertheless, the impact on both society and the economy has been significant.

At the same time, the refugees themselves faced a range of difficulties—on one hand, concerning **their living conditions**, and on the other, their **desire to relocate and settle in another country**. Over the years, the average time from lodging an appeal to the issuance of a decision has improved. The table below presents data on the duration of this process.

Table 5: Time for applications' decisions for International Protection

AVERAGE TIME FOR 2nd INSTANCE DECISIONS				
AVERAGE TIME FROM APPEAL LODGING				
	01/12/2019 TILL 29/2/2024		01/12/2019 TILL 31/12/2020	
LOCATION	AVERAGE TIME (Days)	DECISIONS	AVERAGE TIME (Days)	DECISIONS
MAINLAND	93	45305	100	6974

ISLANDS	81	12523	77	3881
TOTAL	91	57831	92	10855
NOTE: Average time (in days) has been calculated as the difference from appeal lodging to issuance of decision for those appeals that have been filled and a decision was issued in the same period.				
AVERAGE TIME FROM APPEAL DISCUSSION				
	01/12/2019 TILL 29/2/2024		01/12/2019 TILL 31/12/2020	
LOCATION	AVERAGE TIME (Days)	DECISIONS	AVERAGE TIME (Days)	DECISIONS
MAINLAND	51	55443	55	16559
ISLANDS	55	13164	56	4457
TOTAL	52	68607	55	21016
NOTE: Average time (in days) has been calculated as the difference from appeal discussion to issuance of decision for those appeals that have been discussed and a decision was issued in the same period.				

Source: Hellenic Republic, Ministry of Migration and Asylum, General Secretariat for the Reception of Asylum Seekers

Environmental / Climate Challenges: *How does the problem interact with challenges related to the environment, general ecology, or climate crises?*

The economic crisis and migration on the Greek islands have complex interactions with environmental, ecological, and climate-related challenges. For example, the large influx of people has put significant pressure on the environment, especially in areas unprepared for such an increase in population. Some key issues regarding the refugee crisis and the area under study include:

Plastic Waste: One of the most profound problems is the plastic waste left behind by refugees as soon as they arrive on the islands. It is estimated that each person brings an average of around 8 kilograms of waste, mainly consisting of discarded life vests.

Overuse of Resources: Additionally, the overuse of natural resources is noticeable due to the increased population resulting from migration. This is particularly problematic for the islands, which already face water shortages. Overuse of water resources exacerbates the situation.

Overcrowded Camps: Another issue involves the overcrowding of camps on the islands. The lack of resources results in hygiene and waste management problems, among others. Overpopulation can lead to poor sanitation and health conditions, affecting both migrants and locals. These conditions also have a negative impact on the environment and public health. The economic crisis further reduces the government's capacity to address environmental and climate-related issues.

Technical Challenges: *What are the technical challenges you engage with? Where are technological bottlenecks (including processes) to be overcome?*
Some of the key technical challenges we engage with include:
Water Supply: The islands face a lack of sufficient water supply, which becomes more pronounced when the islands are overpopulated due to the refugee crisis.
Lack of Housing: The large number of refugees could not be accommodated by the existing housing infrastructure. Although camps were established, the housing issue was not fully resolved.
Shortages in Healthcare Facilities: Refugees arrived on islands already struggling with healthcare issues. This problem was exacerbated by population growth.
Education: According to Article 55 of L. 4939/2022, asylum-seeking children are required to attend primary and secondary school under the public education system, under conditions similar to those of Greek nationals. It is crucial to monitor educational attendance for refugees and the relevant infrastructure involved. According to the Ministry of Education, the highest enrolment rates were achieved for the 2021-22 school year. Specifically, up to 95% (16,417 refugee students) were enrolled in schools, and 75% (12,285 refugee students) were successfully enrolled. Additionally, 1,578 educators were recruited for 110 Reception Education Structures for Refugees (RESR) and Reception Classes in Primary and Secondary Education across the country.
Information Management: This involves data collection and the secure sharing of information among relevant stakeholders.
Several technological challenges and process bottlenecks need to be addressed. Specifically:

- **Coordination and Communication**: Effective coordination among stakeholders is essential for implementing the task. Developing and executing communication and coordination strategies can be a technical challenge. In the early stages of the refugee crisis, there was no clear central plan, and stakeholders acted individually, without coordination. This was likely due to the emergency nature of the crisis—an unprecedented situation for the state. Over time, with the contributions of both the state and the EU, structures, procedures, and a more coordinated approach were established.
- **Dissemination of Proper Information**: Ensuring that accurate and timely information is shared among stakeholders while respecting privacy and security concerns.
- **Access to Competent Stakeholders**: Ensuring that the appropriate stakeholders have access to the necessary information and resources.
- **Reflection of Real Situations and Opinions**: Ensuring that the actual situation and opinions of those affected are adequately represented.
- **Avoiding Bias**: Ensuring that stakeholders remain impartial and do not allow biases to affect the decision-making process.
- **Regulatory and Legal Framework**: Legal and technical expertise is required to ensure that the legal and regulatory frameworks are in place to support the effective implementation of the task.

Social Challenges: *How does society and its behaviour impact the problem? Can or should certain groups play a specific role? Which ones?*

Society and its behaviour significantly influence economic crises and migration. Various factors, such as social attitudes toward migrants, discrimination, social cohesion, community engagement, awareness of migrants' challenges, education, government policies, and healthcare services, all contribute to the problem. Negative perceptions of migrants can lead to discrimination, while fostering social cohesion and inclusivity can help address migration challenges.

Community engagement provides support, resources, and social networks for migrants. In the early years of the refugee crisis, local communities contributed by voluntarily offering materials (food and clothing), housing refugees, and providing employment or care to those in need. However, as the crisis continued and the involvement of NGOs and state assistance increased, the voluntary contributions from residents declined. One factor behind this decline was the perception that much of the funding was directed toward addressing the refugee crisis while the local population was still struggling due to the lingering effects of the economic crisis.

Awareness and empathy for migrants' challenges can drive support for humanitarian initiatives and social services. Civil society organisations, the media, education systems, government policies, and healthcare professionals all play crucial roles in shaping public opinion and fostering a more inclusive society.

Certain groups can and should play specific roles in addressing issues related to the economic crisis and migration. These groups have unique capacities and responsibilities in contributing to effective solutions, including:

- **Government Authorities**: These bodies coordinate resources, develop policies, and ensure essential services for both migrants and local populations.
- **NGOs**: NGOs provide direct support to migrants, raise awareness, and work to reduce discrimination.
- **International Organisations**: The United Nations, UNHCR, and IOM provide funding, expertise, and coordination support.
- **Local Communities**: Communities actively engage in integration efforts by offering support, resources, and social networks to migrants.
- **Employers and Business Associations**: These groups can offer job opportunities and promote social and economic integration.
- **Educational Institutions**: Schools help foster intercultural understanding and tolerance.

For example, from 2015 to January 2021, Greece received €3.12 billion in EU support to manage migration and borders, funded through three EU funds: €2.03 billion from the Asylum, Migration, and Integration Fund, €450 million from the Internal Security Fund, and €643.6 million from the Emergency Support Instrument. Additionally, in 2015, 14 NGOs operated on Chios Island, including organisations like the Hellenic Red Cross, Spanish Red Cross, Praxis, Apostoli, and UNHCR.

The Gaps: *Identify the areas where your issue is lacking resources the most. Where are gaps in the current approach?*

Gaps in the current approach to managing the refugee crisis include:

- **Management of migration crisis**: This involves cooperation with other countries, especially EU countries that are receiving refugees. There is also a lack of a comprehensive legal framework, which creates problems for both refugees and the societies receiving them.
- **Insufficient human resources**: Shortages of essential personnel, such as doctors, teachers, and legal professionals, result in ineffective services for refugees.
- **Delays in asylum applications**: Due to inadequate human resources, asylum application processing times are prolonged, leading to the overcrowding and deterioration of conditions in refugee camps.
- **Integration challenges**: The lack of infrastructure, human resources, and sometimes the wariness or suspicion of local communities hinder the successful integration of refugees.
- **Information management gaps**: There are gaps in data collection and the secure sharing of information among relevant stakeholders and refugees, complicating the coordination efforts.
- **Financial resource insufficiency**: Limited financial resources contribute to ineffective services and hamper the ability to provide adequate support for refugees.

Revision of the Problem Statement: *After answering the questions above, reconsider the initial problem statement. Does the description contain more than necessary? Might it have to include more information? What role do the different facets play?*
After examining the various factors, the problem statement may need to be expanded to reflect the **multi-dimensional nature of the issue. It should now encompass not only the immediate pressures of refugee influx but also the ongoing challenges in the legal, economic, social, and environmental domains**. These facets must be addressed holistically for an effective response. The different groups—government authorities, NGOs, local communities, international organisations, and other stakeholders—play critical roles in managing the crisis and facilitating the integration of refugees. The key is to enhance coordination, resource allocation, and long-term planning.

Key indicators and their dynamics over the last 5-10 years
Key indicators that best represent the refugee crisis on Greek islands include:

- **Arrival numbers**: The number of migrants and refugees arriving on Greek islands is a critical indicator, reflecting the overall scale of migration trends.
- **Demographics**: Age, gender, family composition, and country of origin are essential to understanding the needs of migrants and customising services and assistance accordingly.
- **Asylum applications**: The number of asylum applications and their outcomes (approved, denied, or under appeal) help measure the legal status of migrants and their access to protection.
- **Resettlement and relocation**: Data on the number of migrants resettled or relocated to other countries provide insights into global cooperation and burden-sharing in managing the migration crisis.
- **School enrolment**: Tracking migrant children's school enrolment rates, participation in language assistance programmes, and educational services can provide insight into the integration process and the effectiveness of educational policies.

Additional indicators might include employment rates, migrant employment in various industries, and trends in crime and security, as well as the processing times for asylum applications and legal cases.

Desired Feasible Futures (Normative Visioning)
In an ideal future, the situation would be characterised by:

- A well-coordinated and integrated approach to managing migration, with seamless cooperation between Greece, the EU, international organisations, and NGOs.
- Refugees would be adequately supported with access to housing, healthcare, education, and employment opportunities, allowing for their smooth integration into society.
- Local communities would experience increased social cohesion, with strong networks between migrants and host populations, reducing tensions and promoting mutual understanding.
- The Greek islands would have the resources and infrastructure to manage the population increase sustainably, with minimal environmental impact.
- The legal and regulatory frameworks would be fully equipped to handle asylum applications efficiently, ensuring refugees' rights and needs are addressed in a timely manner.

This vision would foster a society where refugees contribute positively to the local economy and culture, while the local population benefits from the diversity and economic opportunities brought by migration.

Phase 2

The purpose of this phase is to map and analyse the complex system of factors that influence the resilience of the island of Chios, especially in the context of migration, social integration, environmental stress, and economic development. A participatory, multi-method approach was used to ensure that all relevant dimensions — social, economic, political, environmental, legal, and technological — were considered in the analysis.

4.2.3.1 Key Factor Selection

To identify the most influential and uncertain factors affecting resilience in Chios, a structured and participatory methodology was applied.

Step 1: Preliminary Research

The process began with a review of academic literature, foresight studies, and local reports to identify possible resilience drivers. This desk research created a solid foundation for later participatory exploration.

Step 2: Participatory Workshop (June 21, 2024)

A multi-stakeholder workshop was held with participants from local government, NGOs, civil society, and community organisations. Through brainstorming and moderated discussion,

participants contributed over 150 factors they believed influence the island's resilience. These included issues of social cohesion, employment, infrastructure, migration policy, and environmental pressure.

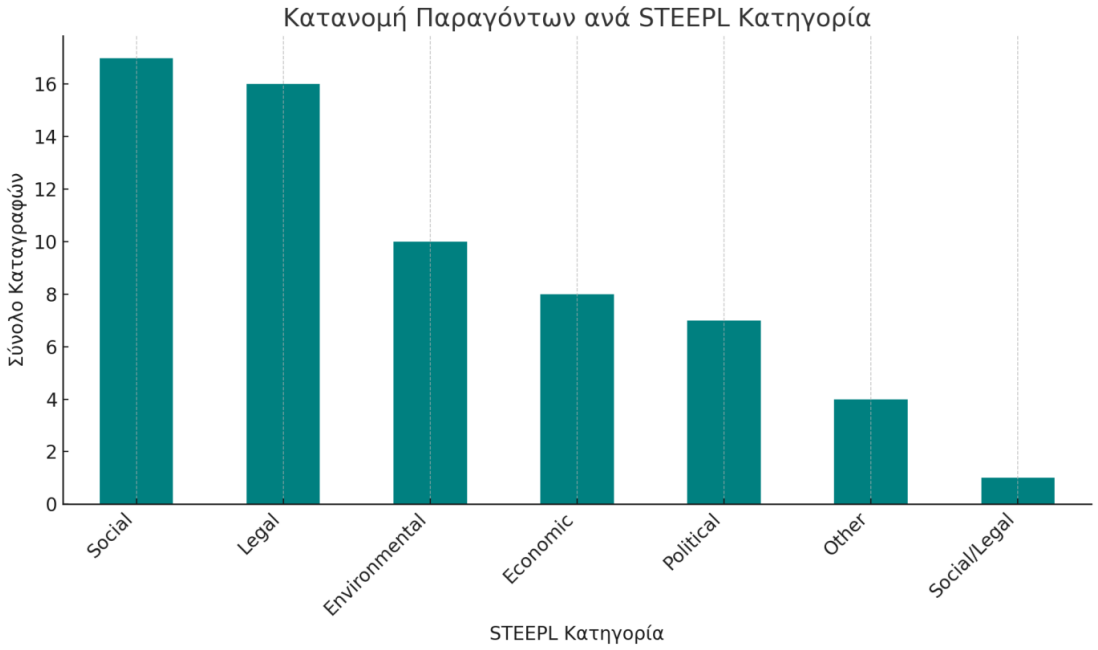


Figure 23: : Distribution of factors per STEEPL category, based on stakeholder input regarding resilience on the island of Chios.

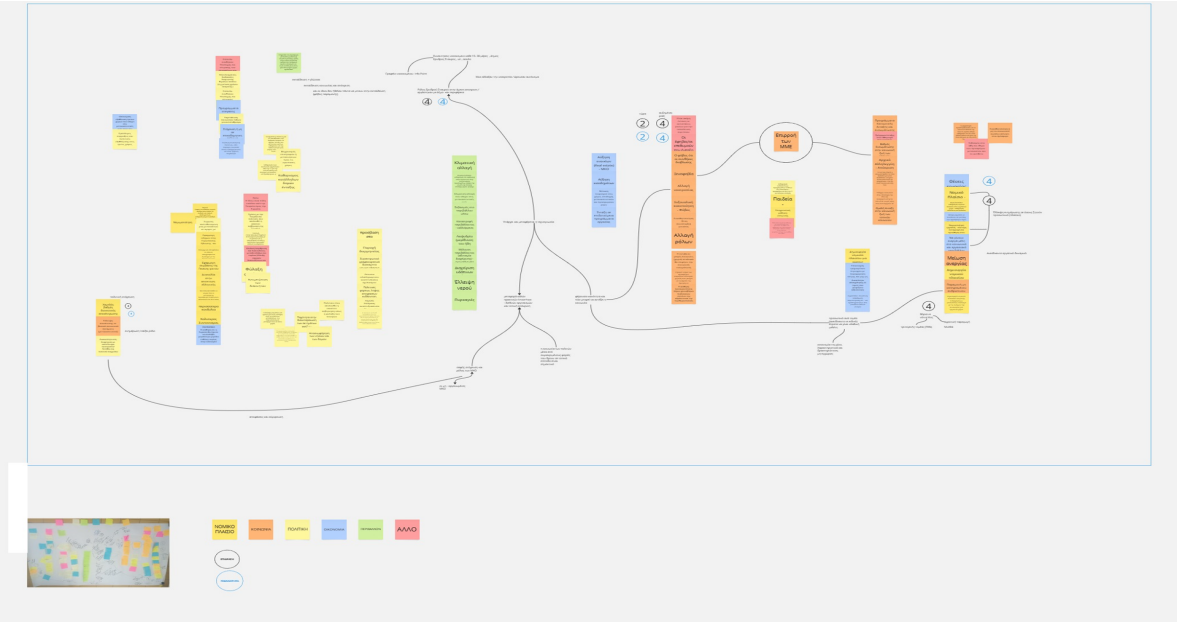


Figure 24: Miro Board Participatory Workshop (June 21, 2024)

The following table represents the most critical factors towards past, present and future resilience on the island of Chios as they were proposed by stakeholders from various sectors and organizations who participated in a workshop on the 21st of June 2024. The factors are grouped based on the field they refer to and are categorized based on six general categories.

Table 6: Chios Lab Influencing Factors

Description of factor	Category
Spatial planning and urban structure	
Creation of a legal framework for residential premises	Legal framework
Colonization of deserted areas with housing and land as tenants	Economy
Employability in areas they know (manpower utilization)	Economy
Spatial planning - Residential structure (concentration of wealth and activities in the single urban centre)	Economy
The morphology, taking into account the social level of Chios to a large extent determined the good degree of resilience of Chios in the face of this whole crisis	Society
Respect for the morals and customs of refugees - immigrants and vice versa	Other
Multiculturalism and interconnectedness	
Sensitization or not of society towards the refugee	Society
Social inclusion and integration programs	Society
Sports Inclusion Program (participation in action through UNHCR)	Other
Degree of Integration in the social life of the locals	Society
First Solidarity - Resident Response	Society
Mutual respect and obligations	Society
There is difficulty in accepting ethnic diversity especially in small places operating in traditional contexts	Society
Accession	
Smooth integration into the social life of local communities	Society
Jobs	Economy
Legal Framework - labour	Legal framework
Legal framework: Defining a legal framework in the workplace - Defining an educational framework for the inclusion of children in schools	Legal framework
Undeclared work with consequences for refugees' attitudes towards local society - increases exploitation and 'hostility'	Economy

Legalization of work - short registration and promotion to the place of their desire	Legal framework
To become active members in the social and work environment	Economy
Reducing unemployment	Society
Creating a legal work framework	Legal framework
Remaining of unregistered human resources	Economy
Work	
Creation of a legal framework for the residence of incoming immigrants according to the needs of the economy for workers	Legal framework
Definition of training programs for local and immigrant - refugees across the EU in the context of changing mindsets - acceptance into the social fabric	Policy
Education - school	Legal framework
Compulsory Greek language learning through programs - Vulnerability	Legal framework
Education	
Multicultural education for integration into society, based on respect for cultural differences - Today, wariness and fear of the "foreigner" is still strong	Other
Parental resistance to girls' education is still strong	Other
Adolescents desire inclusion	Other
The fear that living conditions will change	Society
Xenophobia	Society
Change of mindset	Society
Sexual abuse - Fear	Society
Sensitization - Position (coexistence) of women	Society
Changing roles	Society
Integration into small societies (villages) will gradually bring about social integration	Society
Today part of the refugees remains inactive, which can strengthen the refusal to integrate.	Society
Social Inclusions	
The sense of temporality due to time-consuming procedures increases inertia and marginalization	Society
Media	
Media influence	Society
Rent increase (Real estate) - NGO	Economy
Increase in income	Economy
Reduction of tourism in the countries receiving immigrant and refugee flows	Economy

Economic pressures on the local community	
Joining subsidized work programs	Economy
Climate change	Environment
Climate change - definition and implementation of good practices in dealing with problems caused by climate change (water, food shortages)	Environment
Climate change driving migration flows	Environment
Respect for the environment through education	Environment
Environmental destruction - crops	Environment
Water scarcity (enlargement of the existing one)	Environment
Environmental pollution (failure to manage) – garbage, etc	Environment
Water resources management	Environment
Climate crisis	
Fires	Environment
Low degree of decentralization	Legal framework
Lack of consensus on key issues (immigration)	Society
Problematic management	
Inability to manage resulting in imbalance/instability and politics (gaming)	Policy
Europe -directed flow of immigrants to markets with labor requirements	Policy
Implementation of European Union directives and their establishment as states	Legal framework
Ministerial decisions which are signed according to the policies of each government	Legal framework
Implementation of the Geneva Convention on the definition of a refugee	Legal framework
Difficulty in obtaining Greek citizenship	Legal framework
more funds from the EU	Legal framework
guarding the borders	Legal framework
Multilevel decision making	
The feeling that Europe should assume a greater share of responsibility mainly in the economy	Economy
Economic impoverishment of third countries leading to migration flows to Europe	Economy
Global situation	
War conflicts and impoverishment policies in third countries	Policy
Level of reception and housing conditions for refugees and immigrants	Other

Effective asylum management procedures (e.g. reduction of waiting time)	Policy
Recognition of civil rights, eg ownership	Policy
Housing programs	Economy
Exploitation of social classes for immigration compensation, e.g. Investment projects (Airport)	Policy
Politics and living conditions	
Sustainable economic policy, equal benefits between newcomers and the native population	Economy
The abrupt climate change affects the refugee-immigrant in normal living since there is no proper infrastructure and they are exposed to the sun without protection	Environment
Chios is the gateway from Turkey to Europe	Other
Relations with Turkey and policies followed by each Turkish government	Policy
Dealing with Traffickers	Policy
We have been living in a border dispute with our neighbour for several years and any tension creates conditions of insecurity	Policy
Borders	
Sectoral Structure and interconnections between sectors and sectors (lack of strong interconnections and synergies)	Other
The European policy and the directions of international law. The relations between neighbouring states also determine the resilience of a small society such as Chios.	Policy
Mechanism of returns or movements to European countries	Policy
Increased arrivals	
Defining a dynamic mechanism by the EU to deal with continuous migration and refugee flows	Policy
Speed in processing asylum requests	Policy
Decongestion of islands and structures	Policy
The implemented policies of the central government. Depending on the policies in force, the resilience of Chios and its society in relation to the immigration and refugee crisis is largely determined	Policy
State policy dynamics	
The debate between parties and leaders about whether the goal is the integration of immigrants or the prevention and transfer of them to other countries	Policy
Access to the health system	Policy
Providing interpretation	Policy

Centralized bureaucratic rigid legal framework	Legal framework
Absence of comprehensive development planning	Policy
Low Impact of development interventions on local development (GDP)	Economy
The economy of Chios is affected by the migration crisis. Someone will say negatively, but with the right policies, perhaps it could raise the level of resilience. Always in terms of development	Economy
Various	
Education and Language	
Society disclosure and response	
and they themselves didn't always want to enter the training (fear of Eve)	
Info Point Hospital Office	
Hospital meetings every 15-30 days, Red Cross Municipality, un, asylum	
They didn't change the balance / They acted autonomously	
Role of the Red Cross in the immediate response / they worked with the Municipality and the region	
Lack of information to those requesting staff (context)	
Unskilled workforce	
Agricultural production	
Wages	
North vs South Chios	
Tertiary sector (70%?)	
Staff by sector (unskilled vs specialist) - a sector study had to be done	
economy of Chios and non-domestic activities	
political targeting	
information matters	
decisions and conflict	
clear targeting and role of NGOs	
non-organized NGOs	
civil society through specific bodies operating at the local level is important	
transfer of good practice know-how - international organizations and local response	
Know-how exists and is transferred	

Step 3: STEEPL Classification
All factors were categorised under the STEEPL framework:

- Social
- Technological
- Environmental
- Economic

- Political
- Legal

This step ensured comprehensive thematic coverage and helped identify overlaps and interdependencies.

Step 4: Factor Evaluation (Impact & Uncertainty)
Each factor was assessed based on:

- Impact: Its potential influence on system resilience
- Uncertainty: How unpredictable or unstable the factor is in the future

The visual below shows how each factor was scored and will help illustrate the basis for prioritisation in the next section.

Table 7: Chios Lab Assessment of Influencing Factors

Grouping	Text	Category	Effect	Improbability	Comments
	Creation of a legal framework for residential premises	Legal framework	4	1	
	Colonization of deserted areas with housing and land as tenants	Economy	4	1	
	Employability in areas they know (manpower utilization)	Economy	4	1	
Spatial planning and urban structure	Spatial planning - Residential structure (concentration of wealth and activities in the single urban center)	Economy	4	3	
	Respect for the morals and customs of refugees -	Other	4	1	
Multiculturalism and interconne	Sensitization or not of society towards the refugee	Society	4	1	
	Degree of Integration in the social life of the locals	Society	3	2	
	First Solidarity - Resident Response	Society	4	1	
Accession	Mutual respect and obligations	Society	4	1	
	Jobs	Economy	4	1	
	Legal Framework - labor	Legal framewor	4	1	
	Legal framework: Defining a legal framework in the	Legal framewor	4	1	
	Undeclared work with consequences for refugees'	Economy	4	1	
	Legalization of work - short registration and promot	Legal framewor	4	1	
	To become active members in the social and work	Economy	4	1	
	Reducing unemployment	Society	4	1	
	Creating a legal work framework	Legal framewor	4	1	
	Remaining of unregistered human resources	Kiononia	4	1	
Work	Creation of a legal framework for the residence of	Legal framewor	4	1	
	Definition of training programs for local and immigr	Policy	4	1	
	Education - school	Legal framewor	4	1	
Education	Multicultural education for integration into society, t	Other	4	1	
Social Inclusions	Adolescents desire inclusion	Other	4	1	
media	Media influence	Society	4	1	
Economic pressures on the loc	Rent increase (Real estate) - NGO	Economy	4	1	
	Climate change	Environment	4	1	
	Climate change driving migration flows	Environment	4	1	
Climate crisis	Water resources management	Environment	4	1	
	guarding the borders	Legal framewor	4	1	
	Implementation of the Geneva Convention on the d	Legal framewor	4	1	
Multilevel decision making	Difficulty in obtaining Greek citizenship	Legal framewor	4	1	
	Economic impoverishment of third countries leadin	Economy	4	1	
Global situation	War conflicts and impoverishment policies in third c	Policy	4	1	
	Level of reception and housing conditions for refug	Other	4	1	
	Effective asylum management procedures (e.g. rec	Policy	4	1	
Politics and living conditions	Housing programs	Economy	4	1	
	The abrupt climate change affects the refugee-imn	Environment	4	1	
	Chios is the gateway from Turkey to Europe	Other	4	1	
Borders	Relations with Turkey and policies followed by each	Policy	4	1	
	Speed in processing asylum requests	Policy	4	1	
State policy dynamics	The implemented policies of the central governmen	Policy	4	1	
	access to the Health system	Policy	4	1	
	Providing interpretation	Policy	4	1	
	Centralized bureaucratic rigid legal framework	Legal framewor	4	1	

4.2.3.2 STEEPL Analysis

Following the identification of over 150 potential factors affecting the resilience of the island of Chios, a **STEEPL framework** was applied to classify and better understand these variables. STEEPL stands for **Social, Technological, Environmental, Economic, Political, and Legal** — a foresight-based model that ensures holistic, multi-dimensional analysis of complex systems.

A. Factor Categorisation by Theme

Each of the factors gathered during the participatory workshop and stakeholder interviews was assigned to one or more of the STEEPL categories. This classification helped ensure that no major dimensions influencing resilience were overlooked.

- **Social**: Inclusion, multicultural interaction, local attitudes, youth participation, xenophobia, societal response to migration
- **Technological**: (Minimal reference in this phase; further analysis required in next stages)
- **Environmental**: Climate change, resource scarcity, pollution, water management, fires
- **Economic**: Employment, informal labour, income shifts, NGO funding, housing markets
- **Political**: Local and EU policy implementation, border relations, asylum processes
- **Legal**: Rights to work/reside, education access, citizenship, bureaucratic limitations

The STEEPL categorisation allowed the project team to visualise how factors are distributed and identify any overrepresented or underexplored areas. While economic and social issues were prominent, technological aspects appeared less frequently and will require targeted attention in subsequent analysis.

B. Prioritisation of Key STEEPL Factors

To move from broad classification to **focused foresight**, the team conducted a prioritisation exercise using two main criteria:

- **Impact (Effect)**: How significantly the factor influences resilience on the island.
- **Uncertainty (Improbability)**: How unpredictable or unstable the factor's evolution is in the near future.

From this scoring process, the **10 most critical factors** were identified. These combine high impact with varying degrees of uncertainty, making them priority areas for scenario planning.

	A	B	C	D	E
1	**Grouping**	**Text**	**Category**	**Effect**	**Improbability**
2	structure	Inhabitation of scarcely-populated/ abandoned areas with housing and land	Economy	4	1
3	interconnectedness	Respect for the heritage and customs of refugees - migrants and vice versa	Other	4	1
4	Work/ education/ healthcare	educational framework for the inclusion of children in schools- define legal	framework	4	1
5	Education	differences - Today, wariness and fear of the "foreigner" is still strong	Other	4	1
6	media	Media influence	Society	4	1
7	local community	Rent increase (Real estate) - NGO	Economy	4	1
8	Climate crisis	refugee-immigrant in normal living since there is no proper infrastructure and they	Environment	4	1
9	Multilevel decision making	Difficulty in obtaining Greek citizenship/ long legal procedures for EU documents	framework	4	1
10	Global situation	migration movement	Policy	4	1

Figure 25: Chios Lab Prioritisation of Factors

Each factor was also linked to one or more STEEPL categories, showing how certain dimensions (e.g., Social, Legal, Economic) intersect with particularly influential or volatile areas. For example:

- *"Spatial planning and urban structure"* is categorised as Economic, with high impact and moderate uncertainty.
- *"Media influence"* is categorised as Social and is seen as a powerful driver of both perception and response.

This prioritisation forms the foundation for the subsequent steps of **Influence Matrix Analysis**, **Wild Card Exploration**, and **Scenario Development**.

C. Key Takeaways from the STEEPL Analysis

- **Balance across categories**: The STEEPL method highlighted a relatively even distribution across societal, economic, environmental, and legal issues, but fewer references to technology — suggesting a need for deeper analysis in that area.
- **Overlaps between domains**: Many factors straddle multiple domains (e.g., education as both social and legal), underscoring the need for integrated policy responses.
- **Foundation for scenarios**: The 10 prioritised factors and their STEEPL tags serve as a robust basis for developing strategic scenarios and resilience pathways in Phase 3.

Influence Matrix Analysis

The purpose of this step was to analyse how the most critical resilience factors interact with one another, revealing the central drivers of systemic change and the dependent elements most affected. Understanding these relationships is essential for identifying leverage points and shaping robust future scenarios for the island of Chios.

A. Methodology

Using the six high-priority factors identified through the STEEPL analysis, we developed an influence matrix to evaluate interdependencies. Each factor was assessed based on:

- How much it influences other factors, and
- How much it is influenced by other factors.

This matrix was populated through a combination of expert judgment, stakeholder consultation, and cross-factor analysis. It reflects the direction and strength of systemic relationships.

B. Key Factors Included in the Matrix

The following six factors were included as nodes in the influence system:

- Media
- Global Situation *(Climate crisis, war, economic instability)*
- Climate Crisis – Infrastructure and Resources
- Education
- Spatial Planning and Urban Structure
- Multiculturalism and Interconnectedness

Each factor was selected due to its high impact and/or level of uncertainty identified in earlier assessment phases.

C. Matrix Insights

Most Influential Factors:

- **Media:** Shapes perceptions of migration, integration, and public sentiment; influences both social cohesion and institutional response.
- **Global Situation:** Acts as an upstream driver of migration flows, environmental stress, and geopolitical tensions.
- **Spatial Planning and Urban Structure:** Influences housing patterns, urban density, and socio-economic integration — key components of long-term resilience.

Most Dependent Factors:

- **Multiculturalism and Interconnectedness:** Highly affected by media narratives, educational initiatives, and inclusive legal frameworks.
- **Education:** Serves as both a driver and outcome of integration; its effectiveness depends on policy implementation and societal openness.
- **Infrastructure under Climate Stress:** Sensitive to both global conditions and local planning responses, especially regarding access to water, energy, and housing.

INFLUENCE MATRIX How strongly does Factor A (column C) influence Factor B (row 4)? Rate on a scale from 0 (no impact) to 3 (high impact). *(Example values are filled in for demonstration purposes)*		PASSIVE Sum	20,0	16,0	14,0	16,0	12,0	14,0	12,0	0,0	12,0
			Inhabitation of scarcely-populated/ abandoned areas with housing and land	Respect for the heritage and customs	The availability of legal framework (work, education, healthcare)	Cultural integration and education in a diverse society	The impact of media on the perception and reaction of the public	Rent increase (Real estate) - NGO	The level of infrastructure and other resources of the migrant shelters that are exposed to the cascading climate	Increased number of migrants due to global situation (Climate crisis , war and impoverishment)	The speed and complexity of administrative procedures related to obtaining refugee status
ACTIVE Sum	Description	Factor	Spatial planning and urban structure	and interconnectedness	Work/ education/ healthcare	Education	media	Economic pressures on the local community	Climate crisis - infrastructure	(Climate crisis, war and impoverishment)	Multilevel decision making
13,0	Inhabitation of scarcely-populated/ abandoned areas with housing and land	Spatial planning and urban structure		3	0	3	1	2	3	0	1
13,0	Respect for the heritage and customs	Multiculturalism and interconnectedness	2		2	3	2	1	1	0	2
12,0	The availability of legal framework (work, education, healthcare)	Work/ education/ healthcare	3	2		3	2	1	0	0	1
14,0	Cultural integration and education in a diverse society	Education	2	3	2		2	2	1	0	2
16,0	The impact of media on the perception and reaction of the public	media	3	3	2	3		1	2	0	2
6,0	Rent increase (Real estate) - NGO	Economic pressures on the local community	2	1	1	1	0		1	0	0
14,0	The level of infrastructure and other resources of the migrant shelters that are exposed to the cascading climate phenomena	Climate crisis - infrastructure	3	1	3	1	3	2		0	1
16,0	Increased number of migrants due to global situation (Climate crisis , war and impoverishment)	Global situation (Climate crisis , war and impoverishment)	2	2	2	1	1	3	2		3
12,0	The speed and complexity of administrative procedures related to obtaining refugee status	Multilevel decision making	3	1	2	1	1	2	2	0	

Figure 26: Chios Lab factor Influence Matrix

4.2.3.3 Wild card & weak signal analysis (Tetralemma Workshop)

This section aims to explore potential **low-probability, high-impact events** (wild cards) and **emerging early signs of change** (weak signals) that may significantly affect Chios' resilience . While a separate, dedicated wild card scanning activity was not conducted, relevant insights

were drawn from the Tetralemma Scenario Workshop held in December. That exercise explored extreme and unconventional futures that help illuminate systemic vulnerabilities and emerging patterns.
In particular, the "Disruptive Development" and "Shifted Paradigm" scenario categories produced during the workshop align closely with the concept of wild cards and are used here as proxies to support anticipatory planning.

A. Methodological Basis

The findings in this section are based on scenario-building exercises from the Tetralemma framework, applied across six resilience-related factors. Each factor was explored through five future trajectories:

- A: Projected/Expected
- B: Distinctive Divergence
- C: Hybrid Possibilities
- **D: Disruptive Development** (major breakdowns or systemic shocks)
- **E: Shifted Paradigm** (transformational shifts toward entirely new systems)

The **D and E categories** — involving collapse, breakdowns, or radical transformation — were used in this analysis to represent **wild card-type scenarios**.
Additionally, weak signals — subtle trends or early-stage shifts — were noted during stakeholder discussions and scenario development.

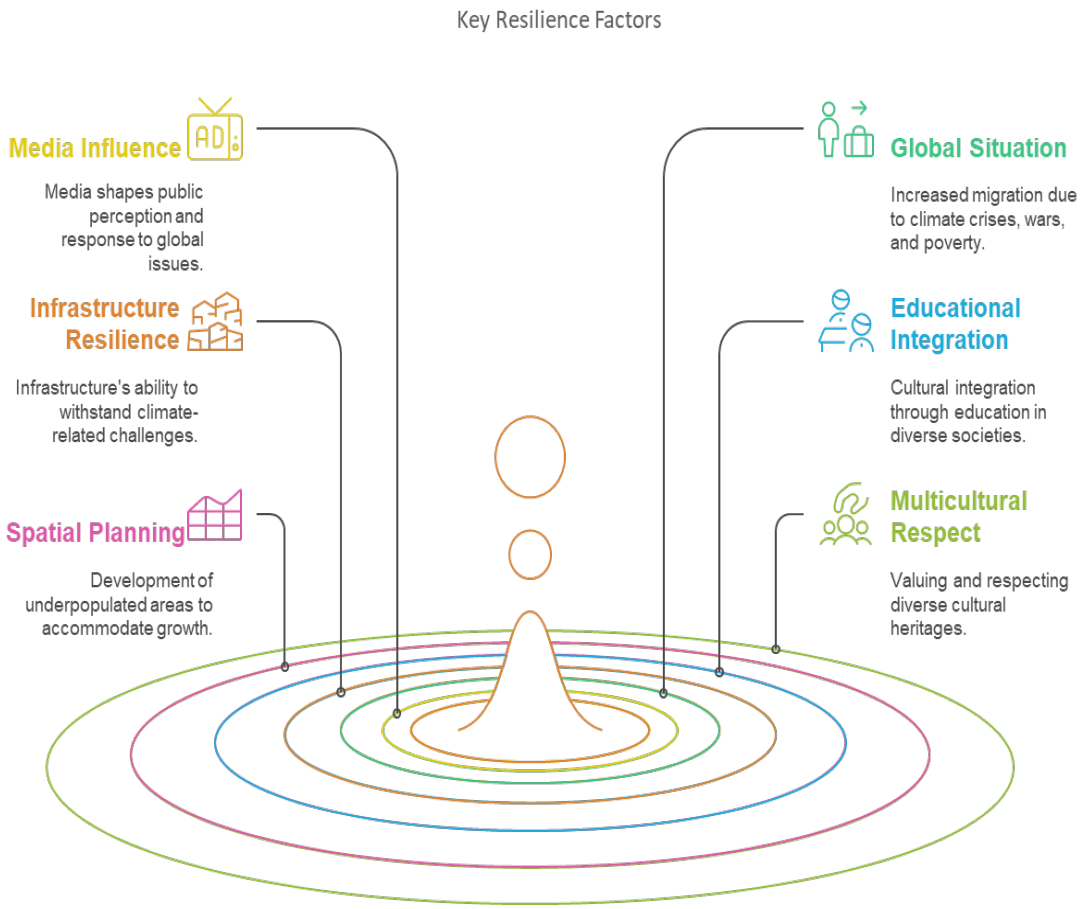


Figure 27: Key Resilience Factors

B. Disruptive Projections from the Tetralemma Exercise

Table 8: Chios Lab Disruptive Projections

Factor	Projection	Potential Impact
Media	Information overload, collapse of trust in media	Polarisation, misinformation, reduced societal cohesion
Global Situation	Geopolitical collapse, uncontrolled migration surge	Strained services, overwhelmed infrastructure, potential conflict
Infrastructure	Extreme water scarcity, collapse of refugee camp facilities	Public health crisis, displacement, resource conflict
Education	Radical cultural reorientation or failure to integrate diverse learners	Inequality, breakdown in social mobility and long-term inclusion
Spatial Planning	Resettlement without planning or community acceptance	Friction, underdevelopment, planning failure
Multiculturalism	Fanaticism and loss of mutual respect	Breakdown of integration, increasing intergroup hostility

These projections demonstrate the types of **disruptive shocks** that may not be probable in the short term but carry **major consequences** for resilience.

C. Weak Signals Identified

- A: Projected/Expected
- B: Distinctive Divergence
- C: Hybrid Possibilities
- D: Disruptive Development (major breakdowns or systemic shocks)
- E: Shifted Paradigm (transformational shifts toward entirely new systems)

While not wild cards in the strictest foresight sense, categories D and E present radically different futures that serve a similar analytical purpose — highlighting overlooked risks and triggering strategic reflection.

Scenario Development

This section presents an exploration of plausible future trajectories for the resilience of the island of Chios, using the **Tetralemma scenario framework**. Unlike linear forecasting, the Tetralemma enables the structured development of diverse futures by examining not only expected outcomes but also unexpected divergences, hybrid paths, disruptions, and paradigm shifts.

This method acknowledges the complexity of interrelated crises facing Chios — including migration, climate stress, social cohesion, and infrastructural limitations — and prepares stakeholders for a wide range of eventualities.

A. Methodology

The scenario-building process was implemented through a participatory online workshop in **December 2025**, involving:

- The Municipality of Chios
- The Regional Development Institute of Greece
- Local civil society organisations, NGOs, and experts

Participants focused on six pre-selected **critical resilience factors**, which had emerged from STEEPL analysis, stakeholder input, and influence matrix mapping:

- Media
- Global Situation (climate crisis, wars, poverty)
- Infrastructure & Climate Stress
- Education
- Spatial Planning and Urban Structure
- Multiculturalism and Interconnectedness

Using the **Tetralemma model**, five distinct scenario types were developed for each factor:

- **A. Projected / Expected** – continuation of current trends
- **B. Distinctive Divergence** – a directional shift from the expected
- **C. Hybrid Possibilities** – coexisting or blended outcomes
- **D. Disruptive Development** – systemic breakdowns or radical shifts
- **E. Shifted Paradigm** – emergence of entirely new systems or logics

Scenarios were documented via a Miro collaborative board, then interpreted and translated into thematic insights for future planning and modeling.

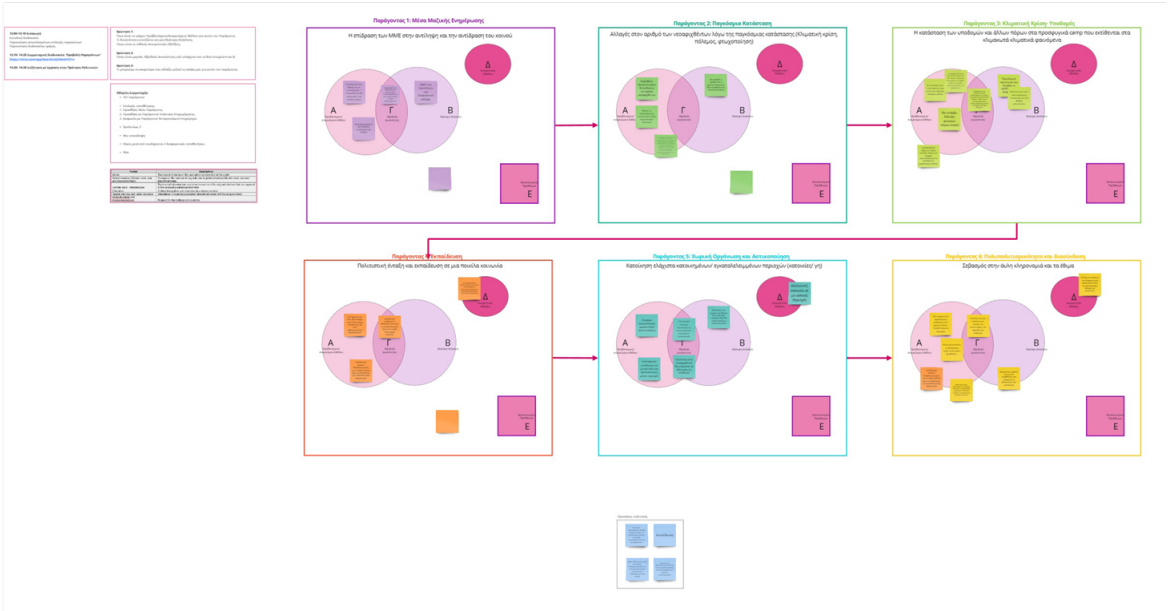


Figure 28: Miro Board with Tetralemma Scheme – Participatory Workshop, December 17, 2024

B. Scenario Highlights by Factor

1. Media

Participants expressed concern over **information overload**, media fragmentation, and the **erosion of public trust**. Local media, while influential, was often disconnected from national narratives. This could result in severe consequences if left unregulated.

- **Disruptive Development**: Complete collapse of trust in information
- **Shifted Paradigm**: Decentralised, community-owned information ecosystems

2. Global Situation

The unpredictability of external crises — including wars, climate-induced displacement, and EU migration policy — was projected to have **direct and compounding impacts** on Chios.

- **Disruptive Development**: Uncontrolled migration influx
- **Shifted Paradigm**: Radical change in global migration governance and burden-sharing

3. Infrastructure & Climate Stress
Infrastructure was identified as a structural vulnerability. **Water scarcity**, in particular, was already affecting both refugees and residents, and could intensify dramatically.

- **Disruptive Development**: Collapse of camp infrastructure and essential services
- **Shifted Paradigm**: Localised, community-scale resource systems with climate-adaptive design

4. Education
Multicultural education existed but was limited in scale. The workshop highlighted a growing need for **inclusive education across all age groups**, especially for adult migrants and refugees.

- **Disruptive Development**: Systemic exclusion of certain populations
- **Shifted Paradigm**: Education models rooted in cultural plurality and informal, community-led learning

5. Spatial Planning and Urban Structure
The abandonment of rural areas and population concentration in urban centres were recognised as resilience threats. Refugee resettlement in underutilised areas could provide opportunities — if managed properly.

- **Disruptive Development:** Forced resettlement leading to local backlash
- **Shifted Paradigm**: Integrated rural development benefiting both locals and newcomers

6. Multiculturalism and Interconnectedness
Participants emphasised that **mutual respect between communities is fragile** and could deteriorate further under political or media pressure. However, some noted emerging grassroots efforts fostering inclusion.

- **Disruptive Development**: Rise in fanaticism and community conflict
- **Shifted Paradigm**: Deep-rooted multicultural integration via civic education and cultural exchange

C. Key Policy Insights from the Workshop

Throughout the workshop, participants repeatedly returned to three overarching policy areas that cut across all scenario paths:

1. Media: Toward Transparent and Inclusive Communication

There is an urgent need to address **misinformation and media distrust**. The lack of coherent, inclusive, and accurate narratives is eroding the community's ability to respond constructively to change.

- Establish **local information platforms** rooted in the community
- Train local journalists in responsible, inclusive reporting

- Promote **cross-cultural media representation** to reflect all voices

2. Education: Expand and Redesign for Inclusion

Education was seen as a cornerstone of both **integration and long-term resilience**. However, current systems do not sufficiently serve **adult learners, cultural minorities, or skill-building needs**.

- Expand multicultural curricula to all age groups
- Support **informal and community-based learning**, including digital access
- Align education with **labour market needs** and plural identities

3. Infrastructure: Climate-Ready and Community-Focused

Chios' existing infrastructure is strained and climate-sensitive. This is particularly true for **water systems, housing**, and **camp capacity**.

- Develop **resilient infrastructure** that supports both locals and newcomers
- Prioritise **sustainable water solutions** and energy systems
- Plan infrastructure with community participation to avoid conflict and failure

This scenario-building phase provides a structured basis for **policy design and resilience planning**, offering not only a vision of what may come — but also a way to prepare for it.

4.2.3.4 Scenario Building

This section presents the **development of future scenarios** for Chios, based on critical resilience factors identified through workshops, interviews, and analysis during the participatory foresight process. These scenarios were designed to explore how key trends and uncertainties could interact to shape radically different futures for the island and its inhabitants, particularly in the context of migration, climate stress, spatial planning, and social cohesion.

A. Scenario Narrative Construction

The **CHIOS Lab** developed three comprehensive scenario narratives in preparation for the final participatory workshop. These scenarios were based on projections of six previously identified **critical influencing factors**:

1. **Global Situation**: Global climate and geopolitical conditions impacting migration
2. **Spatial Planning**: Urban and rural development strategies and demographic change
3. **Media**: Information flow, trust, and the role of local and national media
4. **Climate Crisis & Infrastructure**: Environmental stress and adaptation capacity
5. **Education**: Accessibility, cultural integration, and skills development
6. **Multiculturalism and Connectivity**: Social dynamics and intergroup cohesion

Each factor was mapped across the **Tetralemma framework**, resulting in scenario paths based on combinations of:

- Projected/Expected
- Distinctive Divergence
- Hybrid Possibilities
- Disruptive Development

B. Scenario 1: "Peaceful Adaptation"

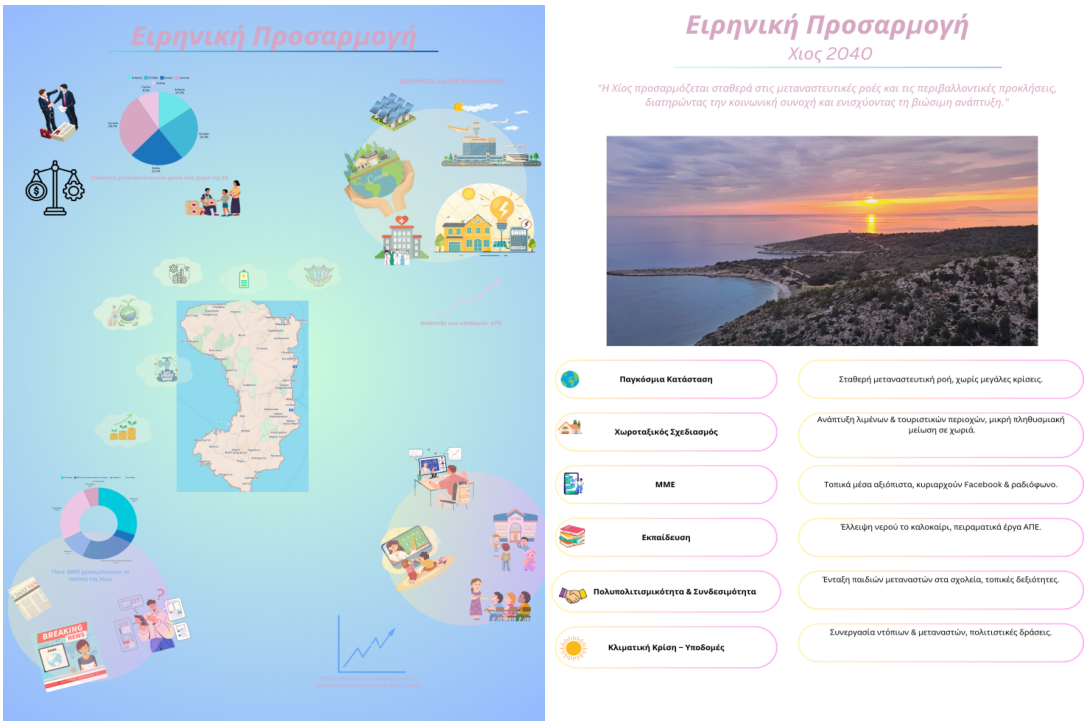


Figure 29: Visualisation Scenario 1 Peaceful Adaptation

Narrative

This scenario represents a relatively **optimistic outlook** where Chios, while still under pressure from climate change and migration, adapts steadily and pragmatically. Migration flows continue at a manageable scale, enabling coordinated responses by local authorities and volunteer networks.

- **Global trends** remain uncertain but stable enough to avoid crisis.
- **Spatial planning** emphasises continuity, focusing on Chios Town and coastal areas.
- **Media** remains mostly local and trusted, helping maintain calm public discourse.
- **Climate stress** appears in seasonal shortages, but pilot sustainability projects are underway.
- **Education** integrates migrant children gradually, supported by NGOs and local teachers.
- **Multiculturalism** is handled constructively through cultural exchange and local traditions of coexistence.

C. Scenario 2: "Regional Differentiation"

Figure 30: Visualisation Scenario 2 Regional Differentiation

Narrative

This scenario imagines a **fragmented future** with uneven development, both across regions of Chios and between institutional actors. National and EU support is inconsistent, leading to "patchwork" solutions and rising inequality.

- **Migration policies** are unstable; some regions see improvement, others deterioration.
- **Spatial planning** diverges between revitalised villages (through agrotourism, local initiatives) and areas of abandonment.
- **Media** becomes polarised, split between local channels and activist social media.
- **Infrastructure development** is irregular—solar panels and green projects exist, but not island-wide.
- **Education** sees innovative pilots in some schools, while others remain under-resourced.
- **Multicultural dynamics** vary: some communities thrive on cooperation; others fear decline in tourism and social tension.

D. Scenario 3: "Accumulated Crises"

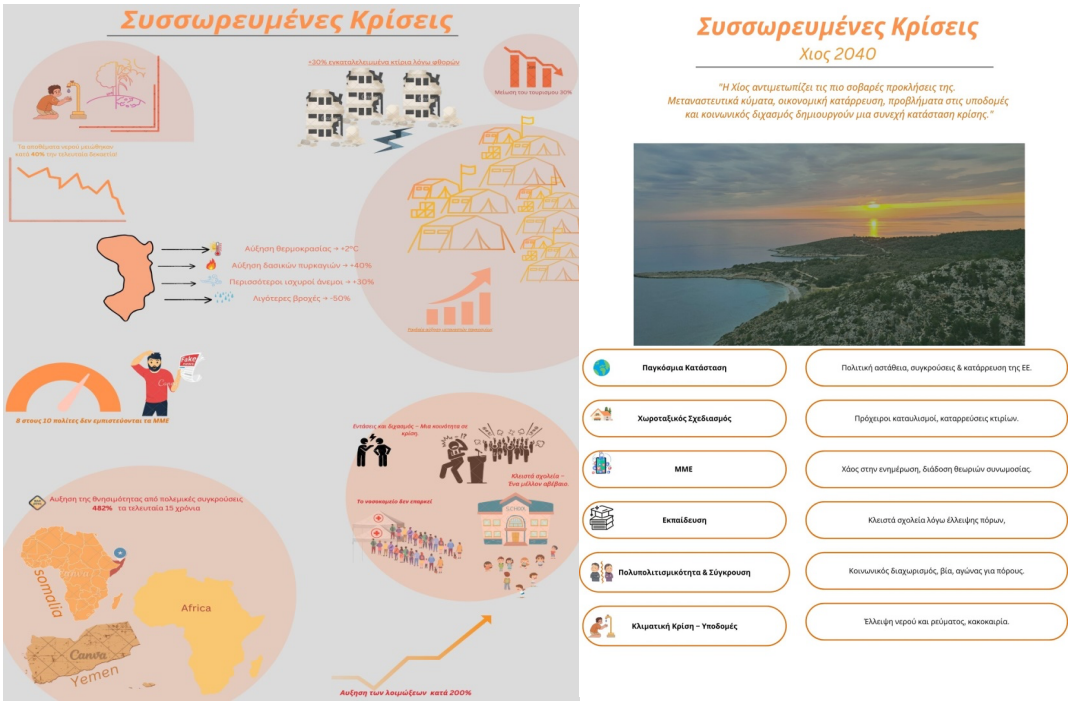


Figure 31: Visualisation Scenario 3 Accumulated Crisis

Narrative

This is the **most pessimistic scenario**, shaped by the convergence of multiple disruptive developments. Migration surges grow unmanageable, climate disasters increase, and national/EU coordination breaks down.

- **Refugee arrivals** overwhelm local systems; official camps collapse, giving way to improvised settlements.
- **Spatial planning** devolves into emergency response and containment zones.
- **Media** is dominated by disinformation and AI-generated propaganda, leading to confusion and fear.
- **Infrastructure** fails under pressure, with frequent outages and declining basic services.
- **Education** deteriorates, with school closures and a breakdown in inclusive access.
- **Multiculturalism** gives way to deep social fragmentation and intergroup competition for scarce resources.

Scenario Usage and Integration

These scenarios were not only narrative tools, but also **functional frameworks** used in the **next phase (Phase 3)** to test proposed policy responses under varying conditions. Each scenario was grounded in stakeholder experience and analytical projection, and helped:

- Clarify uncertainties around each critical factor
- Explore interdependencies between local resilience dimensions
- Support forward-looking planning for both expected and disruptive futures

By identifying what might change — and what must remain robust — the scenarios offer Chios a way to prepare for futures that are not only complex, but also radically different from the present.

Phase 3

The policy solutions recommended by the CHIOS Lab were the outcome of workshops, focus groups, and interviews it conducted with multiple stakeholders, representing health, education, governance, local labour and entrepreneurial institutions. Through these activities, local actors were called upon to actively, openly, and collectively contribute to resilience capacity-building strategies by sharing their experience of the 2015 migration crisis, identifying determining factors, and shaping scenarios, strategies and policies to address such crises in the future. The lab also consulted the project's knowledge base to explore solutions suggested in other contexts and research projects. Some of these sources include:

- ASILE project, 2022: ELSA FERNANDO-GONZALO, EU´s readmission deals under the light of Global Compact on Migration
- Policy Brief, 2021: Beatrice Mosello, Christian König, Emily Wright, Gareth Price, Rethinking human mobility in the face of global changes: A focus on Bangladesh and Central Asia
- TransSOL project, 2018, European paths to transnational solidarity at times of crisis: Conditions, forms, role models and policy responses, Deliverable 7.9
- REBUILD project, 2020, ICT-enabled integration facilitator and life rebuilding guidance, Deliverable: D10.4 - enhancing migrants inclusion effectiveness through participation and ICT

As part of the windtunnelling process, 15 policy proposals were developed and organised across five thematic areas. These areas reflect key domains of resilience for Chios and were informed by stakeholder input, scenario analysis, and the systemic challenges identified in Phases 1 and 2.
Each thematic area includes targeted policies aimed at strengthening Chios' capacity to adapt to future migration pressures, environmental stress, and socio-economic shifts. During the workshop, stakeholders evaluated these policies for their feasibility, effectiveness, and resilience under different future scenarios.

4.2.3.5 Migration Management & Social Integration

These policies focus on ensuring safe, organised, and equitable responses to migration. The goal is to support inclusive integration into society and the economy, while improving accommodation, legal coordination, and the use of technology for migrant services.

Policy Measures:

- Accommodation Infrastructure – Upgrade refugee camps and develop small-scale, sustainable hospitality centers.
- Labour Market Integration – Incentives to employ migrants in agriculture, tourism, and technical professions.
- Use of ICT – Smart tools and platforms to analyse migrant profiles and connect them with local services.

- Multi-Level Policy Coordination /Align migration governance across local, national, and EU/international levels.

4.2.3.6 Resilience to Climate Crisis & Infrastructure

This theme addresses the physical resilience of Chios through sustainable infrastructure and environmental adaptation.

Policy Measures

- Water Resource Management – Rainwater harvesting and water recycling to combat shortages.
- . Renewable Energy – Tax incentives to encourage solar, wind, and geothermal installations.
- Resilient Infrastructure – Investment in infrastructure that can withstand extreme weather events (e.g., flooding, heatwaves).

Education & Skills Development

These policies aim to improve inclusive education, language support, and workforce development — essential pillars of both social cohesion and local economic sustainability.

Policy Measures

- Intercultural Education – Include intercultural content in school curricula.
- Language Support – Volunteer-led Greek language programmes, especially through NGOs.
- Vocational Training – Focus on tourism, agriculture, technical professions, and digital skills for migrants and locals.

Spatial Planning & Development

This theme focuses on addressing urban-rural imbalances, revitalising remote areas, and preparing Chios' built environment for future stress.

Policy Measures

- Revitalisation of Remote Areas – Incentives for migrant resettlement and agricultural engagement in depopulated villages.
- Sustainable Construction – Promote eco-friendly building to protect quality of life on the island.

Role of Media & Social Cohesion

Recognising the power of narratives and public discourse, these policies aim to foster trust, accurate information, and intercultural dialogue in Chios.

Policy Measures

- Local Journalism – Support for credible, community-based news sources to counter disinformation.
- Cultural Events – Organise inclusive festivals and initiatives that promote shared identity and mutual understanding.
- Dialogue Forums – Create participatory spaces for regular interaction between locals and migrants.

Scenarios used for testing

To assess how well each policy would perform under different conditions, stakeholders tested the 5 proposed policy measures across three future scenarios, developed during Phase 2 of the participatory foresight process.
These scenarios were built around six critical influencing factors, which were consistently used throughout the foresight cycle:

1. Global Situation: Geopolitical conflict, climate displacement, and poverty
2. Spatial Planning: Development strategies and demographic shifts
3. Media: Access to accurate information, trust, and representation
4. Climate Crisis & Infrastructure: Adaptability of basic services and housing
5. Education: Inclusion, equity, and workforce relevance
6. Multiculturalism & Connectivity: Social cohesion, trust, and shared identity

Each scenario presented a distinct future trajectory, helping participants explore how feasible, effective, and resilient each policy might be under dramatically different conditions.

Each scenario was explained in terms of its factor projections across the six resilience domains, highlighting varying degrees of uncertainty and disruption. After completing their scenario-specific evaluations, each group was asked to apply the windtunnelling method: testing their selected policies against the other two scenarios to see how performance held up under different conditions.

This exercise revealed:

- Which policies were robust across multiple futures
- Which were context-sensitive or vulnerable to disruption
- What adaptations might be required to enhance policy flexibility

For example, policies like vocational training and multicultural education were widely seen as effective in “Peaceful Adaptation,” but needed redesign or reduced scope in the “Accumulated Crises” scenario.

Policy No.	GROUP 1			GROUP 2			GROUP 3		
	F	E	R	F	E	R	F	E	R
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									

11									
12									
13									
14									
15									

Green – Very effective and feasible.

Yellow – Modest effectiveness, may require adjustments.

Red – Not feasible for specific scenario.

F: Feasibility

E: Effectiveness

R: Resilience

Figure 32: Policy assessment of GROUP 1 with Scenario 1: Peaceful Adaptation

Policy No.	GROUP 2			GROUP 3			GROUP 1		
	F	E	R	F	E	R	F	E	R
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									

Green – Very effective and feasible.

Yellow – Modest effectiveness, may require adjustments.

Red – Not feasible for specific scenario.

F: Feasibility

E: Effectiveness

R: Resilience

Figure 33: Policy assessment of GROUP 2 with Scenario 2: Regional Differentiation

Policy No.	GROUP 3			GROUP 1			GROUP 2		
	F	E	R	F	E	R	F	E	R
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									

Green – Very effective and feasible.

Yellow – Modest effectiveness, may require adjustments.

Red – Not feasible for specific scenario.

F: Feasibility

E: Effectiveness

R: Resilience

Figure 34: Policy assessment of GROUP 3 with Scenario 3: Accumulated Crises

Note: Each number in the first column (Policy No.) of the tables corresponds to the following policies:

1. Improvement of Accommodation Infrastructure through upgrading camps and creating sustainable small accommodation centres.
2. Integration into the Labour Market with employment incentives in agriculture, tourism and technical professions.
3. Use of ICT for analysing the demographic profile of immigrants, facilitating integration and access to services.
4. Development and Coordination of Local, National, European & International Policies for safe and organised migration.
5. Sustainable Water Management through recycling and rainwater collection.
6. Promotion of Renewable Energy Sources with tax incentives for solar, wind and geothermal energy.
7. Resilient Infrastructure for protection from extreme weather events (floods, heat waves, storms).
8. Intercultural Education by incorporating relevant courses in schools.
9. Language Support for Migrants through NGOs and voluntary initiatives.

10. Vocational Training in high-demand sectors (tourism, agriculture, technical professions, digital skills)
11. Revitalisation of Mountainous & Remote Areas with support for agricultural production and remote work.
12. Sustainable Construction for resilience to environmental challenges and to maintain quality of life on the islands.
13. Strengthening Local Professionals and Networks of Information and Journalism for reliable reporting and combating misinformation.
14. Promotion of Cultural Activities (open cultural events, promotion of the heritage of the local community & its young residents) to enhance social inclusion and cohesion.
15. Creation of Participatory Forums and Joint Events for dialogue between locals and migrants.

4.2.4 Achievements

The aim of the CHIOS Lab was to examine how the migration influx affected the island of Chios. The achievements of the Lab objectives reflect noteworthy progress in understanding and addressing the impacts of economic and migration crises on Chios. By developing comprehensive data collection methods, robust analytical frameworks, and regional comparisons, the Lab effectively met its initial needs and overcame the associated challenges.

Objective 1: Focus on investigating the ways in which the recent economic and migration crisis have affected the island's resilience.

To achieve this objective, there was a need for a detailed understanding of how crises impact the island's ability to adapt and thrive. This required both quantitative data and qualitative insights. For this purpose, the Lab:

- Gathered data on specific indicators (number of arrivals, asylum seekers, employment data).
- Designed the methodology for conducting interviews with the stakeholders.
- Designed a questionnaire for the locals to record their views on the refugee crisis.

Objective 2: Explore ways, in which these external shocks have affected dimensions of everyday life, considering additionally aspects related to climate change.

There was a need to understand the multifaceted impacts on everyday life, considering both direct effects and long-term adaptations. Additionally, integrating climate change considerations was crucial for a holistic analysis. For this purpose, the Lab:

- Scheduled interviews and organised workshops with relevant stakeholders to gather information on how the crises affected housing, healthcare, education, and employment.
- Designed a questionnaire for the locals to record their views on the challenges of migration.

Objective 3: Adopt a regional perspective to expand the study of migration to include experiences of neighbouring islands, looking to find similarities between them.

A regional perspective was needed to identify commonalities and shared strategies that could enhance community resilience for Chios, as well as for neighbouring islands, such as Lesbos

and Samos, which have also been affected by migration flows. This required comparative data and an understanding of regional dynamics, which can be incorporated in the participatory methods used by the Lab. For this purpose, the Lab:

- Employed participatory methods and multi-stakeholder approaches, which can be used to study migration in neighbouring islands, and determine the factors, scenarios, and policies applied in other communities.
- Cultivated the motivation and knowledge to enhance participation among neighbouring islands to share experiences, pool resources, join forces, and co-create knowledge and strategies for resilience-building on a broader regional scale.

CHIOS Lab: shaping policy through research

The Lab's achievements have significantly contributed to policymaking and building community resilience. All the data and insights that have been generated by the Lab can be used to inform policies and initiatives that address the challenges posed by economic and migration crises. Special attention is given to strengthening societal resilience and sustainable development through policy experimentation, foresight and participatory approaches. At the final workshop, policymakers at the local level (municipality) and the international level (UN) demonstrated immense appreciation for taking part in the CHIOS Lab study, because it offered them the opportunity to learn: other stakeholders in the local community – their experiences of migration, their concerns, needs, interests and views of the challenges and their solutions; the participatory methods of interaction and co-creation with other stakeholders in the community – collective processes of problem framing, scenario building, and policy recommendation; and the benefits of these methods – the design and implementation of more informed, effective and just policies by giving voice to all interested parties, mobilising local actors and knowledge, and building collaboration with regional, national and international actors in the private, public and social spheres.

These participatory and co-creation methods and processes led to 6 critical influencing factors, which briefly included the global situation; spatial planning; the role of the media; climate crisis and infrastructure; education; and multiculturalism and connectivity. The interaction among stakeholders through workshops, focus groups and interviews also led to 15 policy measures grouped into 5 thematic areas, namely: Migration Management & Social Integration; Resilience to Climate Crisis & Infrastructure; Education & Skills Development; Spatial Planning & Development; Role of Media & Social Cohesion. In the final workshop, these policies were tested against 3 scenarios: Peaceful Adaptation; Regional Differentiation; and Accumulated Crisis. The windtunnelling exercise revealed that a special combination of the specific policies may be more useful under different circumstances: for instance, coordinated action among different scales of governance became more imperative under the more severe and complicated conditions of accumulated crises.

Therefore, the CHIOS Lab did not focus solely on conducting research; it was designed to directly impact how decisions are made on the island regarding critical aspects of migration. This is achieved by:

1. *Understanding cascading crises*

   By analysing how multiple challenges like migration and climate change intertwine and affect Chios, we develop a holistic approach that will enable us to fully address complex situations and inform policies. More specifically, the Lab provided local policymakers with data and analysis of the vulnerabilities and strengths of Chios's economy by demonstrating the benefits of participation and co-creation processes and institutionalising the implementation of participatory methods. The information produced, as described above, will be included in the FUTURESILIENCE knowledge base for other researchers, policymakers, and local actors to consult in confronting similar crises and challenges.

2. *Impacting migration policy*

   The Lab's research on migration patterns and their effects on local resources enables policymakers to support social integration and improve the distribution of resources. On the one hand, data on migrant needs can inform social integration policies that foster social cohesion and a sense of belonging within the community. On the other hand, by identifying areas with high migrant populations, resources like healthcare and education can be distributed more effectively to meet the needs of the entire community in a more efficient and fair manner.

3. *Addressing environmental issues*

   Evidence from the Lab could also be used to support the development of environmental projects, such as regional waste management and water conservation programs. The implementation of environmentally sustainable policies is relevant to building resilience for Chios and the insular Greek area. To evaluate the extent of economic, social and environmental sustainability on the island and suggest relevant policies, the Lab can collect reliable data on the well-being, equality, and social cohesion in the region.

Strength in collaboration

The engagement of a diverse range of stakeholders, including residents, entrepreneurs, local authorities, government officials, NGOs, and refugees, is critical in defining policy solutions. Resilience capacity building strategies and policies in this field require a multilevel and multistakeholder approach, which provides more informed, effective and just policies by giving voice to all interested parties, mobilising local actors and knowledge, and building collaboration with regional, national and international actors in the private, public and social spheres.

The CHIOS Lab brought together multiple stakeholders, representing health, education, governance, the local labour and entrepreneurial institutions, through interviews, focus groups, workshops, and surveys. The aim was to develop:

- Sustainable policies: solutions considering Chios' long-term needs to build a resilient future.

- Improved local resilience: Chios becomes better equipped to manage both current and future challenges. The CHIOS Lab can provide knowledge regarding participatory methods, and policy solutions in dealing with the challenges of migration. It can further help to institutionalise processes of collaboration and co-creation among stakeholders for strengthening migration governance strategies, social integration, and community resilience.

The CHIOS Lab findings revealed that identifying challenges and building local resilience to migration could enormously benefit from participatory and multistakeholder approaches. They led to concrete policy actions recommended to strengthen social integration for resilient communities, targeting both locals and migrants (see Annex for details):

- Education to enhance social integration and mutual respect among diverse cultures.
- Infrastructure, ensuring the supply of and access to all types of resources that promote decent working and living conditions.
- Coordination among distinct levels of governance at the local, regional, national, supranational and global levels to promote subsidiarity in decision- and policymaking processes.
- Media influence to secure the timely circulation of valid and unbiased information for all interested parties at the local, national and international levels.

Discussions with stakeholders revealed the importance of measures for inhabiting scarcely populated and abandoned areas with housing to ensure decent living conditions for migrants, especially during the summer months. These actions are coupled with initiatives for education to enhance the social integration and inclusiveness of multiple cultures and social groups. Migrants can benefit from learning new languages, work skills, laws, and cultures of the host country, while locals can also benefit from learning about different cultures, languages, and values; thus, both can support processes of dialogue, sharing, and co-creation for a new, diverse and inclusive society.

4.2.5 Lessons Learnt

Practical and methodological barriers during the CHIOS Lab

During the implementation of the study, the CHIOS Lab encountered certain barriers. Among them the most important ones refer to facing multiple crises and challenges, enhancing the engagement of stakeholders, as well as gathering data and applying data analysis processes.

1. *Facing multiple crises and challenges*
   The migration influx of 2015 took place during the Greek economic crisis, which led to a rise in unemployment, poverty, and inequality, and further impacted the social fabric of the community. Moreover, as an insular landscape, Chios presents very specific demographic, economic, political and social characteristics. For instance, stakeholders often **mentioned the considerable spatial disparities observed across regions within the island, as the Northen part faces considerable economic and social challenges**. Furthermore, the Lab faced environmental, technical, and social challenges. Environmental challenges include plastic pollution from discarded life vests, water scarcity exacerbated by population surges, and hygiene problems in overcrowded

camps. Technical challenges involve housing shortages, healthcare infrastructure deficits, and education gaps for asylum-seeking children. Social challenges encompass discrimination, social cohesion, community engagement, and negative perceptions of migrants. Despite these difficulties, local communities initially played a crucial role in supporting refugees through voluntary assistance. However, as the crisis persisted, public engagement declined due to resource constraints and shifting priorities.

2. *Stakeholder engagement and participation*
Engaging with a diverse range of stakeholders, including residents, representatives of administrative bodies, labour and entrepreneurial institutions, policymakers, academics, and civil society actors, required **considerable time and effort to build trust and ensure their participation** at the community level.

The Lab faced challenges in **balancing various and often conflicting concerns, interests and needs among multiple stakeholder**s, including, among others, differences in: time-schedules and financial constraints; institutional objectives; ideological backgrounds; views, experiences and memories of migration; proposed strategies to address socio-economic problems at different levels of governance; and perceptions regarding the contribution of innovative participatory methods for policymaking and resilience-building. Also, it is important to mention that the Lab had to manage its activities amid local elections, which posed further restrictions on the availability of stakeholders.
Notably, an environment of multiple crises, as well as diverse needs, interests, and concerns, may foster anxiety, fear, anger, distrust, fatigue, disappointment or even despair. Therefore, it becomes difficult to bring together all those parties who are affected by migration, to discuss openly and actively the underlying determinant factors, and to co-create strategies and policies for building community resilience. For instance, discussions among policymakers and the local community may focus more on distributing responsibility for past mishaps, rather than searching for solutions to deal with the future. Also, migration weighed heavily on the daily lives of all, and it may have been arduous for anyone to share experiences and memories of the crisis.
The moments when stakeholders were reserved or hesitant to respond to our invitation, or follow-up on workshops and interviews were quite disheartening for both participants and researchers and occasionally tested their faith in the effectiveness of participatory methods to collectively resolve problems and build community resilience. Hence, it was important to address another challenge for the community, and the Lab itself, namely, that of restoring trust and hope in a better future and in the ability of all stakeholders to listen and understand one another and jointly construct and employ practical solutions. To deal with this challenge, it was critical, firstly for the lab members, followed by the community members, to renew their faith in the principles and practices of participation and cooperation as the most critical means to confront the challenges posed by migration. It became evident that **enhancing participation and trust was a learning by doing process** by encouraging policymakers at the local level (municipality) and international level (UN) to come to the table, by bringing local residents to the table and ensuring that their voice will be

heard, and informing all stakeholders of the objectives, methods and benefits of the project.

3. *Gathering reliable and sufficient data, and applying data analysis processes*

   It was quite difficult to discover, access and collect reliable data on migration, as well as the economic and social integration of migrants on the island. Such data touches upon sensitive topics, ranging from the personal data of migrants to the broader economic, social and political dimensions of migration at a local, regional, national, supranational and global scale. There are multiple public, private and social entities that deal with migration gather information to support their activities and serve specific purposes and interests, so various data sources regarding migration may exist. However, such data tends to be dispersed and fragmented, or even unavailable, posing barriers to the collection of reliable data which are critical in capturing the diverse aspects and dynamics of migration, and creating strategies and policies for building community resilience in the future.

   It is widely accepted that we can better understand and tackle issues of migration by approaching the phenomenon as a multi-faceted concept and phenomenon and by considering its economic, social political, historical, and cultural dimensions. Such a task requires combining qualitative and quantitative data into a cohesive analysis, which poses challenges. It relies on reaching a common ground among stakeholders regarding the variables, indicators, and measures to be used in the analysis. Notably, decisions on data analysis processes will include the experience and knowledge of all those affected by migration providing a more holistic view of reality, which will also reflect the multiple internal and external shocks, as well as the diversity and conflictual nature of views and interests about dealing with migration.

   The information collected from the CHIOS Lab relied on a combination of quantitative and qualitative analyses, based on secondary data from international and national statistical sources, as well as results from workshops, interviews and focus groups. In particular, the Lab consulted secondary data provided by the UN and the Greek Ministry of Migration and Asylum, mainly included in the problem framing exercise. Information from stakeholders was also used to determine critical factors of migration, areas of action and policy, future scenarios, and policy solutions for strengthening social integration and community resilience (see Annex for details).

Engaging stakeholders from the beginning of the Lab was crucial for building trust and ensuring their cooperation, which was essential for data collection and practical implementation. Stakeholders were eager to share their memories and experiences of the migration influx of 2015 to discuss the failures and successes, and to reinstate migration on the policy agenda to build community resilience, in view of the global situation of military conflicts and climate change, which would foster new waves of migration and population displacement. However, in the beginning they were hesitant and reserved, as they did not have knowledge of the participatory techniques to be employed for the study, nor did they know what to expect from the Lab or from one another.

Organising interviews and focus groups proved to be an essential strategy for ensuring open and active participation, transforming sentiments of hesitation and reservation to excitement and hope for a better future that can be jointly constructed and achieved. Continued follow-ups and feedback sharing with stakeholders after each workshop also helped in sustaining their impetus to take part in all the stages of the exercise from problem framing to scenario development and policy testing. Outreach activities played a critical role in building trust and efforts for policy alignment.

Moreover, by adopting a flexible approach, the Lab was able to adjust methods and strategies, proved vital in improving the project's adaptability to unforeseen challenges and evolving circumstances. Utilising mixed methods approaches and regularly revising plans based on stakeholder feedback were particularly effective.

References

No	*Description/Link*
R1	EC, Eurostat. 2024. Demography of Europe – 2024 edition. Publication Office of the European Union.
R2	Kordel, S., and Gruber, M. 2024. *Migration Impact Assessment: A Toolbox for Participatory Practices*. Baden- Baden: Nomos Verlagsgesellschaft mbH & Co. KG. www.nomos-elibrary.de/?doi=10.5771/9783748939412
R3	Kounani, A., and Skanavis, C. 2020. Resilience of Greek communities hosting climate migrants: the perceptions of environmental educators. In Leal Filho, W. (eds) *Handbook of Climate Change Resilience*. Springer, Cham.
R4	Sakellis, Y., Spyropoulou, N., and Ziomas, D. 2016. The refugee crisis in Greece in the aftermath of the 20 March 2016 EU-Turkey Agreement. *ESPN Flash Report 2016/64, European Social Policy Network*, Publication Office of the European Union.
R5	Olcese, M., Cardinali, P., Madera, F., Camilleri, A. P., and Migliorini, L. 2024. Migration and community resilience: A scoping review. *International Journal of Intercultural Relations*, 98, 101924.

4.3 COSIGHT Lab

Abstract
The German CoSight Lab promoted societal resilience in Hamburg with a focus on resilience and social crises in the context of integration. The Lab conducted stakeholder workshops and interviews with a diverse group of citizens and experts. The results of the CoSight Lab have been channelled into a citizen project called 'CoSaturday' and into local structures to ensure the sustainability of the project results. For this, FUTURESILIENCE offered the possibility to test methods.
The CoSight Lab has shown that social crises in Germany currently have an enormous impact on the resilience of democracy and the state of social cohesion. It became clear that aspects of migration and long-term integration are crucial for a resilient democracy and that the only societal consensus in this highly polarised area is a successful labour market integration of (former) migrants. The lab therefore identified resilient coping strategies for two particular groups that are often forgotten over time: the group of refugee women, often formally "low-skilled", and the group of unemployed young people (so-called NEETs: Not in employment, education or training). In working with a vision, a backcasting and multiple-perspective discussions, four factors were identified that promote societal resilience in the context of social crises and should be taken into account by policy makers and companies:
1. empowered communities that are heard, supported and actively engaged,
2. participatory policymaking that involves those most affected by decisions,
3. robust physical and social infrastructure that can adapt to change,
4. acceptance of diversity that favours flexibility and innovation in the face of future challenges.

- Local Partner: COCIETY
- Mentor: Fraunhofer ISI

4.3.1 Description of the lab

"Cociety – initiatives for a resilient society" is a network of currently ten non-profit organisations all active in different fields of the Sustainable Development Goals. Cociety was founded in April 2023 by its donor Prof. Dr. Michael Otto and created in response to two (general) observations:

- we are socially drifting further and further apart in Germany. The tone and interaction in our society and among us is becoming harsher and in some cases people with different opinions no longer even speak to each other.
- we are currently and, in the future, confronted with many changes and further challenges, e.g. war, COVID-19, climate change the goal of climate neutrality till 2045, digitalisation/AI. A major question for Cociety is thus: How can we successfully deal with these pressures and unexpected

discontinuities and prepare ourselves? How can we strengthen our social interaction and our democracy?

The answer: Cociety is committed to promote greater resilience in our society, i.e. we want to promote a positive approach to crises and conflicts.

One of Cociety's tools: creating spaces for human encounters and facilitating targeted exchanges on conflict topics with and between diverse citizens with different backgrounds, opinions, income, age, education, etc. One of the main products of Cociety is the "**CoSaturday**" dialogue concept to create spaces for meaningful interactions among diverse citizens. This concept facilitates targeted discussions on conflicting topics, bringing together individuals with varying backgrounds. A panel of 100 Hamburg residents, selected to reflect the city's socio-demographic diversity, participated in this two-year project aiming to get further insights into the effectiveness of open conflicts for social resilience. The COSIGHT lab tested methods (Tetralemma, backcasting, normative scenarios or better: visions) and the topic "integration" for the CoSaturdays to improve the dialogues with a broader and more representative audience of Hamburg.

Figure 35: COSIGHT Structure

4.3.2 Initial needs and challenges

The COSIGHT Lab aimed to promote greater resilience in Hamburg's society and beyond by enhancing societal competences to deal with future changes and challenges resulting from the multiple crises we all face.
The goal was to refine and expand the CoSaturday concept to not only address current societal issues (here: integration of people with migration background – in the long-term), but also to create solutions and positive future-orientated scenarios together with citizens, civil society actors, and policymakers. The approach is driven by the belief that resilience is not something that can be imposed from above but must be built collectively and rooted in local realities.
By focusing on the societal challenge of integration (in the context of migration) in Hamburg, Germany, the COSIGHT Lab applied a range of foresight methods to explore current societal

tensions, identify critical issues, and develop long-term approaches to address the “real problems” behind. On the other hand, COSIGHT aimed to identify key factors for successful, resilience-promoting participatory processes and to contribute to a broader understanding of how democratic societies can remain adaptable, inclusive, and strong in times of uncertainty.

During the first participative workshop, triggered by data from the City of Hamburg (Dr. Muth, Hamburg social welfare authority/Hamburg’s integration concept), and the Institute for labour market research and occupational research (IAB, Dr. Buch), many future issues and potential crises signals for the future of Hamburg’s society were identified and discussed. Two main issues were later focussed upon.

A special focus was on identifying strategies to effectively integrate formally low-qualified groups—particularly women and young people with immigration backgrounds—into the local labour market.

To sum up the COSIGHT Lab objectives were:

- **Broad involvement of various stakeholders** of (mainly) Hamburg´s civil society and other sectors
- **Further development of the dialogue concepts "CoSaturday"** in terms of content and applied methods (resilience foresight). In the issue of “integration” and new methods were tested in order to apply and roll-out the revised and expanded concept in the running 2-year lasting CoSaturday project.
- **Developing a scalable foresight method** that addresses a range of topics and challenges (such as mobilisation, climate change, environmental issues, and social welfare) and can be adapted for different geographical contexts.
- **Creating a blueprint** for participatory citizen involvement that can serve as a model for similar projects across Europe.

The project team included Marina Beermann and Anna Keremen, supported by advisors Miriam Petersen, temporally Marije Ijpma and temporally Fee Catrin Roodbol. Leaders and employees from the Cociety nonprofit organisations network were invited to and actively engaged in the COSIGHT workshops.

4.3.3 Work done in the lab

The CoSight lab focused on the interrelations between social conflicts and societal resilience using the example of integration in the context of migration. Why this topic? Integration of migrants is a big issue in Hamburg – as in all major cities. There are many approaches and solutions to deal with the issue, but as the presentations with data input at the first workshop and the following discussions have demonstrated, there are many successful measures in place. But all measures address those migrants who recently came to Hamburg. For longer term residents with migration backgrounds and the second and third generation of young people, there are very few initiatives.

This is displayed in the data: Official statistics show that the majority of women with own migration background do not achieve any formal qualification. The second group are young people under 25 years, where those with migration background and second-generation

migration background (no personal migration) have unproportionally high rates of ending up without formal qualification. This was all discussed and deepened in the first workshop.

The Tetralemma approach was used to generate assumptions about the future of integration in Hamburg. It was then decided to dig deeper into the reasons and future of these two societal groups as it became clear that especially the youth group is the one that in the long-term will cause further problems, might work against the democratic system, might be ignored by society and are lost to the German labour market. In times of demographic change, everyone is needed on the labour market, therefore the young people and women are a potential for society, economy and even politics that needs to be developed.

In chronological order, the following activities took place in the COSIGHT lab:

- 1st kick-off with Fraunhofer ISI (15th of February 2024): decision of topic -focussing on the social conflict area of integration in Hamburg (also with regard to 2nd CoSaturday in October 2024)
- Preparation of the first workshop: identification of stakeholders, creating a workshop concept, including moderation, etc
- 17th of June 2024, 1st workshop(.): "How can integration in Hamburg succeed" with presentations about data, defining the factors that frame the issue of integration, a brainstorming in structured groups, and Tetralemma Approach for the different factors and how they might unfold. Follow-up evaluation after the workshop.

Figure 36: Results from the first workshop (in German language) – major factors for integration in Hamburg (titles: economic, environmental, social, cultural/ identity)

- 2nd CoSaturday: findings from 1st workshop used for content preparation of CoSaturday (October 2024) and foresight methodology (future headlines instead of tetralemma and definition of relevant areas of conflict)

- August/September 2024: expert interviews with FUTURESILIENCE experts to learn about integration, cases and policy measures
- December 2024: preparation of the 2nd workshop with new expert stakeholders. Method: a vision was provided, adapted, and a backcasting from the vision for the two citizen groups was conducted. A roadmap was drawn for the two subgroups (women and youth)
- March/April 2025: 10 deep-dive interviews with Hamburg citizens
- February 2025: 3rd workshop: deep dive in both groups (women and youth) and considerations on policy transfer, ideas for implementation and addressees beyond the scope of FUTURESILIENCE.
- Concrete policy transfer measures for both groups - 1. young people: HANZ presentation and discussion with top-level politicians and CEOs of Hamburg (28.04.2025), women: Impact partnerships of City of Hamburg + wrap video experts.
- Continuous communication measures: LinkedIn, Youtube and stakeholder involvement of the Cociety network, participation in FUTURESILIENCE webinars and FUTURESILIENCE meetings/conferences, continuous Jour fixe.

Methodologically, the COSIGHT lab activities did not follow the foresight toolbox in detail but took out the Tetralemma approach to come up with different future developments (context) during the first workshop, with different developments of citizen groups with migration backgrounds and their next generations in Hamburg. An open discussion about consequences of these (ongoing) developments raised further questions. Scenarios were not systematically built, but from the consequences discussed and the data generated during the workshop and interviews, normative scenarios or rather visions were created that served as an input into the second workshop, where it was discussed, changed and then used for backcasting and roadmapping. In detail, the following steps were followed:

Project initiation meeting

During the initial kick-off meeting with Fraunhofer ISI, we agreed to focus on the social conflict field of integration in Hamburg as a central theme. This topic felt especially relevant given the local context at the time and served as a guiding theme for COSIGHT and the preparations leading up to the second CoSaturday in October 2024, where we aimed to discuss it further together with selected citizens and the support of advised experts.

First COSIGHT workshop

The first COSIGHT workshop focused on identifying key stakeholders and shaping a concept pre-testing the topic "How can integration in Hamburg succeed?" This workshop started with content input, discussion of focus points, consequences of “not integrating migrants and their next generations”. The debates underscored the importance of precise communication and clear definitions within the integration discourse. They also facilitated the identification of local experts for future CoSaturday events and the second COSIGHT workshop. Although the Tetralemma method generated thought-provoking statements (different futures) as an input into the World Cafés in the second CoSaturday, the method itself was ultimately deemed too complex to fully integrate it into the CoSaturday format due to time constraints and the novelty of the method. In the evaluation that followed the COSIGHT workshop, one key takeaway emerged: the need to highlight the issue of labour market integration for people

with low formal qualifications, especially women and adolescents with a migration background because they stood out as a central challenge that deserves deeper attention moving forward.

Implementation second CoSaturday

The second CoSaturday built directly on the insights gained during the first COSIGHT workshop.

These initial findings helped to shape the thematic focus and the methodological approach. Instead of the Tetralemma method, the Lab applied a foresight-based format called “Future Headlines” to explore relevant conflict areas around integration. This allowed to define key issues more clearly from a forward-looking and scenario-based perspective.

Interviews with FUTURESILIENCE experts

The COSIGHT Lab also produced a summary of several expert interviews with those FutuResilience Labs that deal with different kinds of social conflict. The interviews dealt with the influence of conflicts and polarisation on the development of social resilience and transformation. The expert insights underlined that unresolved social conflicts can divide communities and weaken democratic structures. However, when addressed through open communication and collaboration, conflict can become a driver for growth and connection. Resilience, then, is not just about withstanding crises, but about transforming them into opportunities for stronger, more inclusive societies.

The analysis has shown that there are four factors that promote societal resilience:

- **Empowered communities** that are heard, supported, and actively involved.
- **Participatory policy design** that includes those most affected by decisions.
- **Robust physical and social infrastructure** that can adapt to change.
- **Embracing diversity**, which fosters flexibility and innovation in the face of future challenges.

Second COSIGHT workshop

Building on the CoSaturday workshop and its discussions on resilient approaches to integration in Hamburg, Germany, the COSIGHT Lab hosted another workshop on 12th December 2024. This session focused on strategies to effectively integrate formally low-qualified groups—particularly women with migration background and young people with immigrant backgrounds, often second generation —into the local labour market. The workshop brought together stakeholders from diverse sectors to gain interdisciplinary perspectives on existing challenges and barriers.

Two keynotes framed the data input and the input from practical experience. In the case of unemployed young people (keynote input by Simon Busch, Managing Director JOBLINGE gAG Hanse), this is a group that cannot be reached by the formal administrative processes. They have very different backgrounds, not all of them from low-income families, but all of them do not feel to be part of the society. They feel neglected, not seen, unmotivated and often their daily life is unstructured. A qualitative study underlined the factors that hamper young people to structure themselves or search for a permanent job instead of temporary jobs to survive.

The second input came from Manuela Maurer, a founder of a catering service Chickpeace. She employs women with migration background and reported from her practical work and the problems of this group of women. The “women with migration background” and “formally low qualification” often meant those who came to Hamburg and took care of their families first. They often did not learn German as they had to take care of the children, organise schools, household and administration while their husbands were the first to get a job to support them. Some of these women were alone, but many of them with children. That means, small issues of daily life (from food to medical care for the kids) hampered them from learning the language, going to school or qualify themselves. They often do not have information how to get an employment, how the system works, and they are not part of any network. Sometimes, they face administrative hurdles, or their qualifications are not acknowledged.

In both groups, the discussions started with a normative scenario, a “vision”, formulated by COSIGHT: ‘In Hamburg in 2035, labour market integration is based on the overall societal task of enabling young people to contribute their strengths and skills that are valuable for working life.’ In both groups, the vision was adapted. Using the foresight backcasting method, participants split into two thematic groups suited to their specific target group and collaboratively developed a roadmap and formulated actionable recommendations aimed at helping local policymakers address this issue in a sustainable and future-oriented way. The recommendations were selected and focused.

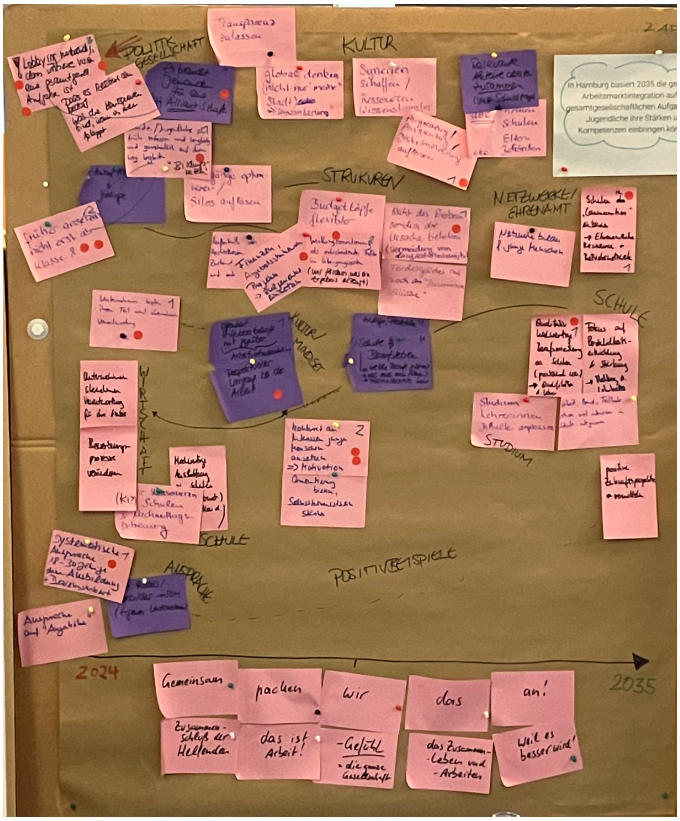


Figure 37: Workshop 2 Backcasting from 2035 Vision to today’s Actions

Deep dive interviews with selected citizens

To gain additional insights from a different perspective and to identify potential gaps that may have emerged while applying the learnings from the experts and the broader FUTURESILIENCE project to the CoSaturday format—the COSIGHT Lab decided to conduct a series of in-depth interviews with selected citizens who had participated in earlier participatory sessions.

These qualitative interviews focused on broader questions of transformative strategies and resilience, capturing participants' viewpoints on integration considering the four key resilience factors identified by the expert group, as well as their reflections on the foresight methods used throughout the process. The insights gathered are now being used for further internal reflection and evaluation.

Third COSIGHT workshop

The third workshop offered a deep dive within the two former working groups on labour integration and opened space for initial reflections on how the insights gathered could be meaningfully transferred into policy. Participants explored the content (vision Hamburg 2035, picture below) more in depth but also tried to bridge the gap between practice and policymaking in a constructive and realistic way. The achievements reflect the discussions and the implementations of the ideas. Interestingly, not only the policymakers were regarded as addressees, but also companies.

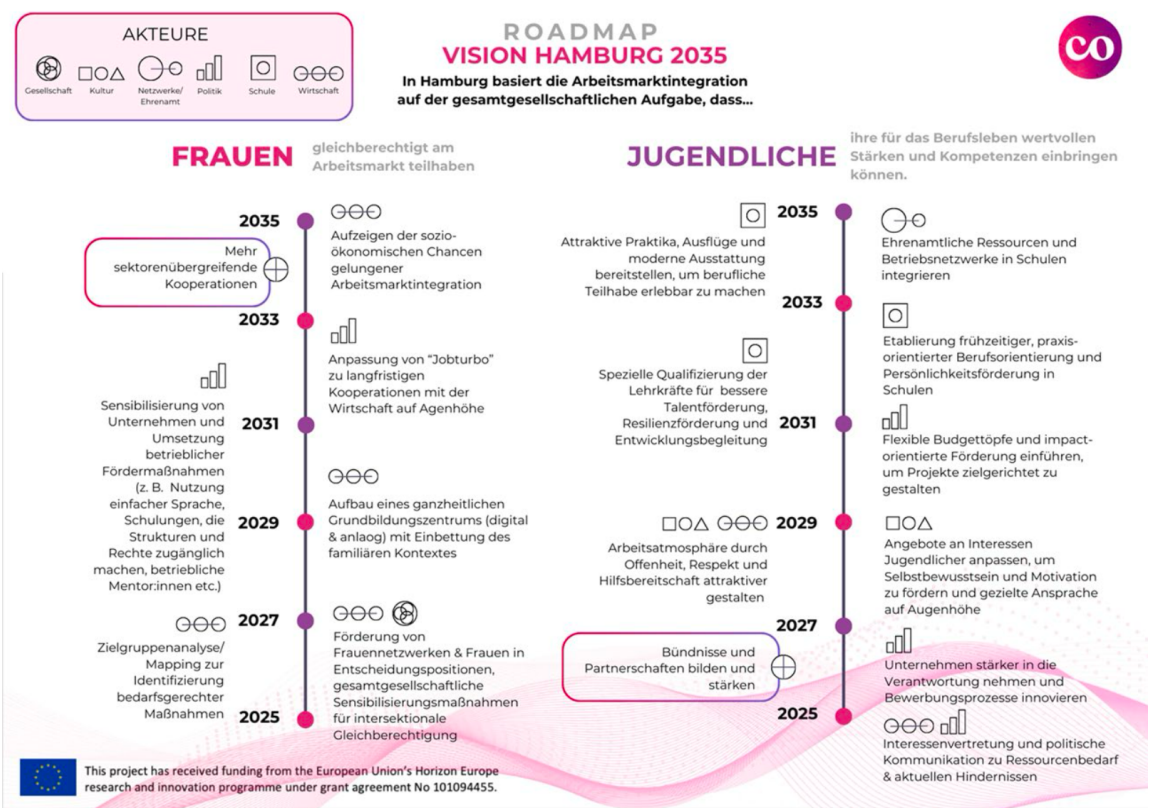


Figure 38: Draft roadmap Vision Hamburg 2035

4.3.4 Achievements

Policy achievements

Evolving from the learnings of the last two workshops and the possible forms of policy transfer with the involved stakeholders, the COSIGHT Lab implements a longer-term continuation of the insights gained for formally low qualified women. Especially the idea of a "one-stop-shop", a building for women that integrates many daily functions from Kindergarten to medical care, where they find advice and administrative help was discussed and framed. This idea turned out to be rather one that could be discussed with private initiatives – and not policymakers (see below).

A second strand was networking and alliances. The alliance building of key stakeholders that took part in the workshops, bringing together different actors from Hamburg will be transferred from COSIGHT in the form of an impact partnership of the "Social Entrepreneurship Alliance" of the city of Hamburg. Cociety and the Social Entrepreneurship Alliance have entered into a co-operation. Thereby, the results of the COSIGHT project will be transferred to a continuing project of the alliance.

The overall aim is bringing together stakeholders and affected women to work on long-term solutions such as e.g a Community Centre (the one-stop-shop mentioned above) with a holistic approach to education and bureaucracy, combining different mandatory structures needed for low-qualified women and mothers in Germany in one place, allowing women to use their limited time efficiently and access information without long distances. It ensures a place in the sense of an ´one-stop-shop´, where trained professionals are able to help women and families with short lines of communication between the different administrative authorities and government agencies.
Secondly, there are achievements around the young peoples' group. The number of "NEETs", i.e. young people between 15-24 years who are not in employment, education or training in Germany and Hamburg is constantly rising – the awareness for this issue had to be raised. The resilience approach has shown that they cannot be ignored. Otherwise, Hamburg is facing increasing future problems on an individual, societal and economical level as well as the current obstacles for labour market integration, all of high political and economic importance. The results of the COSIGHT LAB highlight the importance of tailored education programs, skills development initiatives, and employment opportunities, but also initiatives that help to reach these young people individually.

On 28th of April the COSIGHT LAB presented and discussed the results on how to enhance workforce readiness, bridging qualification gaps, and creating sustainable pathways for young people to thrive in the current labour market, with relevant policy makers in the steering committee of "HANZ", a foundation focusing on getting young people into employment.

Achieved lab objectives

- Adapted inclusion of foresight methods in the CoSaturday concept
- Testing two foresight methods in the context of a concrete societal challenge with a broad range of different stakeholders

- Engaging over 30 stakeholders from academia, politics, NGOs, practical integration work, businesses and media
- Empowering the stakeholders with concrete foresight methods which can help to increase societal resilience to crisis and change
- The foresight methods chosen increased awareness for a proactive foresight approach. This was fostered by combining the methodological approach with concrete implications for policy transfer
- Integration has proven to be a suitable social conflict issue. It concerns everyone, there will be far-reaching changes in the future that will have an impact on all parts of society, everyone has an opinion on it, and these prove to be conflicting in many respects.
- It has encompassing relevance for all involved stakeholders and the openness within the policy transfers of single politicians as well as political institutions has proven that there is need for change and openness for improvements. And this is due to the societal relevance and awareness of aspects of migration and integration in Germany in general.
- The COSIGHT Lab process has shown that with the approach of combining foresight methods with societal resilience issues it is possible to identify relevant societal and resilience blind spots and to build resilient coping strategies on a local level that do have political relevance and connectivity.
- Identification of cross-project factors to foster societal resilience, https://youtu.be/-hlRhOoo1lA?feature=shared

Achievement on use of outcomes

The lab results are being used by regional stakeholders in different ways:

- For the group of formally low qualified (refugee) women, alliance building of key stakeholders will be transferred in the form of an impact partnership of the “Social Entrepreneurship Alliance” of the city of Hamburg. The partnership builds on the insights from the conducted workshops and will be open for the stakeholders already involved as well as new regional stakeholders. The preparatory work carried out in the COSIGHT lab provides an ideal basis for establishing a continuous round table in Hamburg, which can also serve as an important step to build an alliance/lobby for the target group.
- For the group of NEETS, different institutions and stakeholders such as the Senator for Schools and Educational Training, City of Hamburg, the President of the Chamber of Commerce, the President of the Chamber of Crafts, the President of the Employment Agency and Prof. Dr. Otto (see group picture above) agreed on different measures to address the group of NEETS within their specific programs more in future. The project has also shown that currently no responsibility within the set of public authorities exists that focus and handle the needs of the group of NEETS in particular.

Achieved Recommendations

Figure 39: Recommendations for migrant integration into employment with special focus on female and young migrants with formally low qualification (German)

Recommendations regarding integration

- **Networking/Cooperation**
  - Linking specialist stakeholders in Hamburg at working level
  - Strengthening the idea of an alliance
  - Clarifying responsibilities and making them transparent for 24-35-year-old (this is an age group where parents or the schools are not responsible for the group, anymore, in fact, nobody feels responsible)
- **Empowerment**
  - NEETs and formally low-skilled(refugee) women often require tailored programs that address their specific needs and backgrounds. These include life coaching, career guidance and psychological support, mentoring programs and resilience support at an individual level
  - Structural solutions such as holistic health centres in the sense of an “one-stop shop” for women can facilitate tailored programs and its uptake

Recommendations regarding societal conflicts and resilience

By conducting interviews with other experts of the FUTURESILIENCE project, COSIGHT identified four main factors for promoting societal resilience:

- Building close connections with communities has been found essential. Understanding their concerns, meeting their needs, and fostering spaces for mutual learning creates stronger, more

resilient societies. Direct engagement ensures that knowledge reaches people while encouraging communities to share insights and support one another.

- Policy designs should be shaped by the voices of those directly affected, ensuring they reflect real needs, perspectives, and experiences. Addressing root causes participatively and fostering capacity-building leads to long-term stability, empowering communities with the skills and resources necessary for sustainable resilience.
- Both physical and social infrastructure play a crucial role in resilience. Strong systems help communities navigate change, making adaptation and recovery more accessible and efficient.
- Finally, diversity – resilience thrives on diversity at all levels.

4.3.5 Lessons learnt

The lessons learnt in implementing the lab can be divided into a practical/operative level in reference to the COSIGHT Lab on the one hand and the COSIGHT Lab in the context of FUTURESILIENCE on the other hand, the methodological level and a content related level.

Operative/practical level

1. **COSIGHT Lab**

Convening different diverse stakeholders is highly challenging, though of high importance when it comes to creating resilient solutions to societal conflicts. The participation on the COSIGHT lab workshops was voluntary compared to the CoSaturday project (citizen get a financial incentive). The challenges of getting stakeholders engaged and keep them being engaged are vital when launching similar initiatives and must be an integral part of the concept from the outset. Stakeholder management therefore is crucial and takes time. We did not assume that before the project started. Next time we would plan resources for the stakeholder management.

2. **COSIGHT Lab in the context of FUTURESILIENCE**

The FUTURESILIENCE project was designed in such a way that the focus was on testing the methods and stopped when the measures were implemented. This design made it difficult to keep the stakeholders engaged on a longer-term basis. In Hamburg, it was difficult to work with policymakers as there were elections when the first results should be discussed. Discussion rounds at that point in time were not possible.
The motivation and commitment factor of the stakeholders would probably be higher if the project phase had a more long-term focus.

Methodological level

With regard to the foresight methods identified, we have had positive experiences with the (adapted) methods chosen and the sequence selected. The use of the Tetralemma at the beginning was very helpful to better understand the general idea of foresight and to ‘open up’ perspectives (although the method is not appropriate for the CoSaturday-citizens project). The backcasting and roadmapping was helpful because it showed where the intersection between the different stakeholders lies in terms of a desirable state in the future - despite all

the differences in perception of what is currently happening well or not sufficiently in Hamburg in terms of integration.

Recommendations regarding the use of foresight methods
- the framework conditions must match the complexity of the methods
- it should not be underestimated that systemic thinking in different futures is unfamiliar to many. It needs constant, clear methodological guidance.

The backcasting method has been applied to identify concrete timed measures to improve labour market integration for particularly formally low qualified young people and women in Hamburg. In the third workshop (policy transfer) it became very clear, that it was very difficult for all stakeholders to agree on the previously collectively agreed measures and continue with next steps of implementation. Although pursuing the same goal, all stakeholders argued from their own perspective and ´bubble´. Different perspectives and constraints (particularly between political vs. operational actors) as well as limited capacities and resources of all stakeholders involved prevented concrete agreement, commitment and implementation on this specific roadmap. Nevertheless, bringing the relevant stakeholders together and placing the topic in an expert community created a window of opportunity. However, the process would have required more time to develop a common roadmap for a newly initiated community.

4.4 FICTIONS Lab

Abstract
Labour market shocks are a significant threat to the European social and economic environment. The manufacturing sector is one of the most worrisome with high labour shortages. In the face of such labour crises, there is a need for new approaches to build resilience into the sector. The European Commission states that workers must be involved in the design of future work technology, placing a great emphasis on manufacturing work to create good quality jobs.
The FICTIONS Lab brought together a research centre – *Fraunhofer Portugal AICOS* – and a large industrial group – *dst group* – to ascertain whether manufacturing workers trained in emerging digital technologies and in collaboration with design researchers could generate future visions that addressed technological disruptions and skill gaps in manufacturing, promoting wellbeing at work. To do so, the Lab implemented a Participatory Speculative Design process using mixed-methods within three workshops and a survey.

- Local Partner: Fraunhofer AICOS, dst group
- Mentors: University of Urbino and Copenhagen Institute for Futures Studies

4.4.1 Description of the lab

The FICTIONS Lab brought together a research centre – *Fraunhofer Portugal AICOS* – and a large industrial group – *dst group* –, both located in the northern region of Portugal, which is the most industrialised region in the country. Despite a significant investment of the country in the digital transformation of its industrial sector, it faces significant labour shortages. On the other hand, there is also evidence to show that non human-centred digital transformation might be problematic for workers' health and wellbeing.
Therefore, the Lab proposed to test a participatory approach with manufacturing workers so that they could have a say in how digital transformation should be shaped. Specifically, the aim of the FICTIONS Lab was to ascertain whether manufacturing workers trained in emerging digital technologies and in collaboration with design researchers could generate future visions that addressed technological disruptions and skill gaps in manufacturing, promoting wellbeing at work. To do so, the Lab implemented a Participatory Speculative Design process using mixed methods.

The objectives of the FICTIONS lab included:

- Building capacity among industrial workers about emerging technologies
- Engaging in speculative design with industrial workers
- Delivering speculative design representations (e.g. narratives, drawings, videos) of a resilient manufacturing sector
- Experimenting with a methodology of participation with Lead Users in the manufacturing sector.

The FICTIONS Lab was composed of design researchers, digital technology researchers, industrial operators and innovation specialists.

4.4.2 Initial needs and challenges

Although there is a significant body of work on how to involve users in design, namely in digital technology design, this practice comes with two challenges. On the one hand, participatory design is hard to implement in highly demanding work because of issues such as trade secret, impossibility of workers to leave their workstations, or researcher safety. On the other hand, when participatory design succeeds in being implemented it tends to focus on present-day problems, rather than looking at the future.

The FICTIONS Lab proposed to implement a participatory speculative design approach designed to cover the current gaps in the use of participatory design with manufacturing workers. One of the main challenges of this approach was that, in order to generate policy recommendations for the future of digital transformation in industry, the stakeholders involved in the process had to understand digital technology, manufacturing work, and policymaking.

4.4.3 Work done in the lab

Preparatory work

As a first step, we sought to become familiar with the policy recommendations. Therefore, we analysed the FUTURESILIENCE Knowledge Base searching for Labour Market and Industries. From the 68 hits, we selected 10 documents to analyse in more depth, which pertained not just to the topics of interest, but also to the country where the FICTIONS Lab was going to be implemented: Portugal. This analysis let to a set of takeaways for aspects to be addressed in the Lab, as well as to capacity building within the research team, who had no prior experience in policymaking.

We also launched a survey on attitudes towards digital technologies at work next to operators at dst working in three industrial units related to metal work and woodwork. There were 34 valid responses. The results pointed at very positive attitudes towards digital technology at work and a focus on productivity. In a workshop with external specialists, we discussed what we had learned from the Knowledge Base and from the survey, and we did a STEEPLE exercise to identify factors which specialists considered would play an important role in the future of work, such as Ageing, Social welfare changes, or Cybersecurity. In this workshop we also defined the problem of the FICTIONS Lab*: Technological disruptions and skill gaps might have a negative impact on workers' wellbeing*. From this point onwards, we were ready to engage in participatory design with dst workers.

Workshops with manufacturing operators

In the survey, we had asked respondents if they would be willing to take part in the Lab's workshops. A subset of participants showed willingness to do so and this was the group we recruited for our activities, which began with a training phase. In order to be able to discuss the future of technology, it would be important that operators were provided with knowledge about emerging technologies. Therefore, we held three training sessions. Each session had a 2-hour duration and covered the topics of Artificial Intelligence including Generative AI, Cyberphysical systems including Industry 4.0 and 5.0, and Human-Computer Interaction including cobots and eXtended Reality (XR).

We then began a series of workshops with the same group of users who had participated in the survey and who had received training – this was our Lead User group. Numbers varied from one workshop to the other for various reasons, e.g. operator retirement, operator holidays, operator wedding. However, the Lead User group was always represented by a minimum of 8 participants.

In the first workshop we did an overview of how policy was made, by whom, and how it ultimately affected workers' everyday lives. We then presented the problem definition, along with a list of 10 factors expected to influence it in the future. Operators discussed the problem, the factors, they decided they did not want to add or remove factors, and they placed them on an Uncertainty vs Impact matrix. This determined the factors we would address in the following workshops: Ageing, Migration, Resource Availability, and Recognition and Safety at Work.

In the following workshop, we brought materials which represented speculations of actions the company dst might be undertaking if the factors were in place. We represented these actions by simulating the look and feel of posters which dst usually creates to communicate with employees. We also brought large printouts of the working environment in the three industrial units and asked operators to do a collage over those photographs to represent what would change in their environment if those company actions were in place (Figure 40). The exercise was meant to push possible futures into the present and lead operators to reflect on the implications. During this workshop there were several representations of concerns, but also proposed solutions based on digital technology, even though operators were not asked to think of any solutions, must less technological.

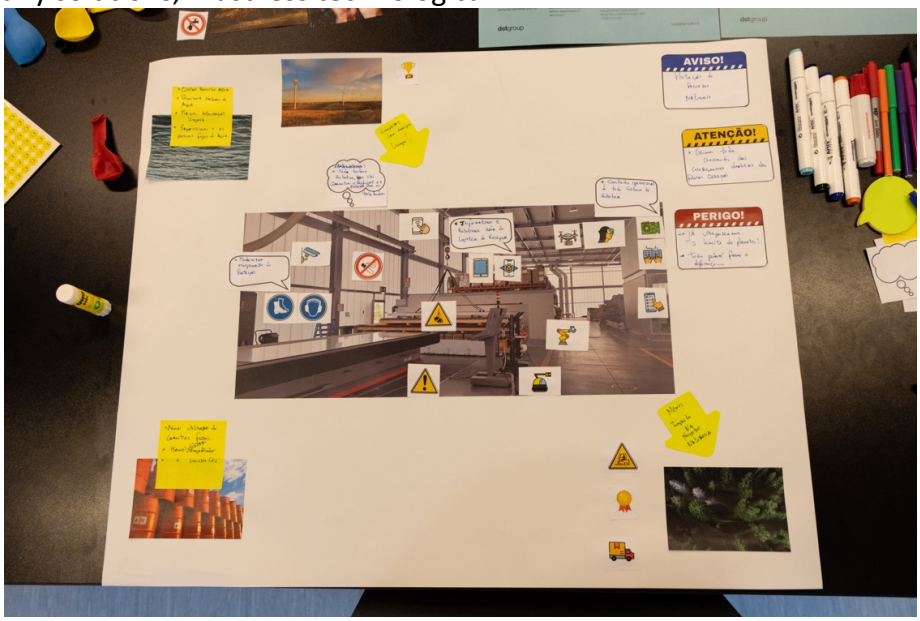


Figure 40 Collage of one of the groups during a workshop with manufacturing operators.

In the third workshop with operators, we brought a speculative prototype which materialised all the solutions. The intention was to get operators to deeply think about the implications of digital technology at work. The prototype was made from an existing company sweater – to help sustain disbelief – and presented as a piece of Individual Protective Equipment. Operators were guided in their reflection to consider the implications of the garment on the types of jobs they could do, the support they would receive, the control they would have over

how to do their jobs, the demand it would be asked of them, and social relations. Operators concluded that although these technologies could bring several advantages to health, they would also likely create new hazards.

Finally, we organised a workshop to generate policy recommendation. In it, operators reflected about the entire participatory speculative design process they had gone through and were asked to generate recommendations for relevant stakeholders: employers, technologists, legislators, and future generations. To make it easier and lighter for operators to express themselves, we designed artifacts and exercises: operators were asked to create book covers for employers, a board game for technologists, demonstration banners for legislators, and a message in a bottle for future generations. The research team at Fraunhofer Portugal AICOS then analysed the artefacts to translate them into policy recommendation format.

Assessment and impact

At the end of the workshops with operators we ran the same survey again on the same sample. We collected 17 valid responses and compared answers between groups: those who had taken part in the training and workshops (Lead User group), and those who had not. There was an observed difference in the Lead User group: they became more concerned with operators' health and rights, as well less confident about the benefits of digital technology. However, given the small sample size and the loss of respondents from the first to the last survey, these results do not enable to reach strong conclusions.

FICTIONS Lab generated policy recommendations and proposed a set of methods for Participatory Speculative Design. By the end of the project, we assessed both the dimensions in a final workshop to which we invited external experts, as well as the group of Lead Users (Figure 41). Policy recommendations were assessed as pertinent, although there were some which raised questions in terms of feasibility or sustainability. The methods were highly praised, namely: recruitment through employer, Lead User approach, the training, and the use of speculative design artefacts to facilitate communication and expression.

Figure 41 Exhibition at the end of the project showing the process and artefacts created with manufacturing operators.

4.4.4 Achievements

The FICTIONS Lab succeeded in building capacity among a group of industrial workers about emerging technologies and operators were able to sustain the knowledge and apply it throughout the workshop, which ran for seven months after the initial training. In the final workshop, operators provided two further comments related to training: 1) the more one knows, the more one is aware of what one does not yet know, so operators were eager to learn more; and 2) operators consider that, ideally, all their colleagues would have access to this knowledge.

The FICTIONS Lab was able to engage in Participatory Speculative design with a group of Lead Users from industrial manufacturing, as well as to deliver speculative representations of recommendations. The way in which the design skills of the research team were employed in designing artefacts to structure the workshops, to provoke reflection, and to stimulate and facilitate communication and expression was highly praised not just by operators, but by external experts as well. Therefore, we were able to use a participatory design process with manufacturing operators to think about possible futures rather than look only at the existing problems and needs.

To those participating in it, the greatest achievement of the FICTIONS Lab was to implement a process, or a set of methods, which can in theory be replicated, given the right conditions, in other industries or locations. This sort of validation would also be important future work.

The Participatory Speculative Design process followed in the FICTIONS Lab generated nine policy recommendations, which were assessed by external specialists for pertinence, feasibility and sustainability, but not implemented in the course of the project:

- Make sure that technology entering the workplace offers enough flexibility to be inclusive
- Make sure that technology entering the workplace is assessed for physical and well as psychosocial safety.
- Make sure that there is an organisational culture that is open to change.
- Make sure that there is adequate and comprehensive training and enough time to learn.
- Make sure that decision makers in companies are trained on technology and cybersecurity.
- Make sure that technology enables oversight but not surveillance that hampers human rights
- Make sure that technology shows evidence of complying with environmental sustainability
- Consider that preserving the environment requires jobs which were extinguished
- Maintain human-centred values in the digital era

However, the most valuable contribution of the Lab, as per external specialists' opinion, but also considering the wider interest of the community, was the proposed process or methodology of Participatory Speculative Design with Lead Users.

4.4.5 Lessons learnt

Below is a list of lessons learned from the implementation of the FICTIONS Lab.

- **Using Design Fictions for Immersion.** Creating design fictions to spark reactions among participants had a significant impact and immersion, especially because these materials were visually styled to match their company's aesthetic and, hence, feel real. These artefacts also enabled participants' self-expression, communication, and collaboration. Furthermore, they acted as boundary objects and enabled conversations during the workshops to move from present-day to future times, as well as from everyday actions to policy level discussions.
- **Adapting Collaboration Methods for Workers.** It is important to anticipate and prepare alternative ways for workers to engage in the workshop sessions. Based on past experience, we knew factory workers often feel uncomfortable drawing, so we provided pre-designed images they could simply cut and use. In the last workshop, we prioritised writing when developing artefacts, as we found it was the medium they felt most comfortable using for expression.
- **Having an Active Partner (Gatekeeper).** A committed partner who helps schedule workshops, provides access to participants and materials, and is genuinely interested in the project is essential. Ensuring that participants feel safe and free to express themselves without fear of retaliation is very important.
- **Capturing Images and Videos.** Recording images and videos proved valuable for disseminating the project, providing proof of concept and 'give' back to participants. Despite review the project goals and prior activities at the start of every workshop, participants said that they only full grasped the extent of the project when they watched the video. As a lesson for the future, we could invest in creating these kinds of media, or use media from prior similar projects, to help communicate the project goals to participants.

In hindsight, there are also things that we might have done differently:

- **Greater involvement with external specialists.** Establishing a closer relationship throughout the project, rather than only engaging at the beginning and end, could have enhanced collaboration and impact.
- **Surveys.** Looking back, distributing the questionnaire on paper raised concerns about whether participants had privacy while filling it in. In the future, we may need to reassess this method to ensure accurate and uninfluenced responses.

The process implemented in the FICTIONS Lab was presented at the HCDWeek event at Fraunhofer Portugal AICOS at the end of November 2024, where attendees were invited to experiment with part of the methods we designed for the FICTIONS Lab. Participants' feedback was very positive and originated an invitation from one of the Portuguese unicorns for Fraunhofer Portugal AICOS to run a workshop with their employees to teach them about the methods.

4.5 IMMER Lab

Abstract
The IMMER lab aimed to enhance the resilience of the Strasbourg-Kehl area in terms of mobility and energy by 2050. The project focused on local resilience and the involvement of a diverse group of local partners. These included companies, the fluvial ports of Strasbourg and Kehl, energy producers, mobility operators, and public authorities. By bringing together these stakeholders, the lab leveraged their collective expertise and resources to address the challenges facing the region.
The IMMER lab performed a series of workshops designed to engage local stakeholders in a collaborative, forward-looking approach. These workshops aimed to develop strategies that will strengthen the resilience of the Strasbourg-Kehl area, ensuring it can meet future challenges. By fostering this long-term vision, the lab aspired to create a robust framework for sustainable development and resilience in the face of evolving environmental and societal pressures.

- Local Partners: University of Applied Sciences Kehl and Association de Prospective Rhenane
- Mentor: Fraunhofer ISI

4.5.1 Description of the lab

The aim of the pilot project IMMER was to contribute to the resilience of local organisations facing major crises (with a focus on mobility and energy) through foresight activities based on narratives. The foresight lab we proposed is conceived as a French-German project located at the Rhine border, more precisely at the metropolitan Strasbourg-Kehl area.

In a nutshell, the objectives IMMER intended to achieve were:

- To increase the resilience of both cities regarding mobility and energy issues by strengthening their cooperation (thanks to a narrative-based foresight experience).
- To investigate the factors supporting or hampering the use of narrative-based foresight by local organisations (municipalities, economic actors, etc.).
- To better understand in how far the context of a border between two EU countries may influence the performance of such resilience-related foresight.
- To allow potentially extending the developed methodology to other fields (e.g. health) possibly also relevant for municipal resilience.
- To provide a sustainable framework allowing all the relevant actors in the area to pursue foresight activities after the end of the project by using and coordinating their respective resources.

The two organizing institutions, the APR (Rhine Association for Future Studies) and the University of Applied Sciences Kehl) have secured the collaboration of the two municipalities concerned (Strasbourg and Kehl), their respective river ports, and a number of major players in the energy and mobility sectors. The organisations were consulted in advance of the

workshops to help us define start-up scenarios for the workshops. They sent a total of around thirty representatives to each workshop to take part in the narrative foresight exercise itself.

4.5.2 Initial Needs and Challenges

The Upper Rhine region is characterized by its border location, where two distinct administrative systems coexist. This configuration leads to increased complexity in the management of regional affairs, particularly regarding mobility and energy management. With so many players involved, coordination and collaboration between the various actors in the region, be they government bodies, private companies or civil society organisations, become essential for an effective response in the case of a crisis. The Upper Rhine is not only a border area, but also a space marked by strong cross-border interactions. This interconnection reinforces the importance of cross-border cooperation in crisis management, as unforeseen events can have direct repercussions on both sides of the border.

4.5.3 Work done in the lab

When developing crisis management strategies in the Upper Rhine region, it is essential to take this cross-border dimension into account. It should be particularly noted that the cross-border Strasbourg-Kehl area is highly integrated: it forms a single conurbation, with many people crossing the border every day to get to their homes or workplaces, two river ports facing each other and accustomed to cooperating, etc. The experience of the COVID-19 pandemic has clearly revealed the importance of cross-border relations and, at the same time, the difficulty of integrating two distinct national policies in the same area.
Without this cooperation, the overall resilience of the urban system is significantly reduced. Cooperation requires open communication, joint simulation exercises and effective coordination of resources and emergency response. Ensuring that information is available and accessible in both countries facilitates cooperation between the various regional players, thereby strengthening collective resilience in the face of crises. The aim of the workshops part of the IMMER project is to promote communication between the key players in the energy and mobility sectors (see the three workshops in the GANTT chart provided in the appendix) and to get them to imagine what unforeseen events in their current risk management strategies could affect the region and thus have an impact on their various activities.

4.5.3.1 Preparatory phase

Before developing narratives, we needed to define the specific objectives and topics. In the case of the IMMER project the aim is to find crises that might affect the Upper Rhine region in the coming decades. Crises that could be large-scale, directly or indirectly impacting all sectors of activity and all citizens in the region. As the project targets the topics of energy and mobility these were two key elements to start developing the narratives.
To identify the main challenges that the region's stakeholders believe they will have to face over the next 25 years, a series of interviews has been necessary. The preliminary data collection work consisted of a series of ten semi-structured interviews lasting around 1 hour. During these interviews, the professionals answered questions relating to the topic in question, i.e. the crises likely to affect the Upper Rhine region by 2050. The interviews were conducted with a representative of each project partner. The questionnaire was the same for all the interviews and was used to guide the discussion in order to obtain the information

needed to organize the following workshops planned in the project. It is important to point out that the questionnaire has been seen as a guide to the discussion, and the exchange was not limited to these questions. Respondents were free to develop certain points in greater detail or to raise other issues that they felt relevant to the subject. The aim of this first series of interviews was not only to learn about the future crises most feared by the partners, but also to gain a better understanding of how they operate in the event of a crisis, the way they use energy, their possible transition to greener energies and, finally, to gain a better understanding of how mobility appeared to be a key priority for them.

4.5.3.2 Workshop #1

On July 4, 2024, the first workshop was organized, bringing together the project's partners, all of whom were active in the Upper Rhine area; the audience was both French and German.

For this workshop aiming at developing the narratives, the *World Café* method has been chosen because it allows all participants to share their experiences and points of view in a simple and interactive way. This method constitutes a creative process designed to facilitate constructive dialogue and the sharing of knowledge and ideas (Slocum, 2006)[6]. First introduced in 1995 by Brown and Isaacs (2005)[7], it is inherently designed to be a participatory tool that facilitates community change by hearing the ideas and opinions of as many community members as possible. Furthermore, as a participatory method, it not only produces data for the researchers but also has the potential to benefit the participants, as it facilitates dialogue and mutual learning, thus motivating their participation and responses.

During the workshop, three scenarios were presented to the participants: 'Fluvial tsunami', 'Societal collapse' and 'Blackout'. Each scenario took place in three stages, concerning three different dates. The workshop lasted approximately 3 hours. Three groups were predefined to maximize the diversity of profiles and experiences within the groups. The three themes chosen for the narratives from the interviews formed the basis of this workshop. Each theme was explored in three 35-minute rounds. Participants were asked to envision and describe the world after such crises. Groups were rotated so that each participant could contribute to one stage of each scenario. Each stage corresponded to a specific time period: 2050, 2051, then 2025. The first date is the moment on which the crisis occurs (emergency issues are raised); the second concerns mid-term problems and solutions; the third means a return to the present: what can we do today to best prepare for problems "discovered" in the future, and prepare the future capabilities we want to have to react when the time comes?

The basic principle of the workshop is to share the knowledge and ideas of all participants for each of the narratives. Risk management is about striving for better outcomes. To achieve this, it is essential to identify various potential risks and understand their causes and

[6] Slocum, Nikki & Elliott, Janice & Heesterbeek, Sara & Lukensmeyer, Carolyn. (2006). Méthodes participatives. Un guide pour l'utilisateur. Bruxelles: fondation Roi ldots.

[7] Brown, J., & Isaacs, D. (2005). The World Café: Shaping Our Future through Conversations that Matter. San Francisco: Berrett-Koehler.

consequences. By proactively addressing potential future threats, organisations can better navigate uncertainties and achieve more favourable outcomes (Anderson, 2014)[8].

In the case of the IMMER project, the aim is not to determine a desired point to reach but to avoid a dramatic situation. By imagining a catastrophe scenario, we can backcast to find solutions to implement and improve the preparedness capacity of local organisations. Envisioning a worst-case scenario can help to identify critical vulnerabilities and potential points of failure within the system in case of crisis (this justifies the choice of very dystopian scenarios). The exercise allowed us to pinpoint specific areas where preventive measures are necessary. By distancing participants from the present, we fostered a more imaginative and unrestricted thought process. Initially, participants may perceive these events as more similar to science fiction than reality, which encourages greater creativity and exploration of unconventional ideas (Hennelly et al., 2015)[9].

The raw output of the workshop consists of the recordings of all the exchanges that took place during each round at each table, as well as the conclusion during which the moderators briefly summarized the stages of the narratives developed, accompanied by the participants' final remarks and questions.

Based on the interview findings and workshop results the following three disaster scenarios “Tsunami 2050", "Blackout 2050" and "Collapse 2050" were developed.

4.5.3.3 IMMER Lab Disaster Scenarios

Scenario 1 Blackout 2050

Figure 42: Visualisation IMMER Scenario Blackout 2050

[8] Anderson, E.J.. (2013). Business Risk Management: Models and Analysis. 10.1002/9781118749388.

[9] Hennelly, Patrick & Graham, Gary & Coles, Eve & Greenhill, Anita & Dymski, Gary. (2015). The Science Fiction Prototyping Framework: Building Behavioural, Social and Economic Impact and Community Resilience.

D-30 to D-1: Worrying signs

In the spring of 2050, the fragility of energy and mobility infrastructures is becoming increasingly apparent. The climate crisis is impacting energy production and distribution in particular, but also road, rail and river transport. The economic, political and social context is deteriorating, and the geostrategic situation is tense.

Day zero: Friday 13 May 2050

An unidentified organisation is targeting several key points on the electricity grid in France and Germany. Sabotage teams manage to infiltrate several power stations and detonate high-impact explosive charges. Major distribution points are also sabotaged and cyber-attacks are carried out simultaneously to maximize the destructive impact. Overnight, the entire system becomes totally inoperable.

A state of emergency is declared as uncertainty over the supply of electricity grows. Communication systems are out of order and information is no longer circulating, with the immediate effect of bringing the public authorities to a virtual standstill.

The weeks that follow

With the regional electricity system shut down, cooling systems are no longer functioning, rapidly rendering perishable foodstuffs unfit for consumption. Money is rapidly disappearing from circulation, leading to extreme levels of hoarding. Weapons and essential or survival products become more precious than money. The blackout leads to a reversal of value chains, and as money loses its value, exchanges of goods become the norm for obtaining goods. The barter economy emerges as the most appropriate exchange model.

Against a backdrop of unprecedented crisis, the food shortage becomes a crucial challenge in the space of just a few days. Populations are driven to the brink of starvation, forced to consume any food they can find to ensure their survival. The health situation deteriorates rapidly, with drinking water supplies severely compromised. This factor is exacerbating the state of a health system already weakened by the widespread power cuts. Access to hospital facilities becomes virtually impossible, while the number of patients continues to grow. Faced with a shortage of medicines, the mortality rate is soaring and some patients are becoming unmanageable. Against this alarming backdrop, a mass exodus begins. City dwellers, in search of vital resources, leave the urban centres or converge on the Rhine. The river becomes a favourite fishing ground, offering a source of food that does not need to be preserved. This migratory phenomenon testifies to the urgency of the situation and the survival instinct that now drives the population.

Crime is soaring, with a worrying upswing in criminal activity, with looting becoming commonplace. This unprecedented crisis leads to profound social changes, the struggle for survival becoming a daily reality for everyone. The social fabric is rapidly disintegrating, giving way to a hostile environment marked by daily scenes of violence. The atmosphere is heavy, imbued with the negative emotions that have come to characterize this decaying society. Faced with a shortage of energy, the inhabitants are forced to rethink the way they travel. Non-motorized means of transport make a comeback. The streets, once dominated by motor vehicles, are now bursting with cyclists and pedestrians. Even more surprisingly, horses are

returning to the urban landscape, bringing to mind an era thought long gone. This shift towards alternative modes of transport bears witness to the forced adaptability of a population faced with a major energy crisis. It also highlights the colossal challenges facing society in maintaining a form of mobility in this new world without electricity.

One year later...

In 2051, energy, and in particular electricity, remains a scarce commodity (with residents not connected to the grid and frequent power cuts).

The absence of electricity has different consequences depending on the seasons. In winter, heating becomes difficult, leading to deaths from the cold. In summer, the inability to cool homes leads to heat-related deaths.

The few infrastructures that have been reactivated produce a very limited amount of energy. Communication channels are still largely out of use, making telephones, computers and televisions obsolete. Alternative solutions for generating small amounts of energy are beginning to emerge: some people produce their own energy by pedalling, a few solar panels have been recovered and put back into service, etc.

The idea of using gas from Russia is also being considered, although the political consequences of this decision for the region are difficult to predict. The question of the intervention of the world's major powers, notably China and Russia, also remains uncertain. It is difficult to determine whether they will be prepared to help Europe or whether they will prefer to invade the region to control its strategic position at the heart of Europe.

Local communities, formed in the months following the blackout, have developed and are now the norm. Society is being organized at local level, which remains the easiest level at which to share information. People are organizing themselves to rebuild a society, although living standards are extremely low due to limited resources, and in some parts of the region conditions are dramatic. The will to rebuild a society is there.

Life expectancy has fallen sharply, medicines are in short supply and access to care remains limited. The risks of large-scale contagion from various infections circulating within communities are increasing every day. The fear of a pandemic is omnipresent, as populations are aware that the lack of medicines makes them particularly vulnerable to microbes.

After a year, inflation is very high, making all goods particularly expensive, because production was interrupted during the blackout and has not yet resumed. When it comes to clothing, for example, people are repairing what they have, and patchwork has become the only way of continuing to dress themselves. Food resources remain scarce, and the crops planted on the outskirts of the towns are still not enough to feed the entire population. A black market has developed for food products and weapons of all kinds, which are now highly prized.

Survival has become everyone's main objective, erasing the pre-crisis rhythm of life, divided between work and holidays. The entire population is now working full-time to survive. People continue to travel, but the state of the roads is deteriorating, making the bicycle, which has been widely used over the past year, less and less suitable. Some are choosing to move to the

countryside to grow vegetables and cereals to support themselves. While waiting for the first harvests, they pick berries. Others moved closer to rivers to fish, adding a source of protein to their limited diet. Eating habits are evolving so that they no longer depend on traditional means of preservation, as refrigerators are still out of use.

There has been a loss of knowledge transfer and training, with the closure of schools and all training facilities. However, despite the priority given to survival, the resumption of education for younger children is beginning to be considered. The teachers still present in the area are thinking about ways of restarting the transfer of knowledge and training for children. Hopes for reconstruction remain high, because over the last few decades, society has been able to cope with numerous crises and adapt. The majority of survivors are convinced that solutions will be found to rebuild after the great blackout of 2050.

The region is facing an unprecedented demographic upheaval. The blackout could lead to a radical transformation of the region's demographic landscape, according to experts. The extreme living conditions imposed by the situation could act as a powerful selection factor within the population. "We are potentially witnessing a form of natural regeneration of humanity," explains a demographer speaking on condition of anonymity. "Only the most resistant individuals will survive, which could, paradoxically, lead to the elimination of certain chronic diseases such as diabetes. However, demographic projections remain extremely uncertain. There are two opposing scenarios: on the one hand, harsh living conditions could lead to a significant decline in the population. On the other, the lack of contraception could lead to an unexpected demographic boom. "It's impossible to predict population trends with any certainty," admits one local official. "We're sailing in troubled waters, between a possible demographic collapse and a potential explosion in births."

Scenario 2 Tsunami 2050

Figure 43: Visualisation IMMER Scenario Tsunami 2050

D-30 to D-1: Worrying signs

Months or even weeks before the river tsunami strikes, the scientific measuring stations of the research institutes and meteorological services are already recording a clear melting of the permafrost and serious cracks in the structure of the glaciers. When the first ice caps break off (around 2 to 3 days before the tsunami reaches Strasbourg-Kehl), high-ranking politicians at national level in Switzerland, Germany and France are informed by the research institutes and civil protection authorities that the disaster is bound to happen. As soon as the first signs of a major mountain collapse appear, photos, videos and reports are disseminated via social media. This information is picked up by the news channels and made available to an even wider audience.

Hours before the catastrophic wave reaches our conurbation, panic quickly sets in, due to the news being widely disseminated by the media. Many of the inhabitants of Strasbourg and Kehl think only of fleeing - generally to nearby areas that are considered safe because they are significantly higher than the banks of the river. The people of Strasbourg rush to the Vosges foothills, or even further afield if they had relatives able to shelter them in the Vosges or other regions. Residents of Kehl do the same, heading for Freiburg im Breisgau or the Black Forest.

Day zero: Friday 13 May 2050

The anarchy generated by this panic causes most of the communication routes to be blocked, making the situation even worse. Furthermore, some flooded areas make the roads impassable, trapping some fugitives. Energy infrastructures such as power stations are affected, bringing most rail transport to a halt. Traffic lights are also failing, further disrupting road traffic - even in areas not directly affected by the flooding. Part of the radio network is out of action, disrupting communications, including mobile phones: people are no longer able to communicate with each other, and the public authorities are having difficulty disseminating safety instructions. As the production and trade are highly dependent on telecommunications (internet, AI...), ordinary economic life collapses. Soon enough, food supplies are in short supply. Among the other networks affected, the water network is disrupted, as treatment plants go out of service and distribution is disrupted, with at least two consequences: drinking water shortages for the population and pollution of land and river water downstream.

The weeks that follow

Some of the flooded industrial facilities are creating secondary disasters and adding chemical pollution to the environment - and even radioactive pollution, as the dismantling facilities at the Fessenheim plant have been affected and there is still radioactive material on site that has not been sent to national reprocessing/storage sites such as La Hague or the facilities in Meuse and Haute-Marne. As far as industrial safety is concerned, we'll know more when the inventory of the damage has been completed, but for the time being mistrust reigns, which is increasing panic among the population.

Essential public services are largely affected: hospitals, police, various municipal services, etc. In an atmosphere of panic reinforced by institutional chaos, selfish and cynical behavior is on the rise among the population. The safety of people and property deteriorates rapidly. The population naturally turned to the nearest authorities (Town Hall, Prefecture,

Regierungsbezirk, etc.), which were momentarily overwhelmed by the scale of the crisis. The self-organization of local residents makes it possible to minimize many of the individual and collective tragedies, but only very partially to resolve the countless problems that have arisen. Cross-border solidarity, which should be a key element in the response to the joint disaster, is not working very well in the short term.

What's more, the Rhine is technically becoming a hermetic border for local residents, which has a major impact on the thousands of cross-border commuters who normally cross it every day, separating families and so on.

One year later...

In 2051, a large part of the population of the Strasbourg-Kehl conurbation (the survivors) found refuge in communes in the region that were not been affected by the disaster. Makeshift camps were set up. Motivation and commitment were strong at first, but after a year, a certain weariness sets in and the refugees feel abandoned. Now that the town centers have been partially destroyed, the question of reconstruction arises. Some people suggest that former picturesque tourist areas should not be rebuilt identically. Can't we build something new on top of the rubble of the old, and thus increase future resilience by building higher (a city 5m higher) and differently (with new architecture)? The overall economic situation has deteriorated as the tsunami has continued its course towards the central Rhineland and Holland.

Many areas other than the Upper Rhine are affected, including populated and industrialized areas. In financial terms, reconstruction has been made difficult because insurance and reinsurance companies (particularly in Switzerland) are unable to fulfil their role. The aid that has poured in from the rest of the world has sometimes harmed more than it helped. Reconstruction policies are being implemented, bearing in mind that the population of Strasbourg has been partially relocated towards the Vosges mountains.

In addition to government intervention and European aid, inter-municipal cooperation appears to be crucial. Inland waterway logistics are picking up, but only to a very limited extent. Supply remains seriously disrupted for most goods, and we are relying heavily on short distribution channels, at least in the short term. The conurbation's energy supply needs to be completely overhauled as a matter of urgency, and many new solutions are being considered - solutions that will undoubtedly shape the future.

The rebuilding of communication routes (roads and railways) is also leading to a rethinking of the entire system to ensure greater resilience. The question of reindustrialization is being debated. Because of the scale of the losses, the insurance industry is having to rebuild and even reinvent itself.

Scenario 3 Collapse 2050

Figure 44: Visualisation IMMER Scenario Collapse 2050

D-30 to D-1: Worrying signs

In 2050, the Earth is already in a state of exacerbated vulnerability. The global economic crisis is dragging on, with growing inequalities driving an insurmountable gap between rich and poor. Politically, tensions between major powers such as the United States, China and Russia are reaching alarming levels. Wars are breaking out sporadically, accompanied by a migratory crisis to which Western governments, themselves experiencing issues, are struggling to respond. The social climate is one of anger, frustration and despair. Against this tense backdrop, the appearance of a virus of unknown origin in South America goes almost unnoticed.

It was only through videos posted on social networks that the world began to catch a glimpse of the growing threat. Individuals in the streets of small Amazonian towns are seen, clearly suffering from some kind of "rage". They are screaming, convulsing and relentlessly attacking anyone in their vicinity. This extreme and violent behavior is reminiscent of images of chaos, but its veracity is initially questioned. Many believe it to be fake news, fabricated to destabilize Western governments already on the brink of collapse. Yet the videos continue to multiply.

The experts are beginning to debate. Could this virus really be a mutant form of rabies? Some think it's a form of food poisoning, others evoke conspiracy theories, but the World Health Organization (WHO) is stalling, refusing to jump to conclusions. Meanwhile, behind the scenes, the virus is gaining ground. It is spreading rapidly through the affected populations, evolving until it becomes transmissible through saliva, making every human interaction potentially fatal.

Health systems in South American countries are overwhelmed. Governments try to conceal the scale of the disaster, but the truth emerges: the virus affects people in unpredictable ways, creating uncontrollable outbreaks of violence. The elites of some of the affected

countries, including senior government officials, contract the virus. The governance of these nations collapses, creating a power vacuum that precipitates further chaos.

Scientists are out of their depth. No treatment appears to be effective. Experimental therapies failed, and vaccines were developed as a matter of urgency, but the results were catastrophic. The virus, nicknamed "Lyssavirus50", became the obsession of the alternative media. In the space of a few weeks, the situation worsened: the first reliable information revealed that cases are appearing in Europe, Africa and Asia. The world's population is waking up to an unprecedented health disaster, but it may already be too late.

The economic, political and social context is deteriorating and the geostrategic situation is tense.

Day zero: Friday 13 May 2050

13 May 2050 is a day to remember. On that day, a global crisis erupted. What had previously been regarded as a conspiracy, an effect of disinformation, became a terrifying reality. The major news channels began to broadcast unbearable images from international airports over and over again. In Frankfurt, one of the world's major air hubs, the situation is spiraling out of control.

In Hall 2 of the airport, a video that has gone viral shows a group of passengers clearly affected by the virus. They are roaming the corridors, screaming and attacking anyone who comes near them. The violence is so brutal, so immediate, that many Internet users at first claim it is staged. But journalists on the scene quickly confirmed the authenticity of the video. Scenes of absolute chaos are repeated in airports around the world. Passenger flows, already colossal, become unmanageable. People, terrified, fight to escape from areas considered to be infected.

The symptoms of the virus are now well known: anxiety, confusion, hallucinations, fear of water and fresh air, but above all, unpredictable hyperviolence. Individuals attack their own family, friends and strangers, without any apparent logic. In airport lobbies, the first victims of this chaotic behavior are beginning to pile up. The authorities, overwhelmed, try to react, but the security forces come up against unexpected resistance. Some police officers leave their posts, refusing to face the threat. Security measures disintegrate. In Frankfurt, passengers break through the roadblocks, rush into the streets and the city begins to panic.

Shops, particularly pharmacies and food shops, are taken by storm. The fear of running out of resources, coupled with the behavioral amplification caused by terror, is leading to irrational behavior. Shelves are being emptied at an unprecedented rate. Hospitals, already saturated, can no longer cope with the waves of patients, and the authorities are considering, out of desperation, calling in the army. But even the military, aware of the uncontrollable nature of the threat, are reluctant to put themselves on the front line. The first cracks in the social fabric appear, as Frankfurt becomes the focus of a global crisis.

The weeks that follow

The first few weeks that followed are marked by a rapid infrastructure collapse. The major cities, once connected by a dense public transport network, come to a standstill. Subways,

buses, trains: everything stops. With no fuel in service stations, travel becomes impossible. It's not just the fear of the virus that is paralyzing people, but the total lack of transport and resources. The once crowded streets empty out, and an eerie silence descends, disturbed only by the sporadic cries of infected people still at large.

The population is divided into four distinct groups. The symptomatic infected, wandering and violent beings, are immediately ostracized. The asymptomatic infected, on the other hand, represent a more insidious danger, as they can transmit the virus without showing any visible signs. Those known as "at risk" - individuals who have been in contact with infected people - live in fear, dreading the appearance of the first symptoms every day. Finally, the uninfected, those who have been in contact neither with the infected nor with the virus, form a minority who try to protect themselves by all possible means.

The authorities, powerless, decide to take extreme measures. Quarantines are imposed in the worst-hit towns. Some areas are isolated behind barricades, sadly reminiscent of the confinements of the Covid-19 pandemic years, but this time the threat is much more direct and brutal. Armed militias are springing up in the deserted streets. These groups form spontaneously to protect the last remaining medical establishments, but also to prevent the looting that is becoming commonplace. Weapons, hitherto restricted to certain fringes of society, appear in the hands of ordinary citizens. Fear and mistrust turn cities into silent battlefields.

A state of emergency is declared in several countries, giving the forces of law and order greater powers. But the number of police and military available is decreasing daily, many having deserted or succumbed to the violence of the infected. Those who remain are forced to use disproportionate violence to maintain a semblance of order, which only makes the situation worse. Abuses of power multiply, and the very concept of the 'rule of law' collapses. Whatever trust remained between citizens and the state is eroding.

Energy infrastructures, in particular electricity, are no longer being maintained. In some regions, such as the Upper Rhine, electricity grids break down, plunging millions of homes into darkness. Refrigeration systems break down, and within a few days most perishable products are unfit for consumption. Faced with this food crisis, money quickly loses its value. Basic necessities - food, water, medicines, weapons - replace money in trade. Bartering becomes the norm. Supermarkets, looted in the first days of panic, are now empty, and hunger is driving people to desperate measures.

The Rhine, usually used for trade and transport, becomes a focal point for survivors. Whole families leave the urban centers, hoping to find food by fishing, or escape routes on boats. But the chaos extends to the water too: pleasure craft and commercial vessels are taken over by armed groups. Scenes of anarchy unfold along the riverbanks, and makeshift rafts tragically run aground, taking with them entire families trying to escape the nightmare of the cities.

Crime is exploding. The authorities no longer have the means to crack down on the growing number of crimes, ranging from simple theft to violent attacks on survivors. With resources running out, conflicts for control over the last food and energy reserves are multiplying. The omnipresent fear of the virus does not prevent the emergence of new social hierarchies based

on brute force and the ability to seize the most precious goods. In a world where the rules of civilization are disappearing, only the strongest and most organized survive.

The situation becomes untenable in the urban centers, and many survivors choose to flee to the countryside, hoping to find some form of self-sufficiency or simply food. Those who remain in the city try to organize themselves into small self-sufficient communities, barricading their buildings and helping each other to survive using the means at hand. Urban gardens are springing up constantly, but they are not enough to feed the starving population.

The social fabric, once complex and interconnected, is being torn apart. Schools, universities, businesses - everything that made up the structure of daily life - is gradually disappearing. People now have just one objective: to survive. And to do that, everyone is fighting with the means at their disposal. In this period of brutal transition, violence has become the norm, and every day dozens of lives are sacrificed to the brutality of a collapsing world.

One year later...

A year has passed since the collapse of society. The great metropoles, once vibrant with life and technology, are now nothing but empty husks, their skyscrapers torn apart by weather and riots. Silence reigns, disturbed only by the sound of a few survivors wandering around, looking for food or shelter. The virus, the rage that turned everything upside down, seems to have died out. The infected have all succumbed, their bodies rotting in the deserted streets. But the price was terrible: around 90% of the world's population perished.

The survivors are a tiny fraction of the human race. Many of them had close brushes with death, but never succumbed to the disease. These virus-resistant individuals intrigue the few remaining doctors and biologists. Rudimentary studies, conducted with paltry resources, are attempting to identify the factors common to these survivors. Is there genetic protection? Specific eating habits? Or just a stroke of luck? These questions are haunting our minds, but they remain unanswered, especially as the scientific infrastructure has been destroyed.

Life is now organized around small local communities, often cut off from the rest of the world. Self-sufficiency has become the norm. Groups of survivors grow their own food, make their own tools and try to recreate a semblance of order. Electricity has become an inaccessible luxury. A few pedal-powered generators and solar panels salvaged from ruined roofs provide energy, but this is not enough to re-establish life as it was before. The self-management model has emerged out of necessity, but it is not without its flaws.

Social tensions, once channelled by governments and laws, resurface violently. In small communities, democratic organization works well at first, but criticism soon emerges. Some people feel that decisions are too slow and that the redistribution of resources is unequal. Conflicts erupt, often for trivial reasons but revealing the deep rifts that continue to divide human beings. Resources, as rare as they are precious, become the object of covetousness. Armed groups form, battles erupt, and violence resurfaces.

Some survivors try to migrate. Loaded down with stolen food, salvaged fuel and gleaned medicines, they wander the ruined roads. But these roads have become dangerous places, infested with criminals and bandits. Gangs, born of post-pandemic chaos, rule certain territories, imposing their law by force. With no official government to oppose them, these

criminal factions thrive. The absence of centralized power has left a vacuum that the gangs fill, terrorizing small local communities and appropriating their resources.

Survival is mainly organized around local exchange systems. Money no longer has any value; only weapons, food and medicines still count. A black market is developing around these products, but the criminality generated by this system makes any attempt at trade dangerous. The value of weapons has soared, as each community seeks to protect itself against looting and attacks.

Life expectancy has fallen dramatically. Medical care is virtually non-existent, and medicines are in short supply. With no access to hospital infrastructure and faulty cooling systems, infections - both viral and bacterial - are wreaking havoc. Diseases that were once eradicated are reappearing, taking advantage of the weakened state of malnourished and poorly treated populations. Each new epidemic raises fears of a new pandemic, because the survivors know that they are particularly vulnerable without access to modern treatments.

The closure of schools and educational institutions leads to a massive loss of knowledge. The transfer of knowledge comes to an abrupt halt, and children grow up in a world where formal learning no longer exists. A handful of surviving teachers are trying to revive basic education for the youngest children, but immediate priorities such as survival are taking over. Yet hope persists. Some groups are thinking of ways to rebuild a society, even if the task seems titanic. They are convinced that, despite everything, humanity will be able to rise again.

However, a radical demographic transformation is underway. Experts cannot predict with certainty whether the population will continue to decline or whether, on the contrary, the disappearance of contraception could trigger an unexpected baby boom. What is certain is that the crisis of 2050 will leave an indelible mark on humanity, both in terms of population and social structure.

4.5.3.4 Workshop #2

On November 21, 2024, the second IMMER project workshop took place in Strasbourg bringing together representatives from private and public sectors of the Strasbourg-Kehl region. The aim was to take over the outcome from the first workshop (July 4th), refine it and use it to simulate a journey into the future.

Divided into three groups, participants addressed the disaster scenarios for 2050 that had been developed during the first workshop: "Tsunami 2050", "Blackout 2050" and "Collapse 2050". The goal was to immerse the participants in these three dystopian scenarios, examining key factors, discussing concrete resilience measures, and exploring identified threats and opportunities.

This method of fictitious time travel offers a better understanding of the issues at stake after having “experienced” situations in several dimensions (technical, political, but also emotional ones). It also serves as an effective tool for encouraging both individual and collective reflection on potential critical situations and fostering preparedness for resilience if needed.

The first phase of the workshop was devoted to immersion in the narratives. To reactivate memories and emotional connections to the scenarios, the current workshop utilized three

videos created by the IMMER team using AI. Two of the videos featured news anchors reporting on the events and conveying government instructions to the public. The third video, which introduced the Blackout scenario, depicted a car broadcasting information from a radio host—a deliberate choice, as in a blackout scenario, televisions and other online information sources would likely be unavailable. The objective of incorporating videos was to reactivate the participants' emotional responses. By providing vivid and dynamic depictions of the scenarios, the videos aimed to create an immersive experience that would foster deeper emotional and cognitive engagement. The videos can be accessed via the following link:

https://www.youtube.com/@user-wg8gz6cw8p

After this, each group began with the analysis of a "TOSA" (Threats, Opportunities, Stakes, Actions) framework adapted by the IMMER team. This framework served as a cornerstone of the workshop, guiding participants in systematically analysing critical aspects of societal resilience across a range of disaster scenarios. The TOSA analysis offered insights into how different sectors—such as energy, mobility, water, and social cohesion—might respond to and be impacted by the challenges posed in each scenario. By addressing potential threats, uncovering opportunities, identifying key stakes, and formulating actionable measures, the participants were encouraged to develop a nuanced understanding of the interdependencies and vulnerabilities within these systems. They were also encouraged to think creatively and immerse themselves deeply in the scenarios. The fields analysed included the above-mentioned but stressed also the role of information systems, and the processes of territorial self-organisation.

In the last phase, in order to establish a tangible and immersive synthesis of the TOSA-analysis of the different scenarios, three participants slipped into the roles of fictional personae. They went from scenario to scenario collecting from every group the necessary information and synthesised the scenarios from their point of view. After the workshop, this collected information has been transformed into narratives. The three distinct "personae" were: the Minister-President of Baden-Württemberg, the head of the disaster management unit, and a young, successful entrepreneur. Three participants that accepted to do so played these roles. The exercise aimed at identifying measures that each persona could implement in their respective role. At the end of this phase, each persona presented the proposed measures to the plenary session.

4.5.3.5 Results of the TOSA Analysis

TOSA Analysis for scenario Collapse

Threats:

- A societal collapse caused by a dangerous virus triggers widespread fear, isolation, anarchy, and violence, disrupting social order.
- Critical infrastructures such as food supply chains, water systems, energy grids, and communication networks fail, causing severe shortages and chaos.
- The rapid spread of the virus overwhelms healthcare systems, while panic and mistrust lead to non-compliance with safety measures.

- Supply chain breakdowns create scarcity of essential goods, unmanaged waste poses additional health risks, and nuclear emergencies arise from neglected maintenance of critical facilities.

These interconnected threats create a cascading crisis with devastating consequence

Opportunities:

- A societal collapse creates opportunities for a return to simpler, sustainable solutions such as manual water pumps, dry toilets, and transportation by horse, bicycle, or boat.
- Local communities strengthen as people build closer relationships with neighbours and form smaller, more connected social circles.
- Communication adapts through traditional means like church bells, reducing reliance on large-scale communication systems and fostering more direct, localized interactions.

This shift encourages resilience through practical, low-tech solutions and deeper social bonds.

Stakes:

- A societal collapse imposes critical challenges centred on energy dependency, with shortages arising from insufficient production.
- A high infection rate paralyzes essential services due to a lack of healthy personnel.
- Governance faces a dilemma between enforcing authoritarian rules or adopting more flexible measures based on evolving needs.
- Mobility decreases to limit the virus's spread, while secondary needs vanish as survival becomes the primary focus.
- Urban areas empty as people limit their movements, leading to reduced population density.

These pressing issues require decisive action to maintain a minimal level of societal functionality.

Actions

- In terms of energy and communication, communities could rely on individual batteries, autonomous energy sources, satellites, old communication systems like radios and Morse code, and local newspapers.
- For water and food supply, water purification tablets, activated carbon filters, and localized food production within a 5 km radius could ensure a basic survival.
- Transport and mobility could be maintained with cargo bikes, trailers, and even steam engine technology.
- Local cooperation becomes essential through shared toilet facilities, community information relays, and simplified bureaucratic procedures for cross-border collaboration.
- Practical aids such as survival brochures and local beer brewing could support community resilience.
- A legal framework should include clauses promoting local autonomy during emergencies, enabling communities to manage crises more effectively.

TOSA Analysis for Scenario Tsunami

General remarks

- We should not treat this crisis by silo thinking since it's all systemic and therefore all interlinked; cascade effects have to be taken into consideration!
- The basis of all actions should be Maslow's pyramid of needs (i.e. considering the hierarchy of needs, from the very basic and urgent ones like food, shelter, etc., to the upper levels like self-esteem, creativity, etc.)

Threats (mainly in the short term)

- Almost the entire energetic infrastructure is concerned, with impacts on all services (from transportation to hospitals…). Survival is threatened. Note that the impact would probably be different between the beginning and the end of the scenario
- Destruction of the mobility infrastructure
    - Impact on public health:
    - Water pollution, that can threaten public health (impact on the drinking water system)
    - A lack of drug supply (medications) can also threaten public health
    - Cold chains of groceries are threatened to break down

Opportunities (at longer term)

- Development of new technologies in the energy sector
- Opportunity to reconstruct the territory in a less dense way and as a more decentralised system – developing therefore more resilient solutions to future crises
- Establishing autonomic mobility structures
- Strengthening of the values of autocracy, self-organisation and solidarity

Stakes

- The supply with groceries, medications and fuel is at stake
- Medical care is a central issue
- Supply of electricity and gas
- Pure survival of people and enterprises
- People are locked in one place and cannot move due to the broken-down mobility system
- Finding the right balance between the mobility of civil protection actors and the mobility of inhabitants
- The role of longer-distance mobility networks

Actions

- Setting up of (heated) evacuation centres that provide food, drinking water, medications and cloths (and all basic needs considered in the Maslow's pyramid)
- Establishing decentralised energy structures and/or resilient networks
- Increasing energy autonomy, efficiency and also self-sufficiency
- Increasing the stock of public boats and alternative mobility devices

- Training of civil protection agents (for instance in the supply of drinking water)
- Public actors have also to be active in social media.
- Development of tools to strengthen social cohesion and solidarity
- Education of resilience and solidarity from early ages on
- Implementing civil communities dedicated to civil protection (like the Community Emergency Response Teams (CERT) in San Francisco -> Community Emergency Response Team (CERT) - City of South San Francisco)
- Individual stock keeping of physical money (cash)
- Establishing structures of engage and coordinate volunteers
- Establishing coordination structures for the reconstruction work
- Establishing a register with vulnerable people and people with special needs in every municipality (exists in Kehl already)
- Setting up cooperation structures between hospitals in Germany and France

TOSA Analysis for Scenario Blackout

General remarks:
For some participants it has been hard to think that such a blackout could happen.

Threats

- Without media, only direct communication is possible, isolating communities.
- Religion gains influence as people seek structure and hope.
- Energy-free transport (bicycles, walking) limits mobility.
- Reliance on wood for cooking and heating leads to deforestation and air pollution.
- Nuclear plants risk failure, contaminating water and the environment.
- Hospitals fail, causing mass casualties from untreated conditions.
- Contamination and poor sanitation create widespread disease and stench.
- Security and social order deteriorate, violence increases, law of the strongest prevails.
- Self-supply theft: Scarcity of resources forces people into theft and looting, destabilizing communities further and eroding trust.
- Ownership/property is now unprotected, deepening social instability.
- Cities become ghost towns, while survival is easier in the countryside, straining rural resources.

Opportunities

- Dynamo generators and bioenergies (biogas, hydroelectricity, solar power) offer renewable energy solutions.
- Energy-free mobility options (river transport, horses, bicycles) become essential.
- Battery-powered radios, Morse code, smoke signals enable information sharing. Due to the specificity of the region, multilingual tools might be developed to share information more broadly.
- Libraries and community boards provide knowledge, know-how and real-time updates.
- Swap systems replace money, fostering local exchanges of goods and services.
- Smaller groups and town-countryside networks strengthen community resilience.
- Repairing items and valuing craftsmen become essential, shifting societal priorities toward practical skills.

- Urban areas may provide better health protections, keeping some people in towns despite challenges.

Stakes

- Access to filtered water ensures survival and hygiene.
- Churches and religious values foster social cohesion, becoming meeting points for communities. However, these spaces may also heighten tensions between groups.
- Self-organization based on individual skills (e.g., first aid, barter systems) empowers communities to adapt.

Actions

- Decentralization of energy systems, including solar-powered mobility and mill restoration for energy production.
- Water-saving policies, wastewater treatment, and creative cooling solutions (e.g., subterranean/clay coolers).
- Fitness and health initiatives to reduce population vulnerability.
- Weed supply for stress management, reducing violence during crises.
- Crisis communicators in neighbourhoods to share information and provide first aid during emergencies.
- Survival kits and plans, with survival classes in schools teaching farming basics and foraging skills
- Development of urban farming, recycling plants, and robust local supply chains to create circular economies.
- EU or state-owned resilience funds for proactive crisis planning.
- Initiatives to increase trust in authorities and ensure reliability during crises.

The actions could be resumed as follows: training, education, decentralisation and relocation.

How can we get crisis preparedness for governments, children and for the overall society ?
How strong can the solidarity of the community be in case of a crisis ?
What could be the points where we could see that influence factors will turn positive ? Comparing an optimistic view with a pessimistic one to see what could be different.

4.5.3.6 Synthesis of the scenarios by fictional personae

In order to establish a tangible and immersive synthesis of the TOSA-analysis of the different scenarios, three participants slipped into the roles of fictional personae. In the last phase of the workshop, they went from scenario to scenario collecting from every group the necessary information and synthesised the scenarios from their point of view. After the workshop, this collected information has been transformed into narratives.

Persona A

I'm Mats-Benjamin, a young entrepreneur from the Kehl-Strasbourg region. My vision has always been to create something meaningful - a business that is not only economically successful, but also really helps the people in my home region. But the world I live in has

changed radically. There is no longer any normality, challenges that my generation could hardly have imagined. Three scenarios in which I have to find my way around drive me to develop creative solutions and break new ground.

The blackout

The world I knew collapsed one day. No electricity, no mobility with petrol or diesel engines. Suddenly bicycles and our own feet were the only means of transport. Clean drinking water? Rare. Medicine, food? In short supply. In my neighbourhood, people began to grow their own food, often on the outskirts of the city or in small gardens. But the greatest needs remained: water, electricity, security and medical care.

There was no longer any centralised leadership, only local leaders in small communities. Without clear rules, the law of the jungle was the order of the day. I sensed that people were desperate for stability and security.

I saw my opportunity here. I started to look into the circular economy and sustainable production. I organised small communities that used their resources efficiently and worked to build stable food sources. It wasn't easy - every decision had to be well thought out. But in the midst of the chaos, my business grew. I was not only a trader, but also a bridge builder, creating trust and structure.

The river tsunami

The tsunami came unexpectedly and left a trail of destruction in its wake. After a while, communication was possible again thanks to private initiatives such as Starlink, but the roads and railways were unreliable. The Rhine was the only stable transport link out of our region.

I quickly realised that people needed basic infrastructure - roads, houses, drinking water facilities. Official cooperation with the authorities was almost impossible. Corruption was the order of the day. Instead, I sought direct contact with local leaders and found ways to work with them informally.

With high unemployment in the region, I had a large, cheap labour force at my disposal. I founded a construction company that helped with reconstruction - bridges, drinking water systems, safe living spaces. The problem of financing was huge, but I learnt to allocate resources wisely and to find creative solutions together with the people.

The social collapse

It was the worst nightmare. No electricity, no telephones, hardly any security. Hygiene was catastrophic, diseases were spreading and people's labour was dwindling. Mobility was severely restricted as the Rhine acted as an insurmountable barrier.

I saw how people began to grow their own food - uncoordinated and inefficient. There was no trade, no money, no markets. Everything came down to bartering, and yet there was mistrust everywhere.

That was my turning point. I started to create small networks of farmers, coordinated their work and installed decentralised food markets. We traded with what we had - services, goods, sometimes just mutual trust. It was not about financial profit. The real profit was in the power of building a community and giving people back a piece of hope.

Three scenarios, three challenges, but also three opportunities. I have learnt that innovation and community spirit can emerge in the midst of chaos and destruction. My goal remains to make the Kehl-Strasbourg region a place where people have a perspective again - no matter how dark the times are.

Persona B

I am Lydia Muller, head of the civil protection unit of the Eurometropole Strasbourg. My life is a constant balancing act between disaster management and the responsibility to protect the lives and safety of thousands. Every crisis brings new challenges, but also new opportunities to make the most of resources and create structures that can withstand even the most difficult times.

The blackout

The sudden power cut hit us like a slap in the face. No electricity, no mobility, no communication - society fell into darkness. But it was precisely in this darkness that our commitment shone brightest.

My first step was international communication. I activated emergency channels to ensure that we were not isolated. At the same time, we installed satellite phones for citizens to ensure at least minimal security and alleviate the worst fears.

A blackout also means that the law is often temporarily enforced more strongly to prevent chaos. But I knew that we had to rethink the structures of civil defence afterwards. This crisis was an opportunity to rebuild people's trust in our organisation and create a foundation for future resilience.

The river tsunami

The tsunami was a catastrophe that affected us all deeply. But it also brought a key realisation: our previous centralised structures were not sufficient to react quickly and efficiently.

My strategy was clear: we had to decentralise resources in order to be able to help people on the ground more quickly. I organised a network of local coordination centres that were in close contact with the communities. It was essential to network the stakeholders - from volunteers to international partners.

Thanks to the European Civil Protection Mechanism, we were able to mobilise help from other countries and dovetail it effectively with our own measures. Communication was key, and I made sure that everyone involved - from mayors to international organisations - was in constant communication.

The social collapse

The collapse of society was the most profound turning point in my life. Without functioning state structures, chaos broke out. Diseases spread rapidly and the gap between infected and non-infected people became a potential fuse for violence.

I knew that we had to restore order. First of all, I reactivated the civil defence to prevent possible confrontations. It was a race against time to get medicines and medical supplies to the region. Emergency plans for such cases that I had once regarded as purely theoretical suddenly became a lifeline for the population.

Communication was another challenge. Without telephone networks, contact with the communities was almost impossible. So we set up a system of civilian relay groups to relay information and instructions. Every step was designed to give people hope and structure as we laid the foundations for a return to stability.

My goal was and is to protect people, no matter how big the challenge. In every crisis, I see the opportunity to grow and learn from the mistakes of the past. I have learnt that civil protection is not just about responding to disasters, but also about giving people hope and a perspective. Together, we can survive any crisis - and emerge stronger

Persona C

I am Merdan Von Otto, Minister President of Baden-Württemberg. In times like these, my task is clear: to ensure security, stability and hope for the people of our country. These crises that have hit us are unprecedented, but I am determined to lead the population through these challenging times.

Safety comes first

From the moment the crises hit us, my top priority was the safety of our citizens. Every action, every decision we take at a political level has one goal: to protect people. Whether by securing food, providing medical care or maintaining order - my job is to lay the foundations for a functioning society, even in the midst of chaos.

Coordination and communication

One of the biggest challenges was logistics. The transport of goods, be it food, medicine or other essential resources, was completely taken over by the public authorities. I made sure that our country had sufficient alternative means of communication, such as satellite phones, to stay in touch at all times - both with the population and with international partners.

Every measure has been carefully planned and we have a clear goal in mind: not only to inform people, but also to strengthen their trust in the government. In these times of uncertainty, it is crucial that people know that we take their concerns seriously and act decisively.

Health and social cohesion

The health of the population and their families is particularly important to me. We have done everything we can to ensure that medical facilities are functioning and medicines are available. At the same time, I was aware that this crisis would not only bring physical challenges, but also psychological ones. That's why I focussed on clear and empathetic communication to alleviate fears and create confidence.

The strength of our country lies in its cohesion. This crisis have challenged us all, but it has also shown what we are capable of doing together. My message to the population is clear: we will overcome this crisis together. Every step we take brings us closer to the goal of regaining stability and normality.

Baden-Württemberg has always been a role model for innovation, strength and solidarity. Now, too, we will show that we can put these values into practice. Together, we will not only overcome the crises, but also emerge from it stronger.

Analysis of all insights resulted in the following lessons for the future per scenario:

4.5.3.7 Lessons from the future scenarios

Lessons from the future Scenario 1 Blackout 2050

A prolonged blackout is a much-feared scenario because it paralyses all aspects of society. Communication systems cease to function, making the transmission of information impossible. Governments, deprived of their means of communication, become powerless and threaten to collapse. Society as a whole is profoundly affected: essential infrastructures, public services and everyday lifestyles are turned upside down. Without electricity, the consequences are felt in all areas, from health to food safety and social relations. In short, the blackout leads to total disorganization, jeopardizing people's survival and well-being, and revealing the extent to which dependence on energy is key to maintaining order and stability.

Having imagined this situation in 2050 and its consequences in 2051, the measures that seem appropriate to put in place in the coming years are as follows.

1. The main short-term problem is organizing emergency resources and ways of communicating with the population when all digital resources are out of order. As companies are currently very dependent on electricity-powered technologies, action to reduce this dependence would be beneficial in the event of a crisis impacting the energy production system. To do this, simulate a prolonged power cut or a cyber-attack that renders the communication network unusable, to see how it would be possible to operate without digital tools and thus be able to ensure communication and minimal activity in the event of a crisis.

2. In order to be able to continue working and producing in the event of a prolonged power cut, we can propose a day without computers in each company, to be set up at a certain frequency in order to develop habits and networks of people who can be mobilized in the event of a crisis.

3. To be more responsive and resilient in systemic terms, we need to be less specialized. As far as energy is concerned, various proposals emerged. Building smart grids now is

one of the ideas discussed. Turning to decentralized energy production infrastructures - which do not require human intervention - redundancy of energy systems. A key element appears to be the diversification of energy supply sources. Having different energy production systems running on different raw materials (gas, uranium, oil, solar, wind, etc.) is one way of ensuring a certain level of energy supply in the event of a crisis. The development of renewable energy units which would supply the system in normal times but which would have the capacity to supply more energy in the event of demand. This could lead to the creation of excess energy capacity.

4. Increase investment in local initiatives. In particular, the construction of networks of people who are key to local and regional resilience. In the event of a crisis, the local level appears to be the most crucial for the populations affected. It is therefore essential to strengthen crisis management capabilities at local level. A local authority must know how to react, protect its population and ensure its long-term survival.

5. The state is currently facing the challenge of its credibility in crisis management. A key issue in this is the often distant decision-making process, which does not always take the specific circumstances on the ground into account. Since decision-makers are usually not directly confronted with the crisis, decisions may often be less well-suited to the situation – in contrast to mayors and local organizations working on-site. A stronger involvement of local actors in the decision-making processes, as well as targeted provision of resources and training, could contribute to noticeable improvements.

6. Sharing agricultural knowledge could be an essential element of resilience. To achieve this, we need to ensure that every inhabitant has access to a growing area. Having access to basic agricultural knowledge could make our highly service-oriented societies less dependent on imports, while at the same time promoting and preserving ancestral knowledge. This approach would promote self-sufficiency and strengthen the ability of communities to survive and prosper in difficult conditions. By disseminating this knowledge, we could build a more resilient and sustainable society in the face of future challenges.

7. To develop a more resilient healthcare system, it is crucial to secure means of communication, even in the absence of conventional resources such as electricity. This means using robust, autonomous technologies, such as satellite communication networks or low-power radio systems, to guarantee continuous communication. In addition, back-up solutions, such as portable solar generators and long-life batteries, can keep intelligent systems operational during a blackout. The creation of an intelligent system must also include data backup protocols and manual procedures to ensure continuity of care, supported by autonomous medical devices and renewable energy storage infrastructures.

The measures proposed here are not only a means of avoiding disaster, but also of responding as effectively as possible to the consequences of a similar crisis. These two visions of resilience are complementary. Despite the negative consequences mentioned by the participants, it was emphasized that such a scenario could also have positive aspects. For example, CO2 emissions

could be considerably reduced, which could ultimately reduce the frequency of natural disasters linked to climate change.

Lessons from the future Scenario 2 Tsunami 2050

Having imagined this situation in 2050 and its consequences in 2051, the measures that seem appropriate to put in place in the coming years are as follows.

1. Carry out a complete review of territorial weaknesses in the event of a serious crisis such as this tsunami. GIS (Geographic Information System) documents need to be produced, with risk mapping. Precise evacuation plans for residents potentially at risk need to be drawn up, and there needs to be communication on the subject.
2. Thinking about the relationship between geographical scales. External aid, such as that from Europe (RescEU) and the rest of the world, must be better coordinated and managed locally. There is a risk that cross-border cooperation will be ineffective if it is not seriously thought through before the disasters strike.
3. Crisis management must be the subject not only of in-depth studies but also of training exercises. Local authority staff are the first to be involved, but this does not mean that the population at large should not be prepared/educated, especially young people... because they are the ones who will be living in the future.
4. The use of modern technologies, such as computer modelling or artificial intelligence, in crisis management should support crisis management in all phases (before, during and after the crisis).
5. Whatever the form, the documents to be made available to the population (crisis manuals) must be adapted to the various categories: residents, public authorities, factories, businesses, etc.
6. Implement ecological measures now to minimize the effects of future disasters such as major floods and associated pollution: reforestation, replanting hedges, water expansion areas such as polders, etc. Tighten up the regulations applicable to industry.
7. When it comes to town planning, check that all precautions have been taken.
8. Crisis management needs to be part of a common body of knowledge, but an institution like the EU is a central player in devising and disseminating basic ideas in this area. At the same time, the exchange of best practice between states should be encouraged - and the Upper Rhine area is a model for this.
9. Sociologically, finding a way to strengthen the sense of solidarity.
10. Politically, to improve multi-level coordination, because crisis management involves both local governance to a very large extent and many resources that are organised nationally (or at Land level in Germany).
11. At cross-border level, set up joint warning systems. This is not only useful in the event of a crisis, but also now, because it forces us to think about the interfacing of national systems and the exchange of ideas.

Lessons from the future Scenario 3 Collapse 2050

Having imagined this situation in 2050 and its consequences in 2051, the measures that seem appropriate to put in place in the coming years are as follows.

1. Companies need to anticipate digital system failures. It seems crucial to develop analogue alternatives, such as low-power radios and satellite communication networks. Regular simulations of power cuts or cyber-attacks will make it possible to test the resilience of infrastructures and guarantee minimal communication in the event of a crisis.

2. To prepare people to function without digital tools, a "digital-free week" could be introduced in every workplace. This would make it possible to develop non-digital skills and strengthen human collaboration networks, thereby ensuring business continuity in times of crisis. This educational approach could be initiated at primary school level.

3. It might be useful to set up a "know-how database" at local level, stored on analogue media so that it can be accessed at any time (such as microfilm), which would bring together multi-purpose skills essential to collective survival. This directory will provide access to vital knowledge in the event of a power failure. At the same time, an inventory of local skills should be compiled to facilitate the efficient redistribution of tasks in times of crisis. This would enable "task shifting" between citizens, ensuring the flexibility and resilience of the local workforce. This inventory should be regularly updated to reflect population movements and the acquisition of new skills.

4. Investment should be made in local and renewable energy sources. These infrastructures, which are autonomous and decentralized, must be capable of operating in times of crisis without human intervention. The creation of energy overcapacities would make it possible to supply energy in times of increased need.

5. Crisis management should be partly decentralized to enable local actors to react quickly. Mayors and local organizations must be trained in crisis management, and resources must be allocated to them so that they can take decisions adapted to local realities.

6. Each housing unit should be able to produce its own food. Basic agricultural knowledge could be disseminated among the population to reduce dependence on imports and agri-food industries. This would strengthen the self-sufficiency and resilience of communities.

7. It seems imperative to promote consumption practices that limit environmental degradation and the spread of zoonoses. Encouraging frugality, such as reducing meat consumption, and raising people's awareness of environmental issues would help minimize the risk of future pandemics.

4.5.3.8 Workshop #3

This third and final workshop of the IMMER project, on 13 March 2025 at the Port du Rhin (Kaléidoscoop), brought together 25 participants who worked in two groups (discussion

tables) of comparable size: 13 people for the French-speaking table and 12 people for the German-speaking table. The half-day discussion was structured in three stages: (1) the possibility of setting up a strategic ‘neoportolan’ (a dynamic pilot chart collectively written) to describe the challenges of future crises and the corresponding forms of resilience in the area; (2) the dissemination of narratives to prepare all residents; (3) the design of resilience ‘kits’.

At the start of the workshop, on the basis of the first two workshops, a reminder of the objectives was given in order to prepare for the project's follow-up after the official end of the contract, and a forward-looking tool was proposed, called the ‘neoportolan’. Historically, between the 13th and 17th centuries, portolans were nautical and coastal charts used by ship pilots, especially in the Mediterranean, to navigate from one port to another with maximum safety. These charts were regularly corrected and added to. They were evolving documents co-constructed by a community of practice (that of ship pilots and captains), crossing the boundaries of the specific organisations that were the ships and even the shipping companies that chartered them.

The proposal to the IMMER project partners is to launch a territorial ‘neoportolan’ project: a cartography of the near or distant future, regularly rewritten by the stakeholders. The results of the discussions held as part of the IMMER project must not remain frozen as a snapshot of knowledge and practices at a specific date. The previous workshops enabled us to sketch out the beginnings of a landscape of risks, vulnerabilities and possible forms of resilience. They also brought together a cross-border community of stakeholders concerned by the subject. It therefore seems crucial to examine the feasibility and desirability of perpetuating a network of neoportolans, by exploring the potential existence of evolving networks of actors in various fields, as well as their current or future capacity to become cross-border. The computerised neoportolan system is certainly central, but physical exchanges remain a very effective way of bringing people together, hence the idea of regular meetings. A form of secretariat needs to be found to convene the network's experts and produce the summaries to be posted online. As for the IT support, it would be of the Wiki type, with texts containing many links referring to multiple related fields, and which must be revisable by the users themselves according to rules to be defined.

The second step of this workshop was about the dissemination of the narratives. Disseminating information to the public at large in the event of a crisis is a real issue. The credibility of those who design content for the public is at stake. Good practice dissemination kits already exist in some areas. The issue is perhaps to network these various specific systems. Certain documents, such as the mapping of risk areas, already provide for territorial anchoring. This type of information is provided, for example, when you buy a property. But the question is: who actually reads it, takes it into account and, above all, remembers it?

The third step of this workshop concerned the development of resilience kits that could be shared with the population of the Strasbourg-Kehl area. A resilience kit is a set of tools and methods designed for one-off and possibly recurring interventions. The aim is to strengthen anticipation and crisis management capabilities.

4.5.4 Achievements

After the first workshop, each narrative resulted in a document of a few pages written by the IMMER team. After the development of three narratives, it has been possible to spot common points between each of them in terms of immediate consequences of the crises, of consequences of the crises one year later and of measures to take in the next coming years to be better prepared to face future crises. This highlights the need for effective crisis management strategies, including preparedness and response plans. During the first step (the situation at the moment of the crisis), each scenario emphasizes a challenge in terms of communication with the population that might lead to a lack of trust in the government and that might lead to social tensions. Regarding measures that could be taken in the coming years, the "societal collapse" scenario deals with training programs and crisis management skills, the" fluvial tsunami" scenario emphasizes comprehensive evacuation plans, and the "blackout scenario" focuses on municipal crisis response systems. All three scenarios emphasize the importance of building smaller, self-sufficient communities. The "Societal collapse" narrative mentions smaller, self-sufficient communities that build resilience, as does the "Blackout" one, which emphasizes smaller, resilient units. Local food production is seen as an essential measure of resilience. Reducing dependence on imports and ensuring that communities have the knowledge and resources to produce their own food strengthens resilience by securing a vital resource.
The second workshop aimed to test a foresight method using narratives in order to think very realistically about what the future could look like in many details, and to put at work various stakeholders from France and Germany together (located in the Strasbourg-Kehl area). The operation fulfilled the objectives, in the sense that:

- the staging of the three catastrophic scenarios revealed a rich variety of issues and solutions (a considerable added value compared to the June 2024 workshop);
- the participants demonstrated a high level of engagement, which suggests that the goal of motivating them to take actions was also met.

The workshop also performed well on the operational level in terms of communication. Major steps have been achieved in English, but a significant proportion of the discussions was in both French and German languages. The synthesis of the workshop can be found in the appendix.
The main achievement of the third workshop was that the notion of neoportolan was favourably received. On the other hand, none of the participants mentioned the existence of anything resembling this in the field of resilience to major crises. Numerous requests for clarification also emerged from the discussion.

Various ideas were discussed concerning the neoportolan project:

- Creation of a prototype by two municipalities cooperating as part of a twinning arrangement.
- Building on existing institutions that have a geographic information system or could develop one, such as the Strasbourg-Ortenau Eurodistrict.
- In the port sector, building on cooperation projects such as between Strasbourg and Kehl or the *Central Commission for Navigation on the Rhine* (which concerns 5 countries).
- Large private companies, particularly in the insurance sector.

- Institutional cooperation (Baden-Württemberg Ministry of the Interior and Strasbourg Prefecture; Upper Rhine Conference, etc.).

Policy impact

Narratives can indeed be a powerful option for enabling economic actors to anticipate and prepare for medium and long-term risks, ultimately contributing to more effective crisis management strategies. This structured approach helped to visualise the potential impacts of future crises and facilitated the development of proactive strategies to mitigate these impacts and strengthen the region's resilience. In this particular case, the four main action points are: strengthening communities, reinforcing communication channels, continuously improving existing crisis management strategies, and strengthening links between neighbouring regions to enable joint recovery.

The results reflect the collaborative effort of the workshops' participants, who were tasked with thinking creatively and critically about the cascading effects of disasters. The insights generated through this process could provide a basis for developing strategies about risk mitigation, harnessing opportunities, and building resilience in critical cross-border societal systems.

Almost all policies and facilities are concerned with the potential radical crises, and therefore the solution is not a specific resilience policy, but transversal actions (every policy must be adapted).

In sum, it can be concluded that policies should encourage the use of diverse and extraordinary communication channels during crises to ensure public engagement. Addressing the challenges of awareness, information, and trust is crucial for effective crisis management policies. Policies should also focus on building trust between the public and crisis management authorities to enhance the effectiveness of communication efforts.

4.5.5 Lessons learnt

First workshop

Despite their advantages, participatory observations also have their disadvantages. Likewise, answers to the questionnaires offered to participants following the workshop may have been influenced by their understanding of the questions and, more particularly, by their willingness to provide honest answers. About obtaining honest answers, asking for the respondent's organisation and name may have prompted some participants to answer positively when they were thinking otherwise. An anonymized questionnaire might perhaps have been appropriate to gather the most honest observations possible in this case. Finally, it is important to keep in mind that the working sample contains only 20 individuals. The workshop participants are certainly not representative of all the actors concerned by the long-term risks associated with energy and mobility issues within the Upper Rhine region. This small sample size may have introduced a bias into the data collected.

It has been possible to observe that the involvement of the participants differed from a person to another sometimes which may have represented a less diversified output for the narratives. But also, as said before, while organizing such workshops, it is common that some participants talk less than other. A result that is not directly concerning the narratives output but their development process. Some participants said during the conclusion of the workshop that they were very sceptical at the beginning but that during the first step they began to find the exercise fun and got caught up in the game and found the results interesting. This point

is important as it enhances the potential of the use of narratives to make people contribute. It proves that developing narratives is not that complicated for the participants and that the output event when people are not specialized in what they are developing can be relevant to anticipate long term crises and their consequences.

Second workshop

We pinpoint the place of creativity and imagination within foresight processes highlighting their role to develop future scenarios and narratives that take into account the diversity of the actual environment and consider a wider range of possible risks.

The workshop revealed many details concerning the behaviour people should adopt in situations of extreme emergency, and highlighted the importance of policies to be started right now for preparing the citizens: educate and train young people early on; plan for redundancy of certain equipment; designate persons responsible for missions in the event of a crisis; etc.

Third workshop

The use of narratives in conjunction with other analytical tools can significantly enhance the ability of an organisation or of a group of organisations to prepare for and mitigate future risks, fostering more resilient and adaptive organisations in the face of evolving challenges.

The cross-border dimension involves a number of additional difficulties, as experience shows that it is more difficult than one might think to create perfectly homogenous maps in terms of content extending to both sides of a state border. Statistical systems, for example, cooperate only partially, and the same concepts do not always correspond to the same realities. From this point of view, it was pointed out that the Upper Rhine area has a valuable institution, which is the *GeoRhena* geographic information system - whose mission is to collect, assemble, harmonise and disseminate as Open Data various thematic data on the trinational Upper Rhine area.

To be credible, stories or narratives must contain facts. Recipients must feel part of a resilient community. They must also be encouraged to communicate with other citizens. A culture of resilience must be developed from a very early age. In a cross-border context, inter-school meetings could be envisaged.

Regarding resilience kits, there are already platforms for creating and distributing them. In Germany, there are the '*dein Ort*' and '*Nebenan*' applications. We could start to develop other platforms, particularly cross-border ones. Prototypes would be desirable, for example based on natural examples of twinning (between towns, between Rhine ports), at the initiative of institutions whose basic mission is cross-border (Eurodistrict, Upper Rhine Conference). The European LEADER network was also mentioned.

4.6 LIQUIDHOUSING Lab

Abstract
The primary goal of the pilot project was to examine and better understand the phenomenon of liquid housing—characterised by the notion that almost anything can be considered “adequate housing,” including squatting, illegal subletting, short-term rentals, overcrowded or substandard housing, and vacant dwellings—in the intermediate city of Tarragona, through an interdisciplinary and international approach.
To this end, the project has successfully raised awareness of the liquid housing phenomenon and engaged institutions with diverse perspectives on housing. This has enabled a balanced discussion that acknowledges both housing as a human right and as a financial asset—an essential foundation for the viability and success of future housing policies. The project has also considered the specific characteristics of the groups most affected by this phenomenon and has developed a total of 20 policy proposals, grouped into five main categories: (1) Housing Policies; (2) Cohabitation Initiatives; (3) Governance; (4) Social Housing Management; and (5) Integration and Training Policies. These proposals aim to support policymakers in addressing the issue from a holistic perspective. Seminars, academic papers, and policy briefs will be produced to disseminate the project's findings.

- Local Partners: University of Rovira i Virgili and University of Galway
- Mentors: Polytechnic University of Cartagena and Foresight Centre

4.6.1 Description of the lab

Tarragona Lab aimed to provide empirical evidence, raise awareness and propose solutions to address the complexity of the “Liquid Housing” phenomenon in the city of Tarragona, a concept stemming from these crises and characterised by the idea that almost anything can be considered “adequate housing”. It addresses various forms of liquid housing (squatting; illegal subletting of housing; short-term -excluding holiday rentals- rental accommodation, forced shared of rooms, overcrowded or substandard housing, and vacant dwellings) at the local level, a challenge seen across Europe, impacting the right to housing and human dignity. The overarching objective of the pilot is promoting access to affordable and social housing.

To achieve this, the project aimed to **provide analytical insight** into the patterns and dynamics of “liquid housing”, **enrich co-creation and participatory processes** for planning, while fostering engagement of multi-level stakeholders and empowering citizens in addressing the "liquid housing" phenomenon, provide local and regional policymakers with **solutions based on best practices** to support the **implementation** of affordable and inclusive housing policies to address the “liquid housing” phenomenon and contribute to the **achievement of the EU’s values**, such as human dignity, equality, non-discrimination or human rights, among others, and other EU urban relevant policies and initiatives. The pilot was headed by the UNESCO Housing Chair URV in collaboration with the Centre for Housing Law, Rights and Policy of the University of Galway.

4.6.2 Initial needs and challenges

The lab faced several challenges in the beginning. We first give an overview and then the detailed problem statement.

Overview

a) **Lack of reliable data** on the "liquid housing" phenomenon. The existing data on the types of liquid housing in the city of Tarragona are not very precise. This characteristic is typical of "hidden homelessness" phenomenon.
b) Right balance between the human right to housing and the right to private property. The project addresses the types of liquid housing by adopting a plural approach concerning the right to housing, as **housing** is, in fact, the only good that is both an **important financial asset and a human right.**
c) The specific features of the groups most affected by the liquid housing phenomenon, as **housing exclusion** disproportionately affects specific groups, including women, young people, children, indigenous people, people with disabilities, migrants and refugees, the working poor, and lesbian, gay, bisexual and transgender people, each in different ways, maybe with common structural causes or factors the project aims to identify.
d) Scope of action of public policies at the local level and resources and competences. The challenge is how to address the types of liquid housing from a **public policy of view**. In this regard, it must be taken into account that Autonomous Communities in Spain hold the main competences on housing, which explains the low involvement of municipalities (which are at a lower tier in the governance framework of Spain) in the management of public aid for the promotion and acquisition of housing.

Problem statement:

The GFC2007 is still having a severe impact on European citizens, which is now combined with the effects of COVID19 (2020-2021) and the inflation crises (2022). The constant process of urbanisation, coupled with the process of emptying of rural space and the lack of social and affordable housing has contributed to housing unaffordability in major urban areas in EU MS. In the Spanish context, credit restrictions and the insecurity of the labour market since the GFC, which are increasing due to the consequences of the economic downturn caused by COVID-19[10], has posed difficulties to accessing homeownership. Access to the former is not a real option for many Spanish households, including young people and the less affluent, especially during the last 15 years. For its part, recent reforms of the law governing urban leases (1994) in Spain in 2019 (at national level Royal-decree Law 7/2019) and 2020 (at Catalan level, where a stronger rent control has been put into force by Act 11/2020, rendered unconstitutional by the Judgement of the Constitutional Court 37/2022) have been passed.

[10] See about the impact of the pandemic on access to housing in Spain Nasarre Aznar, S. (2020). Llueve sobre mojado: el problema del acceso a la vivienda en un contexto de pandemia. *Derecho Privado y Constitución*, 37, 273 ff. See also Nasarre Aznar, S. and Simón Moreno, H., Spain, at C. Schmid, *Ways out of the European Housing Crisis*, Elgar, 2022.

So far, these amendments have not succeeded in making leases a truly desired alternative to homeownership, while the attempts to increase the social housing stock (even including intrusive measures, that interfere with private contractual relationships, which have been taken at a regional level since 2015, e.g. sanctions or expropriations of empty homes) have only had a limited success. This has led big municipalities (where people have concentrated in these turbulent times due to the absence of a proper policy of territorial cohesion) to even accommodate low-income groups in insecure or inadequate housing, such as hostels or shipping containers[11]. Other housing tenures, such as housing cooperatives, are still far from being a self-standing true alternative option to homeownership and leases[12]. The Housing Law passed at the statal level (Act 12/2023) is not expected to become a structural measure to facilitate access to housing as it does not address key issues to address the problem of access to housing such as the diversification of land tenures, territorial cohesion, or multilevel governance[13].

As a result, instead of pushing forward affordable and as much distributed as possible home ownership (like in 1950-2007 or through ownership-like intermediate tenures), for 15 years opted for weaker and weaker titles (homeowners → tenants → co-living → squatting) for the less affluent households[14]. Thus, the line between what real "housing" is (once clear in terms of title, stability, quality, and adequacy) and what is just "provisional shelter" is now becoming increasingly blurry.

Some of the types of liquid housing are cases of hidden homelessness according to the FEANTSA ETHOS Typology[15], which includes all those people who live in public institutions or are about to leave them, without housing title or with relatives or friends in a forced way (in fact, family solidarity has saved many cases after the 2007 crisis), at risk of eviction, in situations of domestic violence, overcrowding, in temporary or non-conventional structures (mobile spaces, semi-permanent structures, such as cabins or cabins, etc.) or in a home without habitable conditions or forms of precarious home ownership (facilitated free of charge by other people or institutions, re-leased or illegally occupied). As it may be seen, this classification, accepted as a common framework in Europe, goes beyond homelessness.

Accordingly, this pilot project Lab focuses on the concept of "liquid housing", stemming from these crises and characterised by the idea that almost anything can be considered "adequate housing". It addresses various forms of liquid housing (squatting, illegal subletting, short-term

---

[11] An example is Barcelona, see Gemma Caballé Fabra et al., *La vivienda compartida en Barcelona y su adecuación a los estándares internacionales*, 2019. Available at: https://www.sindicaturabarcelona.cat/wp-content/uploads/2020/12/habitatge-compartit.es_.pdf

[12] Simón Moreno, H. (2020). Las cooperativas de viviendas en régimen de cesión de uso: ¿una alternativa real a la vivienda en propiedad y en alquiler en España? *REVESCO. Revista de Estudios Cooperativos*, vol. 134. https://dx.doi.org/10.5209/REVE.69165.

[13] Nasarre Aznar, S. (2022). *El Proyecto de Ley de vivienda 2022*. Madrid: Fedea. Available at: https://bit.ly/3pj7L9G.

[14] For reforms in Spain see Nasarre Aznar, S. (2020) *Los años de la crisis de la vivienda*. Valencia: Tirant lo Blanch, 551 ff.

[15] https://www.feantsa.org/en/toolkit/2005/04/01/ethos-typology-on-homelessness-and-housing-exclusion.

rentals and forced shared of rooms, overcrowded or substandard housing, and vacant dwellings) at the local level, a challenge seen across Europe, impacting the right to housing and human dignity.

1. Key indicators. The lack of reliable data

From the **squatting** perspective, it is estimated that around 78,800 homes in Spain are squatted in 2023[16] (more than 87.000 were identified in 2017), the vast majority belonging to financial entities and large landowners (more than 80%). The crime of usurpation is the one that has increased the most in recent years (a sixteen-fold increase in the number of criminal squatting sentences between 2007 and 2017). Furthermore, according to Eurostat[17], 6,4% of the Spanish population live in **overcrowded** housing (meaning they do not have enough rooms considering the size of the household), a situation that has slightly increased since 2019. Regarding **empty dwellings**, there were 26.623.708 empty dwellings in Spain according to the latest Population and Housing Census (2021) published by the National Institute of Statistics (INE).[18] The Catalan Housing Agency[19] already collects information of empty dwellings belonging to financial entities, but no information is provided about those belonging to individuals. Lastly, the Foessa Foundation (2019)[20] estimates that there are more than 4.5 million people living in inadequate housing and more than 2 million in insecure housing in Spain.

For its part, **homelessness** is a problem that is on the rise in nearly all EU Member States, and even though methodologies and sources vary from country to country (which means that there are no comparable European data on homelessness[21]), Feantsa and Fondation Abbé Pierre estimate that 700,000 homeless people are sleeping rough or living in emergency or temporary accommodation across the EU today, which means an increase of 70 percent in the space of ten years[22]. This difficulty in providing concrete numbers is also reflected at the Spanish level, where the National Institute of Statistics only considers people who uses shelters and food resources: an average of 21.684 people per day using shelter services and an average of 51.379 meals served every day (2022)[23]. However, these numbers hardly reveal

[16] According to the data provided by Institut Cerdà, 2023. Source: https://www.icerda.org/es/la-ocupacion-ilegal-de-viviendas-se-cifra-en-78-800-en-espana/.

[17] https://ec.europa.eu/eurostat/cache/digpub/housing/bloc-1c.html?lang=en.

[18] Source: https://www.ine.es/dyngs/INEbase/operacion.htm?c=Estadistica_C&cid=1254736176992&menu=resultados&idp=1254735572981#!tabs-1254736195781.

[19] https://web.gencat.cat/es/tramits/tramits-temes/20184_Registre_Habitatges_Buits.

[20] Fernández Maíllo, G. (coord.) (2019). *VIII Informe sobre exclusión y desarrollo social en España 2019*. Madrid: Fundación Foessa, p. 252.

[21] The number of homeless people in the EU is unknown, as recognised by Fondation Abbé Pierre and Feantsa (2019). *Fourth Overview of housing exclusion in Europe 2019*, 110.

[22] Fondation Abbé Pierre and Feantsa (2020). Fifth overview of housing exclusion in Europe 2020, 11.

[23] National Institute of Statistics (2023). *Encuesta sobre centros y servicios de atención a personas sin hogar*. Available at: https://www.ine.es/dyngs/INEbase/es/operacion.htm?c=Estadistica_C&cid=1254736176925&menu=ultiDatos&idp=1254735976608. Apart from that, the last Survey on homeless people from the Spanish National Institute

the full extent of the problem, since the homeless phenomenon includes not only the roofless people and people living in shelters for homeless people, but also other kind of temporary accommodations, as well as those living in insecure or inadequate housing, as pointed out above. Thus, there is a whole range of **hidden homelessness** that is much more difficult to identify. Therefore, roofless and houseless people are only the tip of an iceberg of a much larger problem.

As it may be seen, the existing data on the types of liquid housing in the city of Tarragona are not very precise. This characteristic is typical of "hidden homelessness" phenomenon.

2. The impact of the types of liquid housing

A. On certain social and vulnerable groups

Housing exclusion disproportionately affects specific groups, including women, young people, children, indigenous people, people with disabilities, migrants and refugees, the working poor, and lesbian, gay, bisexual and transgender people, each in different ways, but with common structural causes[24]. The lack of affordable housing particularly impacts poor and socially excluded people[25].
The types of liquid housing have an **impact** on the affected groups in terms health, difficulty in accessing services, poor living conditions and stigmatisation and social exclusion. Furthermore, they are not included in any register, the contract is not usually formalised in writing, they do not have security of tenure and they cannot ask for aids to pay the rent. From the perspective of the **right to private and family life**, article 7 of the EU Charter of Fundamental Rights recognises this right, which must be interpreted according to article 8 of the European Convention of Human Rights. Article 10 of the Spanish Constitution also lays down the **right of human dignity**. Some types of liquid housing by their nature do not pay attention to these fundamental rights, especially in access arrangements[26].

B. On Spanish society as a whole

---

of Statistics was undertaken in 2012, and results showed that 22,938 homeless people were assisted in shelters and food services during that year. National Institute of Statistics (2012). *Encuesta a las personas sin hogar*. Available at https://www.ine.es/dyngs/INEbase/es/operacion.htm?c=Estadistica_C&cid=1254736176817&menu=ultiDatos&idp=1254735976608.

[24] Report of the Special Rapporteur on adequate housing as a component of the right to an adequate standard of living, and on the right to non-discrimination in this context, 30-12-2015. Available at: https://www.icj.org/wp-content/uploads/2015/12/Report-SRHousing-2015-eng.pdf.

[25] FEANTSA: Homelessness on the European agenda: European Parliament and the European Commission discuss homelessness and Housing First during first European Parliament plenary session of the year.

[26] See María Paula Rodríguez Liévano, Ángeles Galiana Saura (2020), "Capítulo 18. El «Cohousing» como modelo de vivienda colaborativa: Riesgos derivados de la determinación de los espacios y usos, y el carácter dogmático del propósito", in Pedro Antonio Munar Bernat et al. (dir.), Turismo, vivienda y economía colaborativa, Aranzadi Thomson Reuters, 357.

The types of liquid housing have other relevant impacts on society. For instance, homeowners directly affected by **squatters** face a significant financial outlay to adapt their dwelling to its original state once recovered its possession and a loss of its value between 40% and 60%. Furthermore, the effects of "squatting" go beyond the owner who suffers from it considering that 80% of "squatters" occur in **condominiums**, where around the 70% of the Spanish population live. Condominiums do not have possessory actions available to act against squatters, but they may bring an action for an injunction in case squatters do not respect the condominium's bylaws or the co-habitation rules. The impact on common parts of the multi-unit building and, on the neighbourhood, is then relevant. The same may be said concerning other types of liquid housing, such as overcrowding or empty homes. Indeed, the vast number of empty homes in Spain means that homeowners forfeit more than 38,934 million euros in lost earnings annually, as homeowners do not get any return on their investment*, e.g.* by renting them out[27]. Furthermore, there may be mortgage costs which have to be paid. The use of vacant buildings is also an important aspect of providing solutions for rising housing demand. Re-using and regenerating housing resources pertains to the principles of the circular economy, climate mitigation and environmental protection and could be employed to serve the need for social and cultural inclusion[28].

There are other potential impacts on society. The World Economic Forum's Global Risks Report 2023[29] lists lack of affordable and adequate housing as a **global risk** within the "Collapse or lack of public infrastructure and services" category. Specifically in Spain, the "Cost-of-living crisis" category, which means the inability among broad sections of populations to maintain their current lifestyle due to increases in the cost of essential good (housing costs included), is the second risk identified in Spain, which may cause lower real incomes that will result in trade-offs in essential spending, worsening health and wellbeing outcomes for communities. The types of liquid housing, if not properly addressed, may lead to a society of **rich owners** and **poor tenants** facing inadequate housing being considered hidden homeless, to neighbourhoods more susceptible to **social unrest** and less attractive to new businesses', thus having a negative impact on the property market, to several negative implications on economic well-being of individuals, **family formation and fertility**, to an increase in **housing inequalities**, especially regarding young people, and to an increase in the number of **evictions and homelessness**.

3. The human rights at stake

The project addresses the types of liquid housing by adopting a plural approach concerning the right to housing, as **housing** is, in fact, the only good that is both an **important financial asset and a human right**.

---

[27] https://www.pisos.com/aldia/vivienda-vacia-sin-alquilar/1635657/.

[28] European Construction Sector Observatory, The use of vacant buildings is also an important aspect of providing solutions for rising housing demand, ECSO_AR_Housing_affordability_2019.

[29] The Global Risks Report 2023 18th Edition, https://www3.weforum.org/docs/WEF_Global_Risks_Report_2023.pdf. p. 75.

On the one hand, the **right to private ownership** is enshrined in the EU Charter of Fundamental Rights (art. 17) and protected in European constitutions, such as the Spanish one (article 33). There exists a strong relationship between effective private property rights, freedom, and democracy, as property rights contribute to economic conditions conducive to the preservation of democracy and generate wealth that can serve as the basis for opposing the concentration of power in the state[30]. From the **right to housing perspective**, security of tenure (especially private ownership, but also properly regulated tenancies or cooperatives) is the cornerstone of the right to adequate housing[31] (UN Committee's general comments No. 4 (1991) on the right to adequate housing), as it is essential for human dignity and to sustain an adequate standard of living. Insecurity of tenure covers a wide range of local situations, from total illegality (squatting, illegal subletting, short-term rental) to various forms of tolerated occupation (*commodatum*, precarious tenures), or occupation legitimised by customary practices but not considered as legal by government or local authorities[32]. What these cases have in common is the **lack of legal protection** as the occupiers remain in an extra-legal, unprotected sphere. For them, those types of "liquid housing" solutions do not compensate in any way, the loss of their human right to become homeowners or secure tenants, and they do not annul the obligation policymakers have to create the conditions that allow them to become homeowners or secure tenants (but their policies over the last 15 years have been counterproductive).

The challenge is how to address the types of liquid housing from a **public policy of view**. In this regard, it must be taken into account that Autonomous Communities hold the main competences on housing, which explains the low involvement of municipalities (which are at a lower tier in the governance framework of Spain) in the management of public aid for the promotion and acquisition of housing[33].

Conclusion

The **primary goal** of the pilot project is to examine and understand the phenomenon of liquid housing in the intermediate city of Tarragona using an interdisciplinary and international approach. While strategies for addressing the types of liquid housing exist at the local level (*e.g.* through public aids or surveys), the difficulties in detecting this phenomenon and the lack of effective housing policies hinders the municipality's ability and resilience to address

[30] David L. Weimer (Ed.), The political economy of property rights: Institutional change and credibility in the reform of centrally planned economies. Cambridge: Cambridge University Press, 1997; William Singer, J. (2014), *Property as the law of democracy*, Vol. 63.

[31] Article 25 of the Universal Declaration of Human Rights 1948 and article 11.1 of the International Covenant on Economic, Social and Cultural Rights 1966; at the European level in article 31 of the European Social Charter 1961 (revised in 1996) and in article 34.3 of the EU Charter of Fundamental Rights (it recognises not only the need for housing assistance but also for access to social housing for those in need).

[32] Geoffrey Payne and Alain Durand-Lasserve, *Holding On: Security of Tenure - Types, Policies, Practices and Challenges*, 2013. Available at: https://www.ohchr.org/sites/default/files/Documents/Issues/Housing/SecurityTenure/Payne-Durand-Lasserve-BackgroundPaper-JAN2013.pdf.

[33] Iglesias González, F. (2022), Distribución competencial entre Estado, comunidades autónomas y entidades locales en materia de vivienda. *Cuadernos de Derecho Local*, 59. Available at: https://repositorio.gobiernolocal.es/xmlui/bitstream/handle/10873/2287/04_IGLESIAS_P35_P64_QDL_59.pdf?sequence=1&isAllowed=y.

the problem, which goes beyond the right to housing itself, as the types of liquid housing may also have **social, economic, political and environmental implications** for society. Collaboration among various stakeholders is paramount in implementing effective strategies to tackle these challenges and ensure that the types of liquid housing are properly addressed.

Work done in the lab

The first months of the project were dedicated to **collecting quantitative empirical evidence and qualitative data**. To this end, desk research, surveys, and individual interviews with relevant stakeholders were carried out. Regarding the personal interviews, they involved not only stakeholders but also vulnerable individuals experiencing inadequate or substandard housing ("liquid housing"), who were previously selected by a mediator working with the local authority. The interviews took place in a venue familiar to all participants, i.e., the place where they usually meet with the mediator. In this regard, the mediator was involved in the meeting to ensure its proper execution and mitigate potential risks.Another important preparatory element was the stakeholder analysis presented in Figure 45 below.

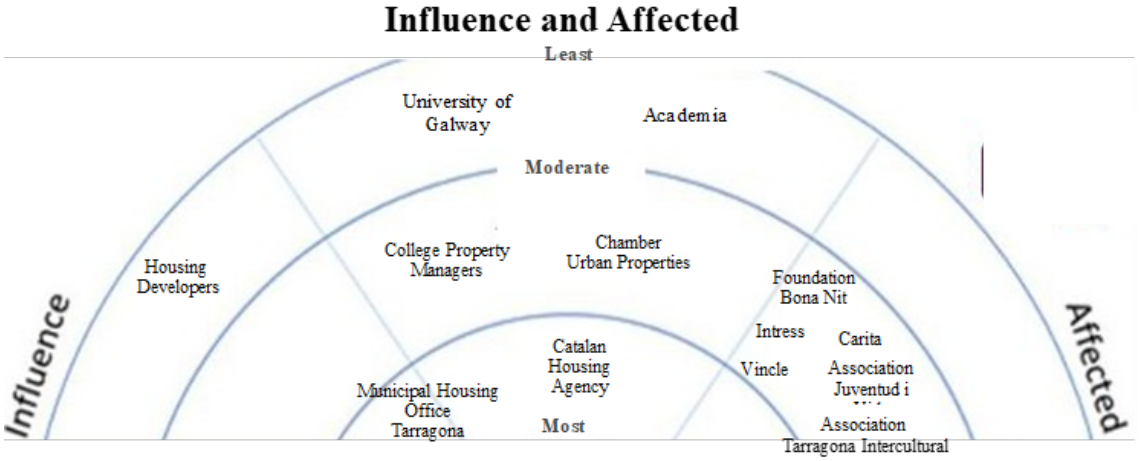


Figure 45: Liquid Housing Stakeholder Analysis

Workshop 1 Factor Assessment & Projections Preparation

The influencing factors were identified thanks to the **interviews conducted** with stakeholders and to the **scientific evidence** on the topic.

For instance, the representative from **Caritas** pointed out the **lack of resources** of those people seeking support from this institution, and the link between housing and work. For its part, the representative from **Intress**, who provide support to migrants (mainly unaccompanied minors), highlighted the lack of a comprehensive housing, social and labour policy and the need for **specific protocols** to aid minors when they get out from the system once they reach full age. The outcome of the interviews is in line with the factors pointed out in reports and scientific works, *e.g.* migrants and tenants are usually those most affected by overcrowded and/or substandard housing[25]. Migrants also share a flat with unrelated people more than local people and have more problems in having enough money to pay expenses related to the house (mortgage, rent, electricity bills, water...)[26].

Here a relevant factor is the **discrimination** in access to or maintenance of housing, a widespread phenomenon, especially related to the structural racism of our country, but also showing the intersectionality with other issues such as gender[27]. As a result of discrimination and housing inequality, many women (*e.g.* who are or have been victims of gender-based violence, those who are part of a single-parent family, retired women, those who work at home, unemployed women, immigrant women, those who practice prostitution and ex-convicts) live in insecure, undignified, and unsafe conditions, at increased risk of homelessness and violence[28]. Unsanitary conditions, forced cohabitation, structural defects, excessive housing costs, overcrowded conditions and insecure tenure are defining elements of the "hidden homelessness" that affects women of foreign origin[29]. This situation of discrimination also affects migrants according to the interviews conducted (**Association Tarragona Intercultural**), which face other difficulties. Indeed, the main barrier when a migrant arrives to our country is the getting registered in the **Municipal Register of Inhabitants**. The Generalitat of Catalonia issued the "Catalan Model of Accompanying and Caring for Homeless People" in 2023[30], according to which registration must be guaranteed: in the case of homeless people and in other conditions of residential exclusion (such as the ones of "Liquid Housing"), the city council must guarantee registration without a fixed address. It is necessary then for the City Council to implement specific registration protocols not only for cases of homeless, but also for people in situation of social exclusion, such as the renting of rooms, as local authorities are more reluctant to accept a fictitious registration in these cases (it causes a system of "indirect discrimination" by the administration) as shown by a recent report drafted by an association in 2024[31]. They usually send a technician to verify whether migrants live in the provided address as migrants cannot provide a signed legal document. This may however force the owner who did not want to authorize the registration to evict the informal tenants. A protocol is needed to summon them to the Social Services to be registered fictitiously.

Regarding young people, the difficulty for them to access affordable housing leads them to live with relatives, friends, to share a flat with strangers or even couch surfing or other collaborative economy situations; in relation to the young people formerly in care, they find themselves with a lack of family or social support networks when they face a process of dis-institutionalization[32].

For its part, **income level** is the most predictive element of residential exclusion in a direct relationship between the volume of that income and the level of integration, especially in poor households, which are pushed to dedicate most of the available income to property-related expenses[33]. This leads to delays in utility payments, a clear indicator of the risk of households. Indeed, in the specific case of housing, four out of five people with high expenditure on housing were poor in 2022 (79.1%). The expenditure dedicated to housing among the population in poverty is equivalent to 39.1% of household income, an effort more than three times higher than that made by non-poor people (12.5%)[34]. In the same sense, 48.9% of Spanish households living in rented accommodation were at risk of poverty or social exclusion in 2021 – the highest percentage in the EU, while 40.9% devoted more than 40% of their disposable income to housing - compared to 21.2% of the EU average-, with particular incidence in families with lower income.

From a different perspective, the representative from **Vincle**, who manages social housing belonging to the Catalan housing agency in one of the most disadvantaged districts of Tarragona (*Campo Claro*), pointed out the low socio-economic level of the people living there, most of them foreigners, with **poor education** and very precarious jobs. Squatting, a more degraded neighbourhood, an unpleasant environment and tension at the neighbourhood level are on the rise since the pandemic in this area. Indeed, in the processes of residential exclusion, the accumulated risks in the dimensions of income and socio-family relations are determining factors, adding the education dimension in foreigners[35]. Also, the reality of the most vulnerable is that they also lose other opportunities, such as digital ones: the **digital divide** only makes it even more difficult for them to exercise full citizenship[36].

Of course, the **budget** devoted to housing also plays a crucial role. Before the coronavirus pandemic, almost a million people (952,000) went to Social Services in Catalonia, an average of 68,000 per month. But in 2020 they grew by 352% and in September 2020 alone, 239,501 users were counted. The number of families who needed extremely urgent help also tripled. In January 2020, 7,350 households requested it compared to 20,700 in July. And to deal with all this desperation, there were only 3,100 public employees: 1,000 social educators, 1,700 social workers and 400 administrators who confess to being emotionally and mentally devastated. Indeed, the socio-economic crisis of recent years has had a double important impact on the Catalan social services system: the request for attention to situations of vulnerability has increased and, at the same time, public revenues available to meet social needs have been reduced and austerity policies have been adopted that prevent others from being adopted to reverse the situation. Problems such as the limitation of resources, the increase in demand and the lack of enough human and material resources are problems have been identified[37]. This does not come as surprise given the fact that the general government expenditure in the EU on housing and community amenities amounted to €154 billion or the equivalent of 1.0 % of GDP in 2022[38]. In fact, according to the Spanish Stability Programme sent to Brussels, the official plan is to allocate 0.5% of GDP to housing and community services until 2026, the same amount allocated both in 2021 and 2022. Housing is the item that will concentrate the least public expenditure[39]. Specifically in the municipality of Tarragona, 44% of people attended by social services in 2022 (13.743 in total, accounting for 10,2% of the total) had problems related to housing (being 57% women and 64% foreigners), according to the Municipal Institute of Social Services of Tarragona. One of the neighbourhoods of the city (*Ponent*) has already been identified as one with the most precarious housing stock in the city. The high percentage of people in a situation of energy poverty, the high level of illegal employment or the lack of enough social housing are relevant problems as well in this neighborhood.[40] The number of homeless people in the city accounted for 60 people (49 were men) in November 2023 (the number was 49 in 2017, 89 in 2019 and 77 in 2021). Lastly, the estimated number of empty dwellings accounted for 8.298 in Tarragona (of a total of 67.200).

The **low budget** allocated to housing explain the problems local authorities face problems regarding the hidden homelessness phenomenon. It must be taken into consideration that the main foundations working in the field in Catalonia focuses mainly on the first three categories of Ethos. This is the case of Arrels Foundation[41], that looks after and guides

homeless people who live in the city of Barcelona, or Mambré Foundation[42], which make homes available to homeless people through collaboration with social organizations.
Lastly, the **erratic multi-housing policies** in the last years have contributed to the raise of the hidden homelessness phenomenon: instead of pushing forward affordable and as much distributed as possible home ownership (like in 1950-2007 or through ownership-like intermediate tenures), for 15 years opted for **weaker and weaker titles** (homeowners → tenants → co-living → squatting) for the less affluent households[43].
Against this background, the following factors were identified from different domains:

Table 9: Selected Influencing Factors

Domain S-Society; T-technology; En-Environment; Ec-Economy; P-Policy; V-Values; L-Legal	Factor
L; P	Absence of a coherent multilevel housing policy (e.g. absence of diversification of land tenures, lack of public investment, lack of coordination between administrations, etc.)
S	Personal and socio-demographic characteristics of the people in this situation (e.g. victim of gender-based violence, LGTBIphobia, age, drug addiction, ethnicity, disabled person...)
Ec	Insufficient income to cover the costs associated with tenure (e.g. due to precarious working conditions)
P	Insufficient public resources (e.g. social services)
V; S	Low educational level of the people in this situation
T	Bureaucracy and digitization (e.g. to access aid related to housing)
S; L	Being in an irregular administrative situation (e.g. immigrant population)
S	Lack of family support and solidarity networks and/or proximity support (e.g. due to separation or divorce, single-person families...)

Workshop 1 Factor Assessment & Projections Execution

The **first workshop** of the *Liquid Housing* Lab took place on Wednesday, June 19, at the Conference Centre of Tarragona. Dr. Padraic Kenna, Director of the Centre for Housing Law, Rights and Policy at the University of Galway (also partner of the project), was the keynote speaker with a presentation entitled *"The Right to Housing and the Types of 'Liquid Housing': How to Achieve Resilience?"* Dr. Kenna emphasised that resilience in this field involves not only providing affordable housing and security of tenure to those affected by *liquid housing* but also empowering and educating them with relevant socio-economic skills and addressing their needs holistically through public authorities.
The workshop brought together 25 participants from various institutions (e.g., foundations, public administration, professional associations, social-sector organisations, neighbourhood associations, academia, etc.), who discussed in focus groups the underlying factors that may explain the *liquid housing* phenomenon and evaluated future scenarios for each factor.

Accordingly, the first part of Workshop 1 was dedicated to prioritising the factors based on their level of impact (from low to very high) and uncertainty (from low to very high). Due to time constraints, the most relevant factors were pre-selected by the local team, so there was no initial discussion during the workshop to choose them from a broader list. However, the list of factors had been shared in advance, allowing all participants to review it prior to the session. Participants were also given the opportunity to propose additional factors during the workshop. In fact, they suggested new ones such as gentrification, political radicalisation, and

tourist apartment policies. The local team decided these could be integrated into the previously selected factors.
The average outcome of the first part of the workshop is presented in Figure 48.

Figure 46: Liquid Housing Factors Assessment

As can be seen, the lack of a coherent multi-level policy, along with personal and socio-demographic characteristics, was identified as the factor with the highest impact and uncertainty. In contrast, factors such as irregular legal status or the lack of family support and solidarity networks were considered to have high impact but low uncertainty. Insufficient public resources and social benefits, as well as inadequate income to cover housing costs, were classified as having medium-to-high impact and uncertainty. Meanwhile, low educational attainment, bureaucratic obstacles, and digitalisation were identified as factors with medium impact and uncertainty.

In the second part of Workshop 1, participants were asked to develop projections for each factor using the Tetralemma method. Below is an example based on the housing policies factor, which was identified as the most relevant.
Participants expressed uncertainty regarding the interpretation of the terms *disruptive developments* and *shifted paradigms*. It was agreed that the former refers to highly unlikely but possible events, while the latter denotes a situation in which the factor in question becomes entirely irrelevant. For example, disruptive developments included scenarios such as the allocation of resources solely by artificial intelligence—potentially introducing bias and discrimination (factor: bureaucracy and digitalisation); the outbreak of a new pandemic

(factor: lack of family support and solidarity networks); or significant improvements in the economic conditions of a migrant's country of origin (factor: irregular administrative status). Examples of *shifted paradigms* were also identified, such as the rise of far-right, anti-immigration political parties (factors: lack of family support and solidarity networks; irregular administrative status). Other disruptive developments mentioned included an economic crisis, a new world war, or the intensification of climate change impacts (factor: lack of coherent housing policies).

It is worth noting that all participants interpreted the *expected evolution* of the problem as a worsening of the situation in the coming years and decades. Regarding the *divergent development* scenario, participants identified specific actions or policies that would be necessary to achieve such an outcome for each factor. This approach is logical, as any alternative projection requires proactive measures to bring about the desired change. The cross-impact analysis presented in Figure 48 confirms the lack of a coherent multi-level housing policy as the most active influencing factor.

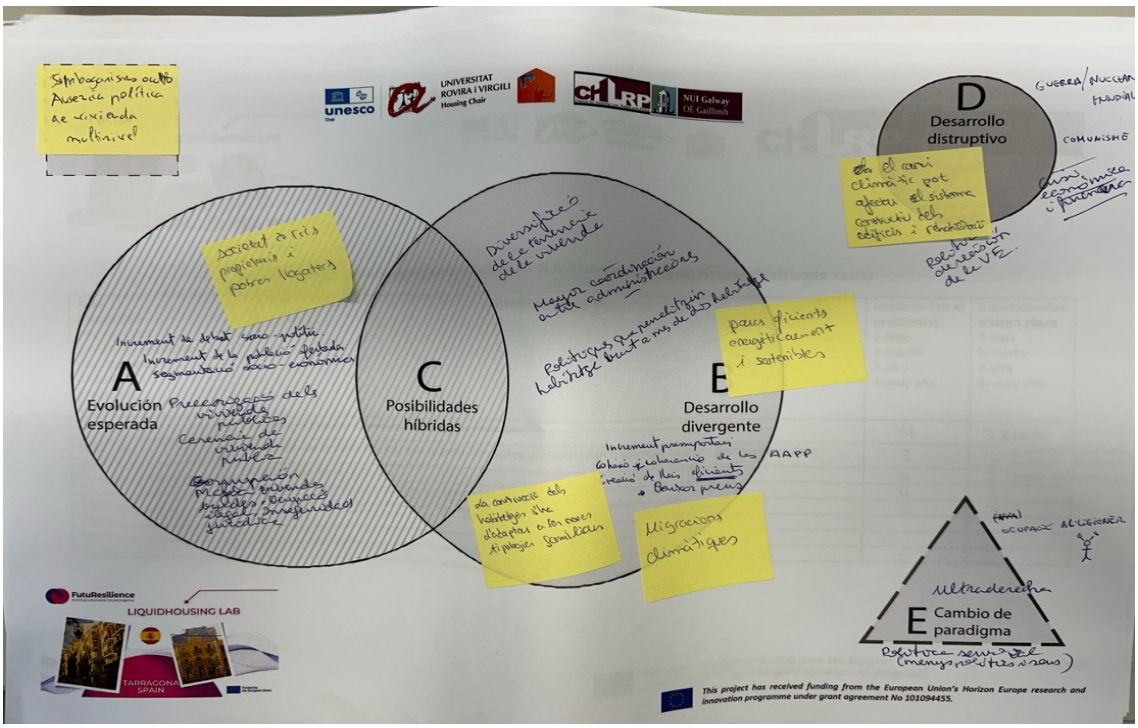


Figure 47: "Liquid Housing Lab". Example of the use of the Tetralemma method.

INFLUENCE MATRIX

How strongly does Factor A (column C) influence Factor B (row 4)? Rate on a scale from 0 (no impact) to 3 (high impact).

(Example values are filled in for demonstration purposes)

The most influential (active) factors are automatically highlighted.		PASSIVE Sum	0,0	6,0	16,0	3,0	1,0	14,0	8,0	6,0
			Lack of a coherent multi-level housing policy	Personal and socio-demographic characteristics of people in this situation (e.g. gender violence, LGTBIphobia, age, drug addiction, ethnicity, etc.)	Insufficient income to cover the costs associated with the land tenure (e.g. due to precarious working conditions)	Insufficient resources and social benefits (e.g. social services)	Low educational level	Bureaucracy and digitalisation (e.g. to access aid)	Being in an irregular administrative situation, e.g. immigrant population	Lack of family support and solidarity networks and/or local support (e.g. separation, divorce, single-person families, etc.)
ACTIVE Sum			Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
12,0	Description	Lack of a coherent multi-level housing policy		1	2	2	0	3	3	1
8,0	Description	Personal and socio-demographic characteristics of people in this situation (e.g. gender violence, LGTBIphobia, age, drug addiction, ethnicity, etc.)	0		2	1	0	1	2	2
4,0	Description	Insufficient income to cover the costs associated with the land tenure (e.g. due to precarious working conditions)	0	1		0	1	2	0	0
9,0	Description	Insufficient resources and social benefits (e.g. social services)	0	1	3		0	3	2	0
5,0	Description	Low educational level	0	0	2	0		2	1	0
2,0	Description	Bureaucracy and digitalisation (e.g. to access aid)	0	0	2	0	0		0	0
11,0	Description	Being in an irregular administrative situation, e.g. immigrant population	0	3	3	0	0	2		3
3,0	Description	Lack of family support and solidarity networks and/or local support (e.g. separation, divorce, single-person families, etc.)	0	0	2	0	0	1	0	

Figure 48: Liquid Housing Influence MatrixWorkshop 2 Scenario Development

The **second workshop** of the *Liquid Housing* Lab took place on Thursday, October 10, at the University Rovira i Virgili. The workshop brought together 20 participants from different institutions, who worked in three focus groups to develop core scenarios by combining the factor projections elaborated in the first workshop. A minimum of three hours was allocated to this session, but it ultimately lasted three and a half hours.

Three scenarios were discussed across the three focus groups. Given the importance of the identified factors, the first scenario focused on housing policy, resulting in five different sub-scenarios. Strategically:

- The first group started with Scenario 1, where the absence of a housing policy leads to a society of rich landlords and poor tenants, with the disappearance of the middle class.
- The second group focused on Scenario 3, where the lack of an adequate housing policy impacts the real estate market.
- The third group analysed Scenario 2, a more favourable one, in which budget increases, improved coordination among administrations, and better housing access are achieved.

This setup allowed for different starting points—two scenarios that evolved as expected but with different impacts (on society and individuals in one case, and on the real estate market in another), and one scenario that diverged from the others. Regarding strategic discussions, participants addressed the impact of each scenario on society as a whole, their institutions, and citizens. The guiding questions were: a) How does this scenario impact society as a whole? Who benefits, and who is disadvantaged? b) How does this scenario impact your institution specifically? What would your day-to-day operations look like? c) How does this scenario impact citizens in general, particularly those experiencing hidden homelessness?

Finally, each group was asked to summarise its scenario in a single sentence:

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

The outcome was as follows:

Scenario 1 shows greater invisibility and social exclusion, a greater percentage or spectrum of vulnerable groups without access to housing and in situations of hidden homelessness, an increase in the current profiles (mental health, drug addiction, etc.), so that the group susceptible to falling into a situation of hidden homelessness increases, an impact on the formation of new families, with special relevance in the birth rate, and a lower rate of youth emancipation, negative effects on family units (an increase in unwanted loneliness, the child population at risk and mental problems), and bureaucracy and administrative delays making it difficult for example to deliver social housing or the processing of public benefits. The participants argue that the precarisation of housing affects all groups across the spectrum, so the low educational level seems to have less importance in this scenario.
With respect to strategic conversations, the evolution towards an increasingly plutocratic society is highlighted, with a drastic increase in the number of poor and excluded people with no possibility of change. In this way, everyone loses, because a society that does not prosper always loses. In addition, the impact at the institutional level is very significant: the transfer of responsibilities from the Public Administration to the third sector, which causes an increased workload; at the level of neighbourhood associations, there is growing insecurity and an increase in more visible homelessness, while at the same time the problems in condominiums increase. Two possible scenarios at the citizen level are highlighted, considering the increase in the homeless phenomenon: 1) new social networks of self-help between families, associations, municipalities, etc.; and 2) greater individualism and degeneration of the urban, social and physical environment as major forms of social exclusion.

Scenario 1 was summarised as follows: "See you in the park bench: the precariousness of housing in all social sectors".

Scenario 2 shows a similar projection: greater invisibility and social exclusion, a greater percentage or spectrum of vulnerable groups without access to housing and in situations of hidden homelessness, an increase in discrimination in accessing and staying in housing, this having an impact on the formation of new families, with special relevance in the birth rate, and a lower rate of youth emancipation, an increase in unwanted loneliness and vulnerable groups completely out of the system due to the increase in technology. The participants the low educational level seems to have no importance in this scenario, in line with the participants in Scenario 1.
As it might be seen, Scenario 1 and Scenario 2 are similar they consider 5 out of 7 factors to evolve in the same way. They differ in the evolution of the factor “Personal and sociodemographic characteristics of the people in this situation”, as well as in the factor “Bureaucracy and digitisation”.
With respect to strategic conversations, it is considered that it affects society as a whole, since it increases vulnerability, social discrimination, urban degradation, insecurity, mental health and conflict. Equally, it is considered that there is no winner: society and, especially, the most vulnerable groups lose. Precisely, housing and social exclusion of citizens (with an increase in inequality) is emphasised. In particular, the scenario has a negative impact on the Public

This project has received funding from the European Union’s Horizon Europe research and innovation programme under grant agreement No 101094455.

Administration, which must attend to more users that include more social groups. The same happens with entities of the third sector.

Scenario 2 was summarised as follows: (There is an irony in this) "A good housing policy promotes the right to adequate and decent housing".

Scenario 3 shows a different projection for the factors taking into consideration that the most relevant factor (housing policies) evolves in a positive way, so there is a budgetary increase, efficient laws and a better coordination of the Public Administrations. It helps to improve bureaucracy, with more facilities for access to the labour market and public benefits for immigrant people; also, the increase of available resources makes it possible to facilitate access to housing for all vulnerable groups, and collaboration networks through cooperatives or support through third sector entities helps to involve civil society; this having an impact on the mediation and integration and inclusion policies are promoted. However, salaries worsen or do not improve substantially, which affects the habitability of housing: the percentage of housing in poor condition; and even procedures are more agile, a dehumanisation takes place. With respect to strategic conversations, the society wins in this scenario, in particular those belonging to the middle class. However, it is pointed out that there are always people out of the system. In addition, the impact at the institutional level is very significant: both the public administration and the third sector may offer better support; at the level of neighbourhood associations, there is less insecurity, and a positive impact on condominiums (less squatters) is highlighted. At the citizen level, a positive impact would take place, even though the expected less quality of the housing stock.
Scenario 3 was summarised as follows: “The illusion of reaching 2040".

Scenario 4 was **developed by the local team** to provide a different perspective from the scenarios discussed in the focus groups. This scenario begins with the following projection: climate change has affected the habitability of homes, which, due to a lack of rehabilitation, leads to climate-induced migration among people experiencing hidden homelessness. As wages stagnate or decline, housing habitability worsens, resulting in a sharp increase in poorly maintained housing, overcrowding, and energy poverty. This situation triggers several social consequences: there is a rise in violence, growing public dissatisfaction with the government—potentially sowing the seeds of social unrest—and a steady deterioration of the public housing stock, including more squatting, evictions, substandard living conditions, and overcrowding. Due to the absence of support networks, emigration abroad increases, impacting the labour market and birth rate. While the affected population may attain a higher level of education, this is insufficient to overcome the condition of hidden homelessness. Bureaucratic hurdles and administrative delays persist, making it difficult to access social housing, process public benefits, and address other essential needs.
Scenario 4 was summarised as: "The importance of adequate housing."

Figure 49 illustrates using the example of scenario 2 how the scenarios were composed from combining consistent combinations of projections for each factor.

This project has received funding from the European Union’s Horizon Europe research and innovation programme under grant agreement No 101094455.

FACTORS	Multilevel housing policy	Being in an irregular administrative situation	Insufficient resources and public social benefits	Personal and sociodemographic characteristics of the people in this situation	Insuficient income to cover the costs associated with tenure	Lack of family support and solidarity networks and/or proximity support	Low educational level	Bureaucracy and digitization
Factors description	*The housing policy should be coherent and multi-level to address this problem*	*Persons in an irregular administrative situation, for example the immigrant population, may have more administrative and other barriers to access decent housing*	*The income and investments that can come from the Administration may be key to addressing hidden homelessness (e.g. social services)*	*Situations such as gender violence, LGTBIphobia, age, drug addiction, ethnicity, etc. they can put people in a situation of hidden homelessness*	*The income of the family unit dedicated to expenses related to the property can condition access to affordable housing*	*The absence of support networks in certain cases, for example when there is a separation or divorce, or in the case of single-person families, can influence the lack of access to decent housing*	*The low level of education can influence the job opportunities of the people affected*	*Bureaucracy and the lack of access to digital media can be an impediment to, for ejemplo, accessing public aid*
Projection 1	The absence of an adequate housing policy leads to a polarization: a society of rich owners and poor tenants and to an increasingly evident socio-economic segmentation. The middle class disappears	The current situation persists with a series of economic consequences: there is an increase in the underground economy and a crisis in the pension system due to a lack of contributions	The chronic deficit of the resources of the Public Administrations implies an increase in the importance and role of social entities when it comes to providing affordable housing. This function is delegated by the public authorities	There is an increase in the current profiles (mental health, drug addiction, etc.), so that the group susceptible to falling into a situation of hidden homelessness increases	Thanks to an improvement in wages and a less precarious job offer on the part of the private sector, there is an increase in the income of the affected groups, which allows them to get out of the situation of hidden homelessness	The lack of support networks implies a decrease in the birth rate and a increase in single-person households	An improvement in the educational level of the affected people allows them to have more job opportunities and better prospects to get out of the situation of hidden homelessness	The increase in technology makes it more difficult if possible to access public services (e.g. aid), leaving vulnerable groups completely out of the system
Projection 2	The absence of an adequate housing policy leads to an increase in the population affected by a situation of hidden homelessness and of people who, starting from this situation, have become homeless	The current situation persists with a series of consequences for people: increase in poverty, lack of attention for social services, lack of job options, employment difficulties. In a word: invisibility and social exclusion	The growth of residential demand, combined with a decrease in available public resources, implies a greater percentage or spectrum of vulnerable groups without access to housing and in situations of hidden homelessness.	There is an increase in inadequate housing and under-housing, as well as overcrowding or squatting. In other words, hidden homelessness increases	Salaries worsen or do not improve substantially, so the problem persists or even worsens. This affects the formation of new families, with special relevance in the birth rate, and a lower rate of youth emancipation	An improvement in the situation is produced based on the work of civil society. Ex. collaboration networks through cooperatives or support through third sector entities	There is a social duality, with highly educated people and others with little or no training, prone to living in a situation of hidden homelessness	The procedures are more agile thanks to a coordinated digital structure, and the generational gap is reduced, so that it will be easier to access, for example, public benefits, etc.
Projection 3	The absence of an adequate housing policy implies the absence of public housing, which becomes precarious, and due to legal insecurity, an increase in empty homes and squatting, as well as an increase in informal settlements (e.g. slums, etc.) and neighborhoods outside the system. The real estate market is strongly reduced	The current situation persists with a series of social consequences: there is an increase in violence and a growing discomfort with the Administration, a possible germ of social revolts	Available resources increase thanks to a greater budgetary endowment, which makes it possible to facilitate access to housing for all vulnerable group	There is an increase in discrimination in accessing and staying in housing and, ultimately, greater social discrimination towards these groups, which affects them when accessing housing	Salaries worsen or do not improve substantially, so the problem persists or even worsens. This affects the education, food and health care of people who suffer from hidden homelessness, as well as the minors in their care	Due to the lack of support networks, there is an increase in emigration abroad, which affects the labor market and the birth rate.	There is an improvement in the educational level of the affected people, but it does not affect or is not enough to leave the situation of hidden homelessness	A dehumanization takes place: human treatment becomes an exclusive service, so that digital services become the norm or of common use
Projection 4	Climate change has affected the habitability of homes, which, as they have not been rehabilitated, causes a climate migration of people in hidden homelessness	Bureaucracy is improving and there is more efficiency, with more facilities for access to the labor market and public benefits for immigrant people, who have improved access to housing	The underground economy is reduced Improved coordination between Public Administrations, which leads to an increase in benefits, but there are still groups that cannot access them	Thanks to greater State intervention in social issues, mediation and integration and inclusion policies are promoted in access to housing, e.g. psychological care services, legal advice, social support and training in skills for independent living	The increase in public aid and the implementation of universal public income, together with the fact that the State guarantees work, allows access to housing for the groups that suffer the most from hidden homelessness	The lack of support networks has negative effects on family units: an increase in unwanted loneliness, the child population at risk and mental problems	Education empowers people to demand decent and affordable housing and to participate actively in the decision-making processes on housing policies and programs in their communities	Resources are awarded based on artificial intelligence, which can lead to prejudice and situations of social discrimination
Projection 5	The budgetary increase, efficient laws and a better coordination of the AAPP allows for the construction of housing and policies that promote the diversification of forms of real estate ownership and sustainable access to housing	Improves the coordination of migration policies between countries, which causes a reduction in the immigrant population, which in the end results in a demographic decrease and a lack of labor	The lack of resources of the Administration causes a progressive deterioration of the public real estate park, with more occupations and defaults	Effective management of complaints of discrimination facilitates access to housing for these groups	Salaries worsen or do not improve substantially, which affects the habitability of housing: the percentage of housing in poor condition, overcrowding and energy poverty increases exponentially	The Administration dedicates more resources to families (e.g. extracurricular activities, improvements to transport schedules) public or customized intervention programs), which helps to alleviate the situation	From the Administration, more human resources are dedicated to the support and follow-up of people with more difficulties	Bureaucracy and administrative delays persist, which make it difficult for example to deliver social housing, the processing of public benefits, etc.
Other projections of the factors can be proposed							It does not have any effect.	

* Scenario 2: How would you define your scenario in one sentence? -> (There is an irony in thisç) "A good housing policy promotes the right to adequate and decent housing"

Figure 49: Example for Scenario Pathway (Scenario 2)

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

The progress of the project was also presented at the **annual meeting of the Monitoring Committee** of the UNESCO Housing Chair on 12 December 2024 in Tarragona, which includes twelve public and private partners. During the meeting, the opinions of the various institutions were gathered in preparation for the discussion of potential policies at the third workshop of the pilot

Workshop 3 Policy Options

The **third workshop** on policy design for the *Liquid Housing* Lab took place on January 22, 2025, in Tarragona, with the aim of identifying policies that can foster resilience in preparation for the four scenarios developed in the second workshop. The workshop brought together 20 participants from different institutions, who validated in focus groups 20 housing policies drawn from the Knowledge Base of the *FUTURESILIENCE* project, other European initiatives, and practices from various regions of Spain listed in the table below. Using the windtunneling approach illustrated in Figure 50 below, the effectiveness of each policy was assessed in all scenarios.

Wind-tunnelling				
Opción estratégica (fichas)	Escenario A	Escenario B	Escenario C	Escenario D (own elaboration)
Policy Card / Ficha de política 1				
Policy Card / Ficha de política 2				
Policy Card / Ficha de política 3				
Policy Card / Ficha de política 4				
Policy Card / Ficha de política 5				
Policy Card / Ficha de política 6				
Policy Card / Ficha de política 7				
Policy Card / Ficha de política 8				
Policy Card / Ficha de política 9				
Policy Card / Ficha de política 10				
Policy Card / Ficha de política 11				
Policy Card / Ficha de política 12				
Policy Card / Ficha de política 13				
Policy Card / Ficha de política 14				
Policy Card / Ficha de política 15				
Policy Card / Ficha de política 16				
Policy Card / Ficha de política 17				
Policy Card / Ficha de política 18				
Policy Card / Ficha de política 19				
Policy Card / Ficha de política 20				
Leyenda (*Legend*)	Estrategia estructural (*Core Strategy*)	Estrategia de apoyo (*Supporting Strategy*)	Estrategia contraproducente o con limitados efectos (*Counter-productive*)	

Figure 50: Windtunneling approach applied in the Liquid Housing Lab

The results were as follows:
The various policies are perceived differently depending on the scenario presented. They can be categorised as Structural (Core Strategy), Supportive (Supporting Strategy), or Counterproductive/with Limited Effects (Counter-productive). The following points can be highlighted:
a) Generally, policies are perceived as supportive strategies in Scenario C, with few considered structural. This may be due to Scenario C's more positive evolution compared to Scenarios A and B, leading to the perception that many structural policies are already fully or partially implemented. The same may be said concerning Scenario D, as the starting point is different from Scenarios A and B, i.e. it focuses more on the impact of climate change on the habitability of homes and on the persons living there,
b) Certain policies are identified as structural across all three scenarios:

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

- **Policy 8**: Observatory on Hidden Homelessness
- **Policy 12**: Role of Third Sector Entities
- **Policy 19**: Centralisation of Services

Other policies are deemed structural only in Scenarios A, B and D. These should also be considered essential for achieving resilience in this field, as they pertain to the more adverse scenarios. These include:

- **Policy 1**: Fiscal Framework
- **Policy 2**: Diversity of Housing Tenures
- **Policy 4**: Mobilisation of Empty Housing
- **Policy 5**: Budget Increase
- **Policy 14**: Registration Policy

c) Some policies consistently play a secondary or supportive role across all three scenarios:

- **Policy 7**: Specialised Advice on Housing
- **Policy 15**: Collaboration Networks
- **Policy 16**: Awareness Campaign
- **Policy 18**: Protocol for Young People Under Guardianship

d) Divergences are noted in the assessment of certain policies, such as:

- **Policy 3**: Promoting Co-living Initiatives
- **Policy 9**: Promote Social, Cultural, and Political Participation
- **Policy 11**: Housing as a Subjective Right
- **Policy 17**: Reduce the Digital Divide

These are perceived as supportive or having limited effects, potentially influenced by scenario evolution. For instance, Policy 3 is seen as impacting emancipation and birth rates—issues identified in the scenario's progression. Policy 9 is considered necessary for identifying needs rather than providing solutions and Policy 11 requires resources to be operational, which are scarce in Scenario B.

Detailed Policy Descriptions

Here are some comments of the participants about the policy cards:

Policy 1: It is suggested the prohibition of the liberalisation of officially protected housing. Fiscal measures must focus on vulnerable populations. It must be applied distinct tax considerations to rental income for the most vulnerable sectors.

Policy 2: Promote "downsizing," i.e., intergenerational exchange. Tenure should address housing needs corresponding to an individual's life stage without leading to precarious conditions (e.g., container housing). Increased dissemination and education are necessary. Additionally, encourage the conversion of commercial premises into residential units.

Policy 3: Community technicians should conduct follow-ups, identified as a primary issue. This measure is considered counterproductive in Scenario 2, as it affects emancipation and birth rates—problems detected in the scenario's evolution.

Policy 4: Encourage the rehabilitation and repopulation of rural areas with vacant housing. Prioritise positive incentives, such as tax benefits, especially for small property owners.

Policy 5: Allocate a sufficient portion of GDP to the construction of social housing and increase the budget for rehabilitating the housing stock, contingent upon offering affordable rentals. Address governance issues and the need for consensus across all administrative levels, as well as enhanced public-private collaboration.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

Policy 6: Emphasise the necessity of cooperation between the administration and third-sector entities, and the formalisation of actions among local organisations.
Policy 7: Promote alternative conflict resolution methods to judicial proceedings, highlighting the lack of resources and personnel.
Policy 8: Highlight the need for data quantification, with the observatory functioning as an external entity collecting data rigorously, objectively, and neutrally. Political consensus beyond the typical four-year term is essential.
Policy 9: This policy is necessary for identifying needs rather than providing solutions, though it should be part of a broader social policy at the community level, including neighbourhoods and homeowners' associations. In the scenario, it appears to be loosely connected to hidden homelessness.
Policy 10: Stress the importance of coordination and streamlined procedures, differentiating between large and small property owners. Small owners should not be broadly held responsible for functions that the administration should guarantee.
Policy 11: Considered necessary but requires adequate resources. Notably, in Scenario B, it is viewed as a mere declaration of intent rather than a tangible measure, emphasising the need for effective housing policies.
Policy 12: Third-sector entities are deemed crucial in public-private collaboration and efficient social housing management, though a regulatory framework is needed.
Policy 13: Suggest greater flexibility in granting work permits.
Policy 14: Recommend formalising the process to offer services, employment, training, etc.
Policy 15: Support is considered essential for individuals' life processes and should be led by the public administration, which must allocate resources and collaborate with the third sector.
Policy 16: Encourage intercultural and diverse encounters, including with homeless individuals, to raise awareness. Propose mandatory implementation in schools or institutes. Additionally, combat misinformation.
Policy 17: Provide support to individuals with low or no digital skills and aim to "humanise" technology.
Policy 18: Establishing a protocol is fundamental to determine the needs for addressing deinstitutionalisation by social services or shelters. The issue is noted to arise from the age of 18.
Policy 19: Perceived as essential as it would facilitate the coordination of all services.
Policy 20: Propose the role of a Public Property Administrator for communities lacking one. The administrator is often the first to detect issues and can serve as an effective communication channel with citizens, acting as intermediaries.

New policy cards

Participants in the focus groups proposed an additional measure: promoting territorial cohesion. This implies that public authorities should ensure the availability of housing not only in major cities but also in rural areas. Naturally, this must be accompanied by economic, employment, and connectivity strategies.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

Nº	Policy	3. List of policy cards Policy description	Source of inspiration
1	Fiscal framework	Create a fiscal framework aimed at: promoting an increase in the supply of affordable rental housing, for owners or tenants? Facilitating the construction of housing, e.g. by acting on building permits? Facilitating rehabilitation and energy efficiency? Facilitating the purchase of new housing?	"España 2050" 2021. 2º frente: Garantizar de forma efectiva el acceso a una vivienda digna y adecuada, reduciendo el esfuerzo económico y mejorando su adecuación, p. 269. https://www.lamoncloa.gob.es/presidente/actividades/Documents/2021/200521-Estrategia_Espana_2050.pdf.
2	Diversity of housing tenures	Encouraging alternative forms of tenure to ownership and renting: temporary ownership or shared ownership? Housing cooperatives with ownership or leasehold? Social rental? Co-living units with private rooms of 6m2 sharing common elements? Temporary local accommodation, made using industrialised methods from recycled shipping containers?...	EU Commission: Kenna, P., Benjaminsen, L., Nasarre-Aznar, S. and Busch-Geertsema, V., *Pilot project "Promoting protection of the right to housing – Homelessness prevention in the context of evictions"*, 2016, p. 197, https://data.europa.eu/doi/10.2767/463280.
3	Promoting co-living initiatives	Promoting initiatives for co-living in solidarity between young professionals aged 25 to 35 and people in very precarious living conditions (Home for All Alliance, Denmark) / Access to student housing for young people who want to become students in the "near future" (Lazare co-living project, Paris) / Intergenerational co-living experiences.	HSP Publication: 50 out-of-the-box Housing Solutions for the Locked Out (Solutions 1 & 2), 2019. https://www.feantsa.org/en/news/2019/12/11/hsp-publication-50-housing-solutions?bcParent=27. FUTURESILIENCE knowledge base: MERGING - Report on case analysis on five housing projects (1-12-2023)

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

Nº	Policy	3. List of policy cards Policy description	Source of inspiration
4	Mobilisation of empty housing	Mobilisation of empty housing from private owners to increase the supply of social rental housing. Private mechanisms (e.g. rent rehabilitation?; With positive incentives (e.g. subsidies/guarantees in exchange for allocating it to social rental)? With negative incentives (e.g. sanctions or expropriations)?	"España 2050" 2021. 2º frente: Garantizar de forma efectiva el acceso a una vivienda digna y adecuada, reduciendo el esfuerzo económico y mejorando su adecuación, p. 269. https://www.lamoncloa.gob.es/presidente/actividades/Documents/2021/200521-Estrategia_Espana_2050.pdf.
5	Budget increase	Guarantee a sufficient part of the GDP to finance housing policies. More construction and acquisition of housing? More aid to families for paying rent? More staff from the City Council and Social Services? More aid for rehabilitation?	Prof. Dr. Sergio Nasarre Aznar, "The challenges of housing in Europe. Special attention to the evolution of the situation in Spain", Popular Parliamentary Group in the European Parliament, 2025, p. 76, https://sergionasarre.eu/wp-content/uploads/2025/03/snasarre-challenges-of-housing-in-europe-2025.pdf.
6	Cooperation between organisations at local level	Local and/or regional integrated strategy to reduce hidden homelessness and thus facilitate cooperation between the various organisations and channel a local vision of shared support for these people.	Prof. Dr. Sergio Nasarre Aznar, "The challenges of housing in Europe. Special attention to the evolution of the situation in Spain", Popular Parliamentary Group in the European Parliament, 2025, https://sergionasarre.eu/wp-content/uploads/2025/03/snasarre-challenges-of-housing-in-europe-2025.pdf, pp. 73-75.
7	Specialised advice on housing	Specialised advice service on housing, e.g. late payment of rent, drug use, mental health problems and poor maintenance of flats, as well as various cultural conflicts between neighbours.	*Estudio sobre los procesos de desinstitucionalisación y transición hacia modelos de apoyo personalizados y comunitarios*, Personas en situación de sinhogarismo, https://estudiodesinstitucionalizacion.gob.es/wp-content/uploads/2024/01/3.-Estudio-EDI-Sinhogarismo.pdf. Good practice: Servicio de asesoramiento sobre vivienda de Helsinki, p. 128.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

Nº	Policy	3. List of policy cards Policy description	Source of inspiration
			HSP Publication: 50 out-of-the-box Housing Solutions for the Locked Out (Solutions 37), 2019, https://www.feantsa.org/en/news/2019/12/11/hsp-publication-50-housing-solutions?bcParent=27.
8	Observatory on hidden homelessness	Create an observatory/body that allows us to understand the reality of the problem of hidden homelessness.	"España 2050" 2021. 5º frente: Mejorar los instrumentos de gobernanza, monitoreo y evaluación de las dinámicas territoriales, p. 273, https://raco.cat/index.php/PapersIERMB/article/view/429360/523764
9	Promote social, cultural and political participation	Promote the social, cultural, socio-economic and political participation of people (e.g. access to ordinary leisure, cultural and sports activities and facilities, as well as their social, cultural and political participation for their active participation in public housing policies. Through the Consell de l'Habitatge; neighbourhood associations, etc?) .	FUTURESILIENCE knowledge base. RE-INVEST - Social investment in basic service sectors for vulnerable groups (30 Aug 2023), p. 48. Fondation Abbé Pierre, FEANTSA, and ASF, Ending the Criminalisation of Homelessness in Europe, 19-12-2024. The voices of homeless individuals must be given much greater weight, and their perspectives should be integrated into the development of public policies, p. 16, https://www.feantsa.org/public/user/Resources/reports/2024/HNG/SANC_Brochure_EN_V1_1.pdf
10	Measures against evictions	Avoiding losing housing through eviction is just as important as access to housing. It is essential to adopt effective measures to prevent, deal with and respond to evictions when vulnerable groups are involved. Through... help with rent or mortgage payments? legal moratoriums on evictions? advisory services? improving dialogue between social services and courts?	EU Commission: Kenna, P., Benjaminsen, L., Nasarre-Aznar, S. and Busch-Geertsema, V., *Pilot project "Promoting protection of the right to housing – Homelessness prevention in the context of evictions"*, 2016,p. 196, https://data.europa.eu/doi/10.2767/463280.
11	Housing as a subjective right	Recognise the right to housing as a subjective right, either in the constitution or in the country's legislation, and clearly	The Housing Law of the Basque Country (Law 3/2015, of June 18) has been an important milestone in the deepening of social rights, with the recognition of the subjective right to the legal and stable occupation of a home, see https://www.etxebide.euskadi.eus/derecho-subjetivo-acceso-vivienda/.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

Nº	Policy	3. List of policy cards Policy description	Source of inspiration
		define the responsibilities of the different levels of public authority in housing matters (including regions, provinces and municipalities) / At local level, agreement signed by political leaders and public housing managers, so that the City Council establishes a housing guarantee for people in a situation of hidden homelessness.	
12	Role of third sector entities	Promote the participation of entities from the social third sector and/or the social economy in the promotion and management of housing solutions and community alternatives for coexistence aimed at people in a situation of serious residential exclusion.	Third Sector entities specialising in social and affordable housing have joined together to create AVIVAS, the network to transform the current real estate model. It seeks to move the European figure of Housing Associations (organisations that, from non-profit or limited profit, promote, build, buy, rehabilitate and manage affordable and social housing, supported to a greater or lesser extent by public administrations to promote it 'activity. to our country), see https://www.cohabitac.cat/en/avivas-arrives-the-first-non-profit-state-alliance-for-social-and-affordable-housing/
13	Educational and training resources	Develop educational, training and socio-labour resources specifically aimed at people in a situation of serious residential exclusion and promote active employment policies that take into account their needs.	Educational level has also been shown to be a protective factor against exclusion in this recent past, which has been characterised by the effects of the economic crisis. The higher the educational level, the lower the rates of social exclusion, and in particular, of severe social exclusion. FOESSA, Informe sobre exclusión y desarrollo social en España, 2019, p. 209, https://www.foessa.es/main-files/uploads/sites/16/2019/06/Informe-FOESSA-2019_web-completo.pdf.
14	Registration policy	To promote the registration (sometimes fictitious) of people residing in the municipality and facilitate their administrative regularisation, thus avoiding indirect discrimination by the Administration.	Good practice at Fundación Atenea, *La exclusión social de las personas jóvenes desde la vivienda, un análisis con perspectiva de género*, 2022, p. 144, https://fundacionatenea.org/wp-content/uploads/2024/01/Exclusion-residencial-poblacion-joven.pdf.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

Nº	Policy	3. List of policy cards Policy description	Source of inspiration
15	Collaboration networks	Strengthen emancipation and support programmes in the transition to adult life aimed at young people, migrants or natives, without family references.	See Exclusión residencial entre las personas jóvenes: desafíos y propuestas para una sociedad más inclusiva, Revista de Estudios de Juventud, October 2023, nº 127, pp. 40-41, https://www.injuve.es/sites/default/files/adjuntos/2024/01/revista-estudios-juventud-127-sinhogarismo-exlusion-residencial.pdf.
16	Awareness campaign	Promote activities aimed at raising public awareness about the problem of hidden homelessness, e.g. to combat discriminatory practices in the tenant selection process. Role of public entities? Of private entities?	Fondation Abbé Pierre, FEANTSA, and ASF, *Ending the Criminalisation of Homelessness in Europe*, 19-12-2024. It is therefore key to launch a counter-narrative and claim a larger presence in the media. Organisations need to use these platforms to convey a different image of people experiencing poverty and raise awareness of the challenges they face, p. 16, https://www.feantsa.org/public/user/Resources/reports/2024/HNG/SANC_Brochure_EN_V1_1.pdf
17	Reduce the digital divide	Promote policies to reduce the digital divide: training programmes in digital skills? More infrastructure? Easy access via Wi-Fi networks in public areas, etc.?	Partners feedback.
18	Protocol for young people under guardianship	Have a protocol for young people under guardianship when dealing with deinstitutionalisation. Articulate active measures that help the process of transition of adolescents towards an independent life.	Fondation Abbé Pierre, FEANTSA, and ASF, Ending the Criminalisation of Homelessness in Europe, 19-12-2024. Inspired in vulnerable individuals exiting prison or recovering from long stays in general or psychiatric hospitals (Effective housing and relocation solutions should be established for those transitioning from institutional settings), p. 16, https://www.feantsa.org/public/user/Resources/reports/2024/HNG/SANC_Brochure_EN_V1_1.pdf. Amaia Bravo, Iriana Santos-González, Menores extranjeros no acompañados en España: necesidades y modelos de intervención, Psychosocial Intervention, Volume 26, Issue 1, 2017, pp. 55-62, https://doi.org/10.1016/j.psi.2015.12.001.
19	Centralisation of services	Centralising all needs and problems related to housing and hidden homelessness in a single centre of attention in the municipality.	Observatorio de la Juventud y de las Mujeres Jóvenes, Exclusión residencial entre las personas jóvenes: desafíos y propuestas para una sociedad más inclusiva, Revista de Estudios de Juventud, 127, 2023, Programa Futuro&Co, pp. 165 ff., https://www.injuve.es/sites/default/files/adjuntos/2024/01/revista-estudios-juventud-127-sinhogarismo-exlusion-residencial.pdf.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

№	Policy	3. List of policy cards Policy description	Source of inspiration
20	Role of property managers	Property managers can identify the communities of property owners in the municipality where vulnerable people, the elderly or those with mobility problems reside, and encourage the creation of support networks and help with problems of accessibility, energy efficiency, etc. in collaboration with the municipality.	Partners feedback.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

On Monday, 7 April, a **meeting** was held with the **Tarragona City Council** to assess the feasibility of implementing the policies proposed during the third workshop. During the meeting, it was highlighted that the implementation of certain policies would require the adoption of regulations at the regional level (for instance, Policy 1 concerning fiscal measures, Policy 4 regarding sanctions and expropriations of vacant housing, and Policy 5 related to budgetary increases). It was further noted that some policies are already being implemented (such as Policy 2 on the diversification of housing tenures), while others could be promoted directly by the City Council. These include initiatives such as awareness-raising campaigns (Policy 16), the promotion of social and cultural participation (Policy 9), and fostering greater cooperation among local organisations. Moreover, the centralisation of services (Policy 19) was identified as a priority, considering that the implementation of several policies (e.g., Policy 10 on eviction measures, Policy 14 on registration procedures, and Policy 18 on protocols for individuals under guardianship) largely depends on the actions of the Social Services Department.

4.6.3 Achievements

The achievements of the lab with regard to the initial challenges are the following:

a) **Raise awareness about** the "liquid housing" phenomenon. Thanks to the survey conducted in the beginning of the project we succeeded in providing evidence about this phenomenon in Tarragona, although more surveys are needed to have a clearer picture of this problem. The findings show that **33% of respondents** report the presence of **squatted housing** in their area of Tarragona, as well as **families at risk of eviction (9%)**, **dwellings lacking minimum habitability standards (24%)**, **situations of energy poverty (20%)**, and **overcrowded housing (17%)**. The percentages are lower among respondents who are **members of their building's homeowners' association board**—for instance, **squatted housing and families at risk of eviction are reported by only 7%** of this group.

This can be explained by the fact that such issues are typically concentrated in communities **without a property manager**. Regardless, this project corroborates the findings of a report prepared for the **Barcelona Ombudsman**, which confirmed the existence of these **hidden homelessness** situations in the city of Barcelona.

b) **Partners involvement**. The lab has succeeded in involving institutions with different visions on the housing issue, which has allowed the discussions to find the right balance between housing as a human right and as a financial asset, necessary for the viability and success of the housing policies to be adopted, as well as to take into consideration the specific features of the groups most affected by this phenomenon. See Appendix I for more details.

c) **Policy diversity.** There are a variety of factors behind the phenomenon of hidden homelessness, so a holistic approach to this issue is necessary. For this reason, the proposed policies were grouped into five major blocks: 1) Housing Policies; 2) Cohabitation Initiatives; 3) Governance; 4) Social Housing Management; and 5) Integration and Training Policies.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

4.6.4 Lessons learnt

The lessons learnt after the lab in implementing the lab from a practical and methodological perspective are the following:

1. Already created networks of cooperation. Partner involvement was facilitated by the fact that many were already partners of the UNESCO Housing Chair, while others were members of either the Tarragona Housing Council or the Care Network for Homeless People of Tarragona, in which the Chair also participates. Thus, the existence of dedicated bodies or associations on this topic (in our case, housing) at the local/regional level made it easier for them to engage in the project.

2. Partners availability. The guide stipulates that workshops should last 7–8 hours, potentially spanning two days. However, due to time constraints for participants, it was not possible to organise the workshops over consecutive days. As a result, each workshop was limited to a maximum of four hours in the evening. To optimise the available time, prior preparation by the research team is necessary.

3. Mentor involvement. The mentor's role is essential in guiding projects through the workshop process. Implementing a novel methodology requires more than just a training session; ongoing support is crucial for its success.

4. Methodological considerations. The projections for Scenarios 1 and 2 shared some similarities, while the third scenario differed significantly (see Appendix V). This suggests that the projection of the first factor—whether it follows a more favourable (divergent) trajectory or an expected continuation of current trends—directly influences the overall scenario development. Also, different partners with different perspectives poses the importance of taking control of the discussions in the focus-groups. One moderator of the local team taking part in each in each focus group would help to achieve this. In addition, it was difficult to implement the wild cards within the focus-groups due to time constraints.

5. **Partners interaction**. It is worth noting that the methodology was also new to the partners, who were not used to interacting with other types of institutions (e.g., foundations collaborating with professional associations). The experience proved to be positive for them, and as a result, they may incorporate this methodology into their own institutions.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

4.7 MULTILOCAL Lab

Abstract
The MULTILOCAL Lab examined how emerging multilocal living arrangements and shifting residential mobility trends are transforming local governance, particularly in the context of overlapping polycrises such as climate change, the COVID-19 pandemic, and geopolitical instability. Centred on Tartu County in Estonia, the lab co-developed an innovative digital tool for scenario-based population forecasting that enables municipalities to simulate future tax revenues and public service needs based on dynamic mobility patterns.

Through a series of co-creation workshops, the lab engaged stakeholders from various governance levels to ensure the practical relevance of its outputs. It produced three territorially grounded development scenarios, each designed to test the resilience and feasibility of proposed policy actions. The process revealed five key factors—security, sustainable transport, service organisation, evolving communication channels, and municipal responsibilities—that exert widespread influence across all scenarios.

The findings underscore the urgency of adaptive, data-driven, and locally grounded policymaking to safeguard service delivery, promote territorial cohesion, and navigate future uncertainties. The MULTILOCAL Lab contributes actionable insights for building future-resilient governance models in Estonia and beyond.

- Local Partners: University of Tartu; CentAr
- Mentors: Foresight Centre and EFIS Centre

4.7.1 Description of the lab

The MULTILOCAL Lab pilot addressed the governance challenges emerging from shifting residential mobility and the rise of multilocal living arrangements, both of which were intensified by overlapping crises such as the COVID-19 pandemic, the war in Ukraine, rising energy costs, inflation, and the climate crisis. These trends led to new living patterns where people increasingly reside and access services in multiple municipalities, putting pressure on existing models of local-level public service provision.

The aim of the MULTILOCAL Lab was to understand these evolving spatial patterns and, by bringing together academic expertise and stakeholder knowledge, identify the most suitable policy responses to support local adaptation. Within a co-creation framework, the project successfully developed a web-based digital tool for building local population projection scenarios. This tool enables municipalities to simulate future population changes and assess the implications for service demand and local revenues, using the most up-to-date and integrated data sources.

The objectives of the MULTILOCAL Lab were achieved as follows:

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

- A clearer understanding was reached on how multilocal living arrangements are evolving and what consequences they have for governance and service provision
- A digital forecasting tool was created to support data-informed decision-making at the local level
- A set of policy recommendations was formulated to promote sustainable and integrated responses to the new spatial dynamics.

The work was carried out jointly by the University of Tartu—the leading university in Estonia with long-standing expertise in regional development, residential mobility, family activity spaces, governance, and urban policy—and Eesti Rakendusuuringute Keskus CenTAR (Estonian Centre for Applied Research), a partner with strong capabilities in quantitative analysis, data visualisation, and policy co-creation.

4.7.2 Initial needs and challenges

Over the past decades, the world has faced a growing number of complex and overlapping challenges—including climate change, demographic imbalances, migration pressures, and the COVID-19 pandemic. As a result, resilience has become a key component of public policy. Designing effective policy responses in this context requires up-to-date, data-driven analysis that integrates multiple data sources, applies mixed methods, and uses new digital tools. These tools enable reliable forecasting and the design of alternative scenarios, which are crucial given the high level of uncertainty facing today's societies.

In Estonia, having a second home is a common phenomenon**.** For example, around 5,000 residents of Tartu city have a second home elsewhere in Tartu County. This creates a multilocal lifestyle involving regular movement between locations and a corresponding need for public services in both places. Similarly, a comparable number of people have their main residence outside the Tartu urban region and a second home within it. Multilocal living also includes frequent commuting between municipalities—although digital opportunities have reduced the need for daily travel. In neighbouring municipalities, 40–60% of the working population is employed in Tartu, while in more distant rural areas within the region, about one-third of residents are connected to Tartu for work.

Between 2021 and 2023, several suburban and more remote municipalities gained population through residential mobility**,** with suburbanisation—settling in neighbouring municipalities—being the most prominent trend. Preferences for suburban and rural living vary by socio-economic status. Higher-income households tend to relocate closer to the core city of Tartu, while lower-income groups are more evenly spread across the broader region. Meanwhile, the city of Tartu has experienced population loss due to these outward mobility patterns.

The context of polycrisis has exposed the limitations of traditional, binary understandings of regional population dynamics. The intersection of climate change, digital transition, housing affordability challenges, and the large-scale arrival of Ukrainian refugees has reshaped mobility patterns and made multilocal living more widespread. Urban and rural areas are becoming increasingly interconnected, and many urban families have acquired second homes in rural locations—for reasons such as food security, lifestyle, or perceived safety.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

4.7.3 Work done in the lab

The MULTILOCAL Lab case study focused on the urban region of Tartu, Estonia's second-largest urban area, which includes both the core city and its surrounding rural municipalities (with a total population of approximately 162,000, nearly 100,000 of whom live in the city of Tartu). The Lab examined emerging patterns of residential mobility and multilocal living within the broader context of the ongoing polycrisis.

The main objective was to co-create future scenarios for the region in collaboration with stakeholders and to develop an innovative, demography-based digital tool to support strategic decision-making and spatial planning. At the policy level, the goal was to formulate governance strategies and evidence-based policy recommendations grounded in the project's research findings.

Through a range of activities, the MULTILOCAL Lab directly contributed to the overarching objectives of the FUTURESILIENCE project. Its implementation followed the common framework and guidelines applied across all pilot cases (Figure 55). A more detailed breakdown of activities is provided in the Gantt Chart (Appendix II).

The Lab was structured into three distinct stages, each employing a mix of methods and approaches to support operationalisation and generate meaningful results. The development of the digital tool began in the first stage and continued throughout the project, evolving in parallel with growing insights into local needs and potential future scenarios.

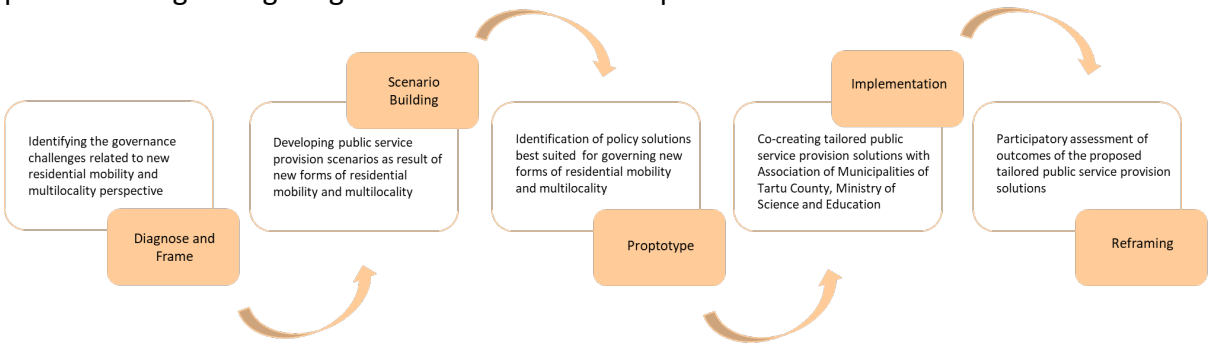


Figure 51: Structure of the MULTILOCAL Lab activities

Stage 1 – Diagnosing and Framing

In this stage, challenges were identified using foresight and design thinking methods. It addressed the first objective of the project by establishing the conceptual framework and conducting desk research, including a literature review, data collection, and data analysis. At the same time, a co-creation framework was initiated, including the formation of a stakeholder network to diagnose the most pressing local and regional challenges related to public service delivery in the context of the polycrisis.

This stage also involved the initial design of the project's central output—a digital tool for population forecasting and public service planning. The findings from the desk research directly informed the early development of the tool's concept and functionality.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

This stage is divided into following activities:

Stakeholder Mapping: All relevant stakeholders were identified based on a preliminary list, which served as the basis for inviting key actors to actively participate in the Lab's activities.

Desk Research and Data Analysis: This included:

a) literature review to understand current trends in residential mobility and multilocal living in the context of polycrisis and their implications for local governance, and
b) data preparation and quantitative analysis of actual mobility flows, multilocal living arrangements, and daily mobility patterns (residences, workplaces, schools) within the Lab area. By combining multiple data sources—registry data, census data, and desk research—the Lab conducted a robust analysis of residential and daily mobility trends in the Tartu urban region over the past four years (since 2020). Key mobility patterns and multilocal living arrangements were identified and contextualised using findings from other studies.

1st Co-Creation Workshop (held on 7 May 2024): This event brought together 15 participants, including experts, stakeholders, and representatives from local and national government institutions, as well as the Estonian Foresight Centre. The workshop had two main objectives:

a) to receive feedback on the preliminary research results, and

to explore the implications of identified mobility trends on future local service provision. Using the STEEP analysis framework, participants jointly identified the key challenges and implications across Social, Technological, Economic, Environmental, and Policy dimensions presented in Table 10 and Table 11.

Table 10: MULTILOCAL Identified Challenges

Social	Technological	Economic
▪ social inclusion & integration ▪ value systems and potential conflicts based on the different views on the local neighbourhood developments ▪ feeling of security ▪ aging	▪ demand for sustainable transport and mobility ▪ technical infrastructure ▪ need for fast internet connections	▪ infrastructure needed to develop new industries ▪ demand for new residential buildings and infrastructure, including rental apartments

Environmental	Political
▪ reuse of buildings and existing infrastructure ▪ pollution, recycling systems, green infrastructure	▪ challenges on planning ▪ higher pressure on budget ▪ reorganization of public transport system

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

▪ environmental values	▪ innovations in transport – demand-based transport and shared transport ▪ provision of childcare and schools preparing for possible future crises

Table 11: MULTILOCAL Selected Influencing Factors

STEEP ANALYSIS	
Dimension	**Findings**
Social	Social alienation, communication through social media
Social	Revitalisation of home areas
Social	Value and expectation differences between new and long-term residents (e.g., harbours, shoreline access)
Social	Integration with village communities (especially in dispersed areas and new developments)
Social	Increased safety when more people live nearby
Social	Aging population
Technological	Young families prefer urban living
Technological	Increased demand on infrastructure – light traffic roads, sidewalks, main roads
Technological	Need for proper water and sewage systems
Technological	Need for fast internet connection
Economic	Evolution of schools and libraries into multifunctional spaces
Economic	Creation of new jobs
Economic	Need for infrastructure related to workplaces
Economic	High housing prices in cities, cheaper options further from the centre
Economic	Lack of affordable rental housing for smaller families
Economic	Larger plots/homes becoming more attractive
Environmental	Renovation of abandoned houses
Environmental	Development of vacant land
Environmental	Increased car use and traffic due to commuting
Environmental	Waste management issues
Environmental	Pressure on environmental aesthetics (e.g., greenhouses blocking views)
Political	Planning becoming more complex
Political	Road maintenance and service costs increasing
Political	Community-based transport and local activities replacing outdated models
Political	Need for services close to home (childcare, schools, libraries), requiring flexible or duplicated solutions
Political	Security concerns (war, food)
Political	Lack of in-migration
Political	Need to coordinate public transport and align with actual demand
Environmental	Growing pressure on natural environments – decisions about what type of development is acceptable

▪

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

Digital Tool Design: The conceptual design of the digital population forecasting tool was developed, incorporating feedback received from workshop participants. Key functionalities were tested and validated to ensure alignment with user needs and planning requirements.

Stage 2 – Scenario Building and Prototyping

Building on insights from Stage 1, this phase resulted in the creation of a range of possible future scenarios—both expected and unexpected. The stage consisted of the following steps:

Assessment of impact and uncertainty levels for each identified challenge. This was done via a questionnaire sent to all involved stakeholders, asking them to evaluate each factor. Respondents rated the uncertainty on a 2-point scale and the impact on a 6-point Likert scale.

Figure 52: MULTILOCAL Impact Uncertainty Assessment (Survey)

The second workshop (held on 15 October 2024), with a total of 10 participants) brought the stakeholders together again. It had two main objectives:

a) to assess the aggregate impact of key development factors through a **Tetralemma and cross-analysis exercise**, and
b) to define potential development trajectories for each selected factor, using the following typology:
A – expected future/current forecast,
B – confrontational development,
C – hybrid option,
D – radical shift in development trajectory.

The analysis identified which factors had the most influence over others and outlined possible development pathways for each key factor.
The resulting cross impact matrix is shown in Figure 53.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

	Passiivne SUM	12,5	12,0	13,0	11,5	13,5	12,0	16,5	11,5
Aktiivne SUM		Security	Affordable housing	Sustainable transport	Circular economy	Service organisation	Changing communication	municipal responsibilities	healthcare
21,0	Security		3,00	3,00	3,00	3,00	3,00	3,00	3,00
10,0	Affordable housing	1,50		1,00	1,50	1,50	2,00	1,50	1,00
14,0	Sustainable transport	2,00	2,50		1,00	2,00	1,50	2,50	2,50
10,5	Circular economy	2,00	1,00	1,00		2,00	1,00	2,50	1,00
12,5	Service organisation	1,50	1,5	2,00	1,50		2,00	2,00	2,00
11,5	Changing communication	2,00	1,00	2,00	1,50	1,50		2,50	1,00
11,5	municipal responsibilities	1,50	1,50	2,00	2,00	2,00	1,50		1,00
11,5	healthcare	2,00	1,50	2,00	1,00	1,50	1,00	2,50	

Figure 53: MULTILOCAL Influencing Matrix

As a result, we identified the factors that have a strong influence on other factors:

- Security
- Sustainable transport
- Service organisation
- Changing communication
- Municipal responsibilities

For these factors the four different projections shown in Table 12 were developed through the Tetralemma exercise.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

	Security	Sustainable Transport	Service Organisation	Changing Communication	Municipal Responsibilities
Expected Development	Stable but tense readiness	Moderate development, spatially uneven	Spontaneous concentration	Fragmentation of communication channels	State assigns more tasks, complexity grows
Confrontational Development	War, global climate catastrophe	Technological, social innovation	Optimal concentration, well-planned	Agreed-upon, widely supported channels	Municipal autonomy, reduced complexity
Hybrid Development	Attacks on infrastructure, manipulation	Restrictions on car use	Moderately guided concentration, uneven development	Emergence of informal authoritative channels	Regional cooperation strengthens, complex issues handled jointly
Radical Shift	Peace	Sharp drop in mobility needs	Disappearance of need; e-services and home services	Total information chaos (ChatGPT-like confusion)	Private sector and communities become service providers

Table 12: MULTILOCAL Factor projections

Based on the results of the workshop, **three logically consistent scenarios** were formulated by combining consistent factor projections as illustrated in Figure 54.

1. Digital Development (Orange)
2. Rising Tensions (Pink)
3. Diversifying Living Arrangements (Green)

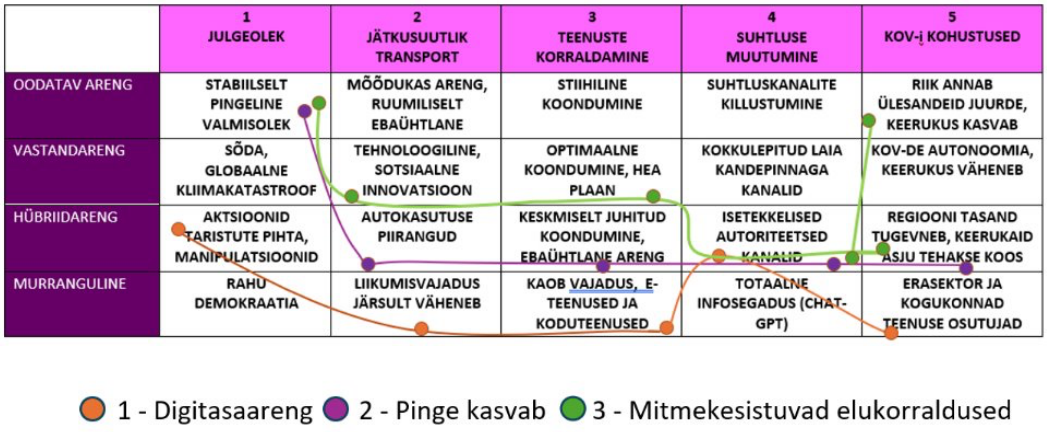


Figure 54: MULTILOCAL Scenario Pathways

Starting from these pathways we developed the following scenario narratives:

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

Scenario 1: Digital Development
In the future, society is fully digitalised, with physical presence reduced to a minimum. Virtual environments such as Teams and Zoom replace traditional work and meeting models. Physical workspaces lose relevance, while drones and autonomous vehicles deliver goods and services directly to homes. Urban traffic is redesigned for pedestrians and cyclists, with car-free zones established in city centres.

All essential services—healthcare, education, banking, and administration—have moved into virtual space. Doctors consult with AI support, schools and universities provide fully digital programs, and commerce is largely conducted through e-commerce platforms. However, local governments struggle to align and integrate digital platforms, especially in the education sector. Platform fragmentation hampers seamless service delivery and increases administrative costs. Service quality is harder to maintain, as digital services lack the personal touch and control of in-person services.

While digitalisation increases accessibility, the digital divide becomes more critical—those excluded from technology or living in rural areas risk losing access to services. Autonomous delivery services are more expensive in sparsely populated areas with lower purchasing power.

Fragmented communication channels and AI-driven information streams deepen social polarisation and spread misinformation. Trust in official service providers weakens, and people may opt for alternative but potentially lower-quality solutions. The lack of reliable central information sources creates an information-saturated but less trustworthy society. Rising scepticism toward institutions may lead to segments of the population avoiding public services altogether, endangering public health and access to education.

Local governments retreat from service provision, transferring responsibility to the private sector and communities. The services provided vary depending on funding and leadership culture. Cities grow more attractive due to superior digital infrastructure, while rural populations continue to decline as services become more expensive and harder to access. The link between place of residence and workplace weakens—many residents become 'invisible' in municipal tax records due to remote work tied to legal entities in other regions or countries.

Scenario 2: Rising Tensions
Global conflicts, economic crises, and climate change create a complex and unstable world with limited resources and constant adaptation. Carbon taxes and car-use restrictions are introduced in cities to reduce emissions, but these measures intensify transport and cost-of-living crises. In rural areas, green transition investments remain insufficient, resulting in inefficient energy and water systems and worsening living conditions.

Public service provision increasingly relies on regional cooperation, as individual municipalities struggle to independently deliver quality education, healthcare, and social care. While some municipalities are well-organised and funded, others are fragmented and underfunded, leading to regional inequality. Economic disparity and crises drive population

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

shifts toward areas with better living conditions and services, overburdening local centres and exacerbating imbalances. Some municipalities benefit from tax revenue growth, while others become more vulnerable. Rural population decline leads to further shrinkage of the local economy and services, forcing residents to rely on informal networks and self-organisation.

The lack of trustworthy information and isolated communication channels deepen societal fragmentation. Communities become dependent on internal networks and interpret reality through community-based channels, with low trust in the public sector and media. This hinders implementation of common policies—some areas support cooperation and reform, while others are driven by opposition and scepticism. Local governments lose much of their autonomy due to limited financial resources, becoming intermediaries for national and international decisions.

At the same time, municipalities face increasing pressure to collaborate and pool resources. Many regions must merge education, healthcare, and administrative services to cut costs and improve quality. Where cooperation functions well, service levels are maintained, but where it fails or resources are lacking, problems worsen.

This scenario results in major demographic shifts, with people migrating to areas offering better living conditions and more stable services. Urbanisation intensifies, and rural areas face deepening population decline, tax revenue loss, and increased dependency on national aid or local self-organisation.

Scenario 3: Diversifying Living Arrangements
Society moves toward diversified development, where local and global trends intersect to shape various models of living. Major cities invest in sustainable transport and energy infrastructure—public transport is efficient, electric vehicles are widespread, and smart traffic management ensures smooth movement. Meanwhile, rural areas remain reliant on fossil-fuel-based transport, and infrastructure development is uneven.

Hybrid lifestyles—splitting time between urban and rural living—become increasingly common. Urban residents with remote work opportunities spend more time in the countryside, boosting local consumption and revitalising rural economies. Families and professionals choose to live part-time in both locations, reducing permanent out-migration and creating opportunities to expand local services. New digital platforms connect urban dwellers with rural areas, enabling short-term rentals, remote farming, and part-time community involvement, with local decisions made in virtual community forums.

Despite this, resource allocation continues to Favor large urban areas, which attract investment and skilled labour. Rural regions face population decline and decreasing service availability. However, some communities succeed in organising local education, healthcare, and care services through collaborative models, shared platforms, and skill-exchange systems. Regional cooperation helps mitigate certain challenges.

Some rural areas also attract investment in microgrid-based energy systems, producing their

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

own solar, wind, and bioenergy, achieving energy independence. Others adopt smart farming systems powered by AI and drones, reducing labour needs and increasing yields. Thus, while some regions thrive, others remain fragmented and heavily reliant on state support.

Local government autonomy and responsibility vary—some areas have strong local leadership and flexible solutions, while others depend on regional cooperation and national directives. A mix of digital and physical services is the norm, but quality and accessibility remain uneven. Successful regions are those that embrace the hybrid lifestyle trend and retain both permanent and part-time residents, revitalising rural areas and supporting sustainable local economies.

The **digital tool was piloted** by participants using a prepared set of exercises. The tool received very positive feedback, and additional input was collected to further refine its functionality in Stage 3.

Stage 3 – Scenario Assessment and Policy Design

In the final phase of the project, potential policy actions aligned with the selected scenarios were shortlisted, and Workshop 3 was held on 12 February 2025, with a total of 13 participants.
The workshop focused on assessing the three scenario narratives developed in Workshop II results by:
a) identifying related opportunities and threats (c.f. Table 13)
b) mapping the most appropriate policy measures for each scenario.

Table 13: MULTILOCAL Scenarios Risks and Opportunities

Scenario	Opportunities	Risks
Rising Tensions	Growth of second-home usage	Complex cooperation needs between municipalities and communities for joint services (e.g., schools, governance)
	Encourages innovation and resilience	Uneven development: migration flows to 'better branded' areas
	Resource reprioritisation due to declining revenues	Infrastructure fails to keep pace with demand
	Boosts local tourism; climate refugees attracted to Estonia	Regional disparities intensify, especially along the eastern border (e.g., wind farm restrictions, lack of investment)
		Predicting service needs becomes harder (seasonal/weekend variation)
		Low uptake of demand-based transport due to cultural preferences
Digital Development	Attracting remote workers with official registration	Service access worsens for people with low digital skills

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

Scenario	Opportunities	Risks
	New collaborative networks emerge	Uneven data connectivity and internet quality
	Innovative services improve and become more accessible	Isolation, increased individualism, weakened social networks
	Enables living even further from urban centres	Uneven regional access to services; areas may suffer
	Reduced need for transport resources	Civic engagement declines, especially in digitally excluded areas
		Address registration problems persist, leading to revenue gaps
Diversifying Living Arrangements	More diverse communities and improved territorial cohesion	Large city centres may experience decline and insecurity
	Strengthened social ties and local service quality	Migration flows to high-reputation areas deepen inequalities
	Growth of smart villages, energy communities, and local innovation	Infrastructure and support systems may not keep up (e.g., mobile coverage, buses, internet)
	New satellite urban centres emerge near cities (e.g. Rae municipality)	Rising complexity in service provision due to high variation in needs

A preliminary list of 10 policy actions had been prepared in advance. During the workshop, participants evaluated each action in terms of its relevance and suitability for the scenarios using a colour-coded system:
Green: Highly suitable and effective within the scenario;
Yellow: Potentially useful, but more appropriate as a background or supporting measure;
Red: Not suitable or counterproductive in this scenario

In addition, participants proposed new complementary measures, which were incorporated into the final list:

Table 14: MULTILOCAL Selected Policy Options

Car-Free Zones in Cities
Description: Restrict the use of private cars in city centres and create car-free zones to improve air quality and mobility.
Objective: Reduce traffic congestion and environmental pollution.
Target Areas: Urban centres and high-density zones.
Integration of Shared Mobility Platforms
Description: Combine public transport systems with sharing economy platforms (e.g., ride-sharing, bike rentals) for more efficient urban travel.
Objective: Improve accessibility, reduce car dependency, and optimise urban mobility.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

Target Areas: Metropolitan areas and transport corridors.
Support for Green Transport
Description: Implement tax incentives and subsidies for electric vehicles and electric buses to speed up the transition to sustainable transport.
Objective: Decrease reliance on fossil fuels and lower greenhouse gas emissions.
Target Areas: All levels – national, regional, and local governments.
Expansion of Public Services
Description: Deliver healthcare, education, and social services directly to households through both virtual and physical solutions.
Objective: Improve service accessibility, especially in remote and underserved areas.
Target Areas: Rural regions, smaller municipalities, aging populations.
Regulation of Intermunicipal Cooperation
Description: Strengthen cooperation between municipalities to increase service efficiency and accessibility through formal frameworks.
Objective: Improve cost-effectiveness and ensure service continuity across local borders.
Target Areas: Small and mid-sized municipalities, regional governance networks.
Flexible Social Services Model
Description: Provide healthcare and social services flexibly, without strict residency-based restrictions.
Objective: Allow people to access services based on real needs and living patterns, especially for multilocal or mobile populations.
Target Areas: Nationwide, with focus on multilocal contexts.
Strengthening Public-Private and Cross-Sector Partnerships
Description: Establish a framework for partnerships between public, private, and civil society actors to ensure high-quality and efficient service provision.
Objective: Leverage diverse capacities and foster innovation in service delivery.
Target Areas: Local and regional service sectors, social innovation ecosystems.
Income Tax Distribution Between Multiple Residences
Description: Create a system that allows income tax to be proportionally distributed between municipalities where individuals have multiple residences.
Objective: Ensure fairer distribution of tax revenue and reduce funding disparities between urban and rural areas.
Target Areas: National tax systems, local governments, digital registries.

The core group of participants remained consistent throughout the three-stage process. While some participants were unable to attend the second workshop, and a few dropped out over time, the co-design process was largely successful, with most contributors staying engaged from start to finish.

4.7.4 Achievements

Key Outcomes

The MULTILOCAL Lab activities resulted in several key outcomes. First, a data-driven analysis was conducted, leading to scientific outputs such as presentations and a short article. These

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

results have since informed follow-up studies and ongoing projects. The scientific contributions include:
a) an overview of residential mobility and emerging multilocal living and mobility patterns in the Tartu urban region
b) a structured dataset that provides a foundation for analysing residential mobility in future academic research.

At the practical level, three development scenarios were created, each highlighting different modes of service provision:

1) localised services,
2) remote service delivery,
3) commuting-based service models.

These scenarios explore how local services could be transformed or adapted, emphasising the roles of various actors—including individuals, service providers, employers, and policymakers. The scenarios and corresponding policy options offer valuable input for policymakers developing regional or municipal strategies.

A second major output of the MULTILOCAL Lab is a web-based simulation tool was developed to support evidence-based local governance and fiscal planning. The tool enables municipalities to estimate and forecast income tax revenue based on demographic and income data, helping them to adapt to changing population and labour market dynamics.

Using demographic projections and income profiles derived from administrative datasets, the tool allows users to simulate how future developments—such as population ageing, migration, or shifts in employment—may affect municipal tax revenue. It offers flexible scenario modelling to explore the potential impacts of policy decisions or macroeconomic trends on local income bases.

The tool supports planning for long-term infrastructure, service delivery, and resource allocation by giving municipalities clear insight into how their tax base might evolve. It also facilitates comparison between different local governments, helping to identify regional disparities and opportunities for cooperation.

In parallel, development scenarios were created to explore how service provision may need to evolve in response to multilocal living trends—ranging from localised and remote services to commuting-based models. These scenarios, combined with the simulation tool, offer practical guidance for policymakers seeking to future-proof local governance strategies.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

Policy impact

Strategic Planning

The EU Strategic Agenda 2019–2024 calls for a fundamental shift toward green and digital transitions, with a focus on inclusivity—ensuring no one is left behind. Within this framework, Europe must strengthen its resilience to better prepare for future shocks and to emerge stronger by accelerating these transitions.

Resilience in the EU Context

The 2020 Strategic Foresight Report positions resilience as a central guiding principle for EU policymaking. Resilience is defined as the capacity to undergo transitions in a sustainable, fair, and democratic way. Achieving this requires reinforcing mechanisms for absorbing shocks and enhancing the ability to adapt and transform in response to change.

MULTILOCAL Lab Contribution

The themes explored in the MULTILOCAL Lab were of high relevance to stakeholders, who expressed strong interest in applying the insights and tools to their own work.

- The **Local Tax Calculator** emerged as a valuable tool for municipalities, helping them simulate future scenarios and assess the financial implications of demographic and economic changes.
- The **scenario-building process** allowed stakeholders to engage with high levels of uncertainty and visualise multiple development pathways based on current and projected trends.
- The **Association of Municipalities of Tartu County** proved to be a committed stakeholder, actively supporting the establishment of the MULTILOCAL Lab and its mission to empower local governments in service planning and provision.

Overall, these activities enhanced the capacity of local governments to respond more effectively to present and future challenges, contributing directly to the EU's broader resilience and strategic foresight goals.

The Digital Tool

https://apps.centar.ee/kov-tulumaks/

The ability to forecast and simulate tax revenue is crucial for local governments in ensuring sustainable fiscal planning. This simulation tool provides local governments with an analytical framework for understanding the financial implications of demographic and economic trends. By integrating demographic projections, income distributions, and macroeconomic forecasts, the model enables municipalities to conduct informed fiscal planning and assess the potential revenue impacts of policy decisions related to labour market dynamics and population changes.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

The tool employs a structured framework incorporating key demographic and economic factors that influence income tax revenue at the municipal level as illustrated in the screenshots provided by Figure 56 and Figure 57. The core elements of the model include:

- **Population Projections:** The model utilises municipal-level demographic forecasts segmented by age and gender for the period 2024–2050.
- **Income Profiles:** Income distributions for municipalities are derived from administrative datasets, including the Population Register and the Tax and Customs Board (TSD and TÖR data). These profiles classify individuals based on taxable income sources, distinguishing between earned income and pension-based income.
- **Macroeconomic Assumptions:** The model incorporates GDP and wage growth projections from the Ministry of Finance's long-term economic forecast.

To accurately model tax revenue, the tool differentiates among various taxpayer groups. These classifications are based on primary income sources and employment characteristics:

- **Employed Workers:** Individuals earning taxable income from employment are further categorised based on occupational status:
  - **Blue-collar workers** (manual labourers, service and sales workers, machine operators, agricultural workers, and craftsmen)
  - **White-collar workers** (managers, professionals, technicians, clerical staff, and customer service personnel).
- **Other Income** Recipients**:** Individuals receiving parental benefits or other taxable income who do not have a formally registered employment position.
- **Pensioners:** Individuals receiving state pensions, including old-age pensions (pillar I), survivor's pensions, and disability pensions.

Each municipality's income profile is constructed by analysing the proportion of these taxpayer groups within each age cohort and their corresponding average taxable incomes. The visualisation of these profiles provides insights into the structural composition of municipal taxpayers, distinguishing between employment-based and pension-based income streams.

The model projects tax revenue by combining demographic forecasts with income profiles. The estimation process follows these steps:

1. **Population Segmentation:** For each projection year, the model calculates the size of different age cohorts within a municipality based on demographic forecasts.
2. **Taxpayer Group Allocation:** The proportion of individuals in each age group belonging to specific income categories is determined using historical income distributions.
3. **Income Calculation:** The total taxable income for each group is derived by applying average income levels from the income profiles.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

4. **Tax Rate Application:** The relevant municipal income tax rates are applied to estimate the tax revenue generated from each group.
5. **Revenue Aggregation:** The projected tax revenues for each group are summed to obtain the total municipal tax revenue for each forecast year.

Beyond baseline projections, the tool offers simulation functionalities to assess the impact of demographic and economic changes on tax revenue. Users can model various scenarios, including:

- **Shifts in Occupational Structure:** The model allows adjustments to the distribution of taxpayer groups within age cohorts, enabling simulations of structural labour market changes.
- **Changes in Workforce Participation:** Users can simulate the impact of increased or decreased workforce participation by modifying the number of income earners in each category.
- **Income Growth Variations:** The tool enables adjustments to the average earnings levels within different taxpayer groups to reflect alternative wage growth scenarios.
- **Demographic Changes:** Users can simulate migration effects by altering the size of specific age cohorts, thus assessing the impact of population inflows or outflows on municipal tax revenue.

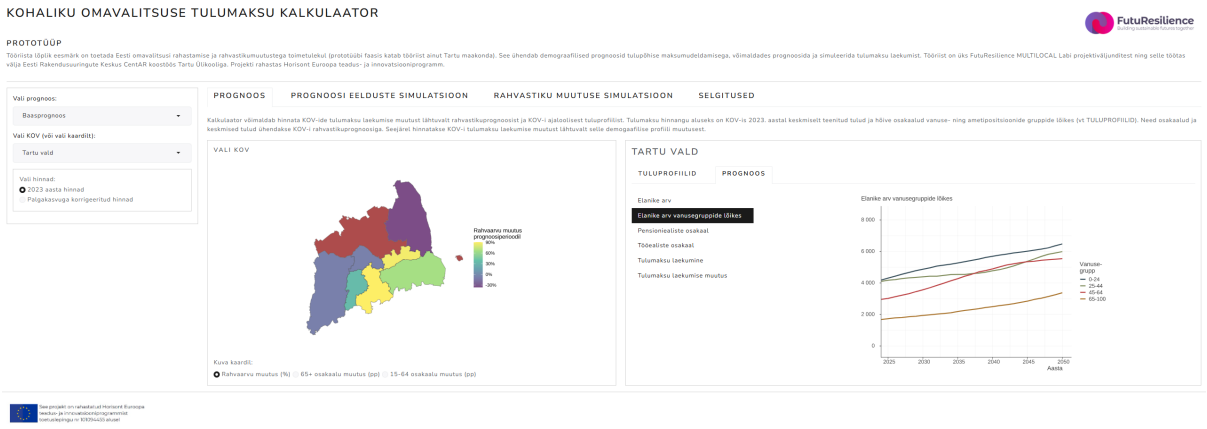


Figure 55. Projected Population Change in Tartu Municipality

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

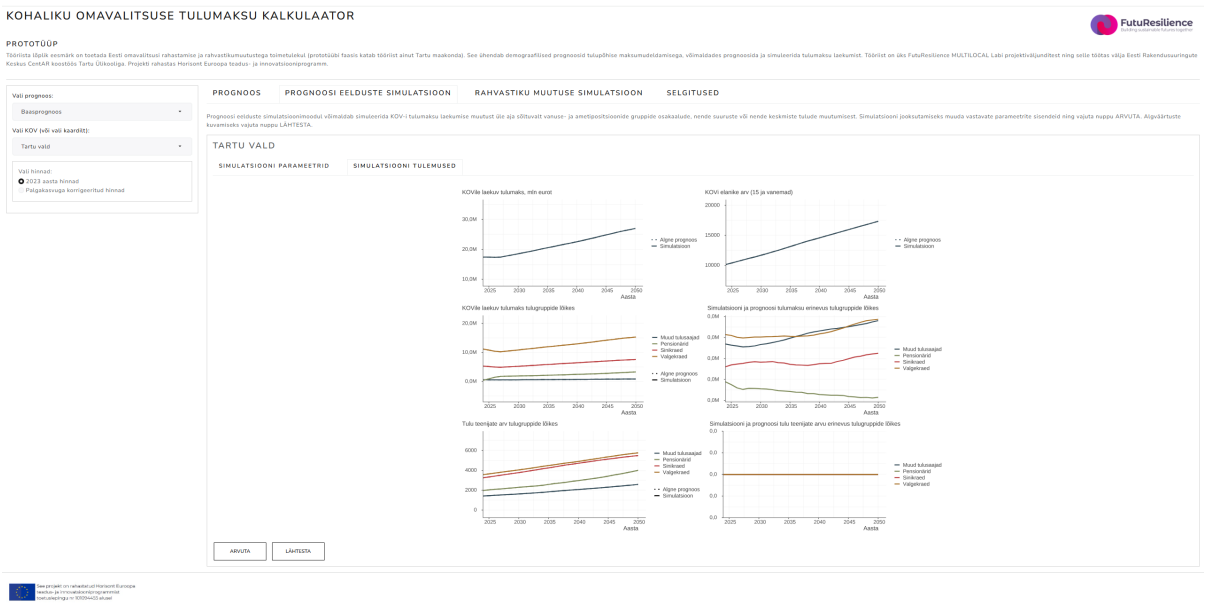


Figure 56. Change in Tartu Municipal Income Tax Revenue Over Time Based on Shifts in Age and Occupational Group Shares, Sizes, or Average Incomes

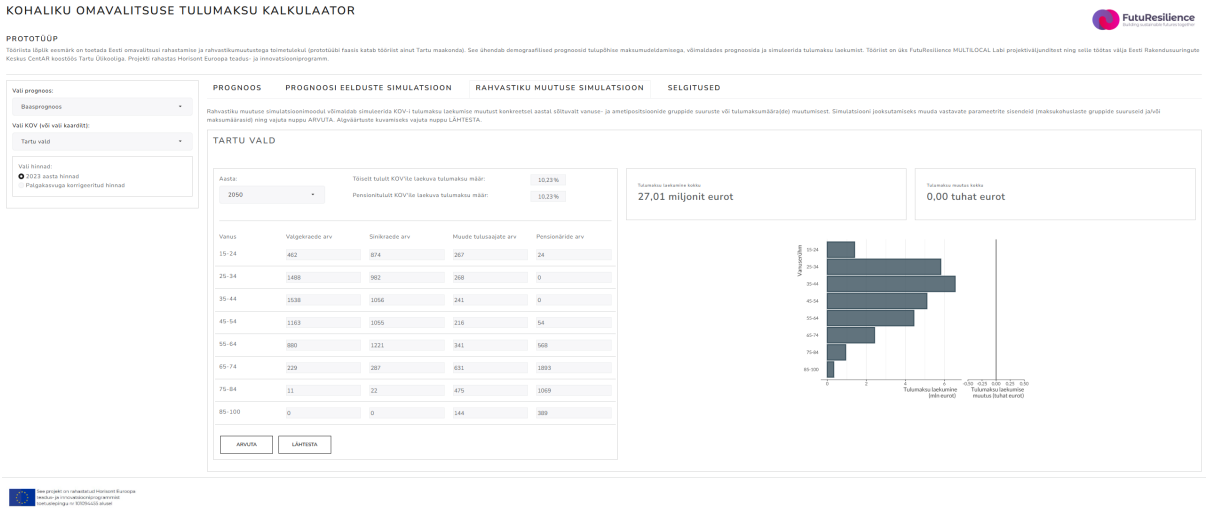


Figure 57. Change in Tartu Municipal Income Tax Revenue Due to Shifts in Population Structure and Income Levels

4.7.5 Lessons learnt

The following points can be considered as lessons learned:

Key Lessons from the Process:

- Early involvement of stakeholders in scenario development significantly improved the relevance and practicality of policy measures.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

- Interactive tools such as the Local Tax Calculator supported evidence-based decision-making and enhanced participant engagement.
- Stakeholders formulated their own policy recommendations, which were subsequently validated within each scenario group, fostering shared ownership and consensus.

Challenges Encountered:

- Aligning policy measures across different levels of government proved to be complex due to diverging priorities and governance structures.
- Uncertainty around long-term funding created reluctance to commit to scaling up the proposed measures.

Policy Engagement and Uptake:

- Policymaker engagement was proactive and consistent throughout the process. Involving them from the start of scenario discussions ensured that recommendations were grounded in real-world governance contexts.
- Several of the locally proposed policy measures have potential for national-level application, promoting broader impact and policy consistency.

Pathways Toward Implementation:

- Piloting selected policies in municipalities to assess their feasibility and effectiveness in real-life settings.
- Feeding findings into ongoing regional and national policy dialogues and development strategies.
- Continuing data-driven testing through scenario-based simulations to refine measures and support informed decision-making.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

4.8 MURCIA Lab

Abstract
The Murcia Lab aimed at identifying policies and actions to improve climate resilience in the neighbourhoods of Vista Alegre and Espinardo in the city of Murcia. Using a foresight-based methodology and participatory workshops, key factors were identified, future scenarios were developed, and 30 policies were assessed in relation to climate challenges such as urban heatwaves, heavy rainfall and flooding, and the need for a more compact and accessible city. The process involved municipal and regional technical staff, citizen representatives, professional associations, and universities. The lab fostered dialogue among diverse perspectives, generated valuable knowledge, and strengthened institutional collaboration. Its results will be made available on the ALEM website and are intended to support future adaptation strategies both locally and in other European cities.

- Local Partner: Municipality of Murcia (ALEM – Local Agency for Energy)
- Mentors: Polytechnic University of Cartagena and Fraunhofer ISI

4.8.1 Description of the lab

The Murcia Lab aimed to identify solutions that enhance urban resilience to the impacts of climate change in the city of Murcia, focusing specifically on two neighbourhoods—Vista Alegre and Espinardo—and addressing the following climate challenges:

- Reducing the impacts of urban heat islands.
- Mitigating the effects of heavy rainfall and flooding.
- Advancing the transition toward a compact, diverse, and proximity-based city model.

Our main objectives were:

1 | To generate knowledge that strengthens urban resilience to climate change impacts in the urban areas of Murcia, drawing on evidence-based research and promoting citizen understanding of those impacts.
2 | To define proposals that improve the city's response to climate change, based on the identification of key factors and the development of scenarios through a process involving urban management professionals.
3 | To promote forward-looking thinking in strategic policies for climate change adaptation and mitigation.

The institutions involved in this lab include the City Council of Murcia, through the Local Energy Agency of Murcia (ALEM), and the Universidad Politécnica de Cartagena (UPCT), through the Urban Research Laboratory (LIUrb). The Murcia lab also collaborated with Fraunhofer ISI, with mentoring on Foresight as core approach for its activities. The workshops brought together professionals and citizen representatives from the fields of environment, urban planning, infrastructure, emergency management, and public health.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

4.8.2 Initial needs and challenges

Identifying the risks associated with climate change is crucial for planning the resilience of our habitats. The European Commission[34] has classified these risks based on the sectors and thematic areas they would affect: water management during droughts and episodes of heavy rainfalls; conservation of forests and forestry in fires, droughts, or landslides; the future of agriculture due to heat stress, disease outbreaks, or flooding; the resilience of urban environments to heatwaves and heavy rainfalls; and the protection of coastal areas against rising sea levels, coastal erosion, and storms.

Identifying areas affected by risks related to climate change

The effects of these risks are not uniform across the European Union, so a necessary first step in improving resilience to climate change is to assess the specific risks of each territory. For instance, if we focus on Murcia, an intermediate city with 450,000 inhabitants located in southeastern Spain, we can observe that its neighbourhoods are experiencing rising temperatures, changing precipitation patterns, and more frequent extreme weather events. These challenges could vary even within the city. The Murcia FUTURESILIENCE lab focused on two neighbourhoods. The Vista Alegre district in Murcia has a dense urban layout with limited green spaces, making it ideal for studying resilience to the heat island effect. In Espinardo, the presence of the Rambla de Algaramasa exacerbates flooding during rainfall, offering an opportunity to explore flood-related challenges. Moreover, the low intensity of amenities and connectivity difficulties with the city centre also make the role of compactness interesting in relation to climate change effects.

Impacts of climate change and possibilities for reduction

Reducing Urban Heat Islands impacts.

Reducing the impacts of urban heat islands is crucial for enhancing the liveability and health of urban residents in Murcia. These heat islands not only diminish urban comfort but also pose health risks, particularly to vulnerable populations. Additionally, they contribute to increased energy consumption for cooling, exacerbating greenhouse gas emissions and straining energy infrastructure. Moreover, the uneven distribution of heat islands may exacerbate social inequalities, underscoring the importance of addressing social equity concerns.
Implementing Nature-Based Solutions (NBS) to enhance biodiversity in urban landscapes is imperative for mitigating heat island effects, improving overall urban comfort, and promoting social equity in Murcia's urban areas.

[34] European Environment Agency. (2021). Nature-based solutions in Europe. Policy, knowledge and practice for climate change adaptation and disaster risk reduction (Issue 01). https://www.eea.europa.eu/publications/nature-based-solutions-in-europe.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

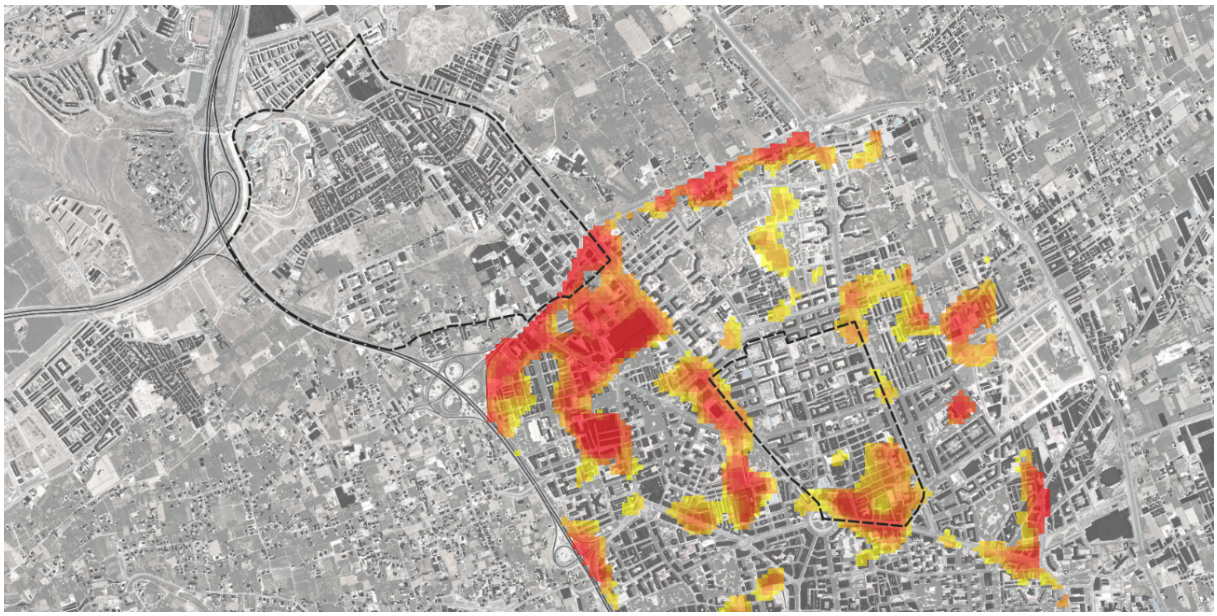


Figure 58: Urban Heat Island estimation in Murcia. Source: Rodríguez Gómez et alt, 2022[35].

Mitigating Flood Risks.

The city of Murcia is dealing with significant challenges related to managing heavy rainfall, often leading to flooding in streets and open areas. Besides damaging buildings and infrastructure, flooding also harms the environment by destroying habitats and polluting water sources. Moreover, it puts lives at risk and widens social disparities.

To tackle these issues, we need comprehensive strategies. This includes improving sustainable drainage systems, using permeable surfaces, and integrating green infrastructure. But it's not just about infrastructure – community involvement is crucial too. By raising awareness about flood risks and empowering residents to get involved in flood management efforts, we can make a real difference.

And looking ahead, long-term planning is also a key. We must address underlying factors like land use planning and climate change adaptation to ensure a sustainable approach to flood management in Murcia's urban areas.

[35] Rodríguez-Gómez, F., Fernández-Cañero, R., Pérez, G., del Campo-Ávila, J., López-Rodríguez, D., & Pérez-Urrestarazu, L. (2022). Detection of unfavourable urban areas with higher temperatures and lack of green spaces using satellite imagery in sixteen Spanish cities. Urban Forestry and Urban Greening, 78(April). https://doi.org/10.1016/j.ufug.2022.127783

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

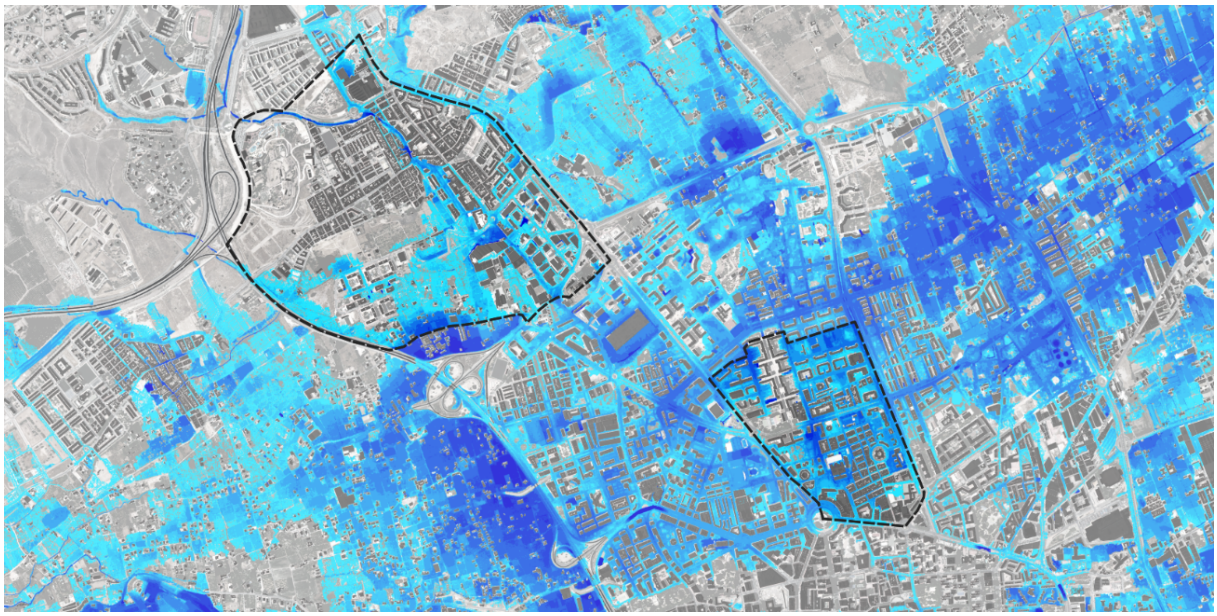


Figure 59: Floodable areas with medium probability in Murcia. Source: [Sistema Nacional de Cartografía de Zonas Inundables, https://www.miteco.gob.es/es/agua/temas/gestion-de-los-riesgos-de-inundacion/snczi.html]

Enhancing Urban Compactness.

Murcia's urban sprawl worsens the effects of climate change, resulting in higher energy usage, longer commute times, and restricted access to essential services.
To tackle this challenge, we need to transition towards more compact urban development policies. This means reevaluating urban planning approaches to encourage mixed land-use development, denser urban areas, and the creation of reliable public transportation systems.

Planning actions to reduce the impacts of climate change

Looking at Murcia, adaptation measures come in various forms and putting them into actions requires substantial coordination and planning. However, deciding which actions to adopt presents its own set of challenges:

- Strategies: It's crucial to take a strategic approach, which includes planning for long-term urban model changes, implementing immediate interventions in the city, and managing risks during emergency events like heavy rainfall or heatwaves.
- Prioritization: Dealing with impacts sometimes requires many interventions across large areas, which can be costly. Therefore, it's crucial to prioritize actions and plan their implementation over time.
- Cross-disciplinarity: Implementing measures across various city management domains necessitates a holistic approach that involves integration among different technical specialists and taskforces.
- Synergies: It is important to remember that adapting to the effects of climate change involves transforming urban environments. Thus, we must establish connections with other goals, such as creating healthier and more equitable cities.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

In this regard, over recent years, the city of Murcia has developed strategies for mitigating[36] and adapting[37] to climate change that encompass various actions across multiple strategic lines of action. Mitigation measures focus on reducing greenhouse gas emissions in the atmosphere through actions such as replacing fossil fuels with renewable energy sources, promoting energy savings and efficiency, encouraging sustainable mobility, and implementing carbon sinks, among others. The adaptation strategy is based on climate projections for the municipality of Murcia, which serve to characterize its vulnerability through a qualitative assessment of the historical socioeconomic impacts of climate-related hazards, as well as an analysis of internal and external factors and other elements that define vulnerability and contribute to current levels.

Planning resilience for climate change with foresight methods and science knowledge

The Murcia Lab focused on assessing resilience using foresight methodologies. This helped identify vulnerabilities and key factors across various future scenarios. Enhancing the resilience of urban areas within the municipality of Murcia against climate change impacts required a comprehensive approach. By tackling issues like urban heat islands, flood risks, and urban compactness, Murcia can strengthen its ability to adapt and create a more sustainable and resilient urban environment for residents. Collaboration among stakeholders is essential to implement effective strategies, ensuring the city's long-term viability in the face of climate change.
Integrating scientific knowledge to tackle climate change impacts in Murcia brings significant advantages but also presents challenges. Utilising scientific insights enables a deeper understanding of climate-related risks and informs evidence-based decision-making, enhancing urban resilience. However, interpreting scientific data can be complex, and uncertainties in climate projections present obstacles to effective implementation. Moreover, while interdisciplinary collaboration is crucial, it can be difficult to achieve in practice.

4.8.3 Work done in the lab

The Murcia Lab followed the guidelines developed within the FUTURESILIENCE project for the implementation of urban labs (see D2.1 Guidelines for pilot cases). A series of workshops were organised, where key factors were identified, possible future scenarios were developed, and potential policies were evaluated.

These workshops brought together municipal and regional professionals from departments such as environment, urban planning, infrastructure, emergency management, and public health, alongside representatives from civic associations and professional bodies.

Problem framing

[36] CETENMA. (2018). Estrategia de mitigación del cambio climático del municipio de Murcia 2030. https://energia.murcia.es/estrategia-de-mitigacion

[37] Factor CO2. (2018). Estrategia de adaptación al cambio climático del municipio de Murcia a 2030. https://energia.murcia.es/estrategia-adaptacion-2030

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

Analysing risks and vulnerabilities

The problem framing of the challenge of climate change adaptation in the neighbourhoods of Vista Alegre and Espinardo, in the municipality of Murcia, required identifying the areas where these risks could have the greatest impact. To achieve this, a series of maps were developed to identify the most vulnerable areas based on their exposure to risk. These maps have evolved over time, with different versions, and have been a key element in all subsequent workshops.
The vulnerability map for heat islands included:

- A spatial identification of exposure, initially based on the simulation conducted by Rodríguez-Gómez et al. (2022)[38], which covered the Vista Alegre neighbourhood. This was later updated with a simulation carried out by Angelo Galindo[39] for the Murcia Lab. Both simulations were generated using operations with multispectral satellite image bands from the Landsat 8 and 9 projects. These simulations allow for the visualization of overheating levels in different areas within these neighbourhoods.
- An identification of areas within the neighbourhoods that are particularly vulnerable to high temperatures. For buildings, the year of construction recorded in the Spanish Cadastre was used as an indicator of the construction technologies applied according to the technical standards in force at the time. The most vulnerable buildings were identified as those built before the NBE-CT-79 standard, which remained in effect in Spain until 2006. This vulnerability was particularly highlighted in public facilities compared to residential buildings. In open spaces, the presence of tall vegetation, based on LIDAR data, was used as an indicator of areas where exposure to risk is mitigated by vegetation cover.

The flood vulnerability map included:

- An identification of flood-prone areas based on information from the National Flood Zone Mapping System (SNCZI) and previous studies conducted by the UPCT team for the Municipality of Murcia. The SNCZI allowed for the identification of areas exposed to high-probability floods (with a 10-year return period) based on water depth, as well as areas that could become flood-prone during medium-probability events (100-year return period). Among these, particular attention was given to Preferential Flow Zones (ZFP), where flood hazard is higher due to water depth and velocity. Additionally, previous studies by the UPCT team helped identify urban micro-watersheds and the surface runoff flows during rainfall events. This spatial dataset enabled an analysis of flood risk as a dynamic phenomenon.
- An identification based con cadastral data of buildings with characteristics that make them vulnerable if exposed to flooding buildings located in flood-prone areas with ground-floor

[38] Rodríguez-Gómez, F., Fernández-Cañero, R., Pérez, G., del Campo-Ávila, J., López-Rodríguez, D., & Pérez-Urrestarazu, L. (2022). Detection of unfavourable urban areas with higher temperatures and lack of green spaces using satellite imagery in sixteen Spanish cities. Urban Forestry and Urban Greening, 78(April). https://doi.org/10.1016/j.ufug.2022.127783

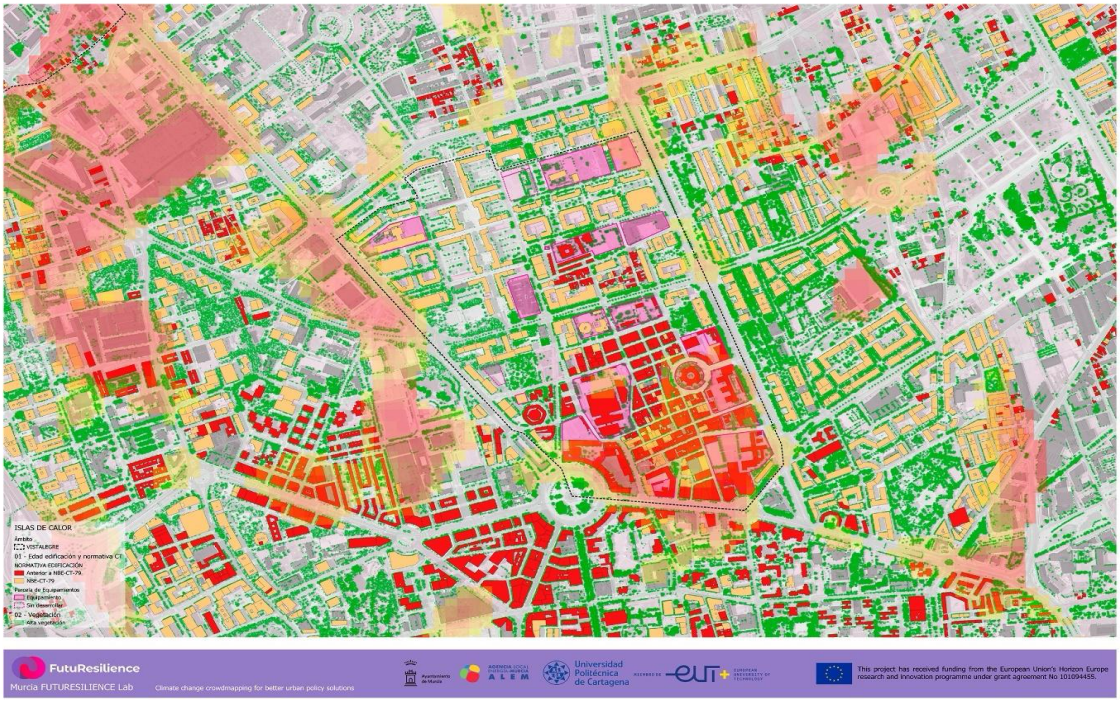
[39] Student of Master's in Spatial Sciences, Islands and Sustainability (Erasmus Mundus Scholarship) of the University of Groningen and Universidad de Las Palmas de Gran Canaria who did a research internship in the Murcia Lab.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

residences (where inhabitants could become trapped during flood events) and buildings with underground structures (which could be completely inundated in case of flooding) were identified. Similarly, public facilities located in flood-prone areas were highlighted.

Finally, the compactness map included:

- An identification of land-use diversity and residential density within the neighbourhoods. Using cadastral data, green spaces and public facilities within and around the neighbourhoods were included as essential nearby amenities, along with the presence of industrial, office, or commercial buildings. Additionally, residential density was distinguished based on the height of residential buildings.



This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

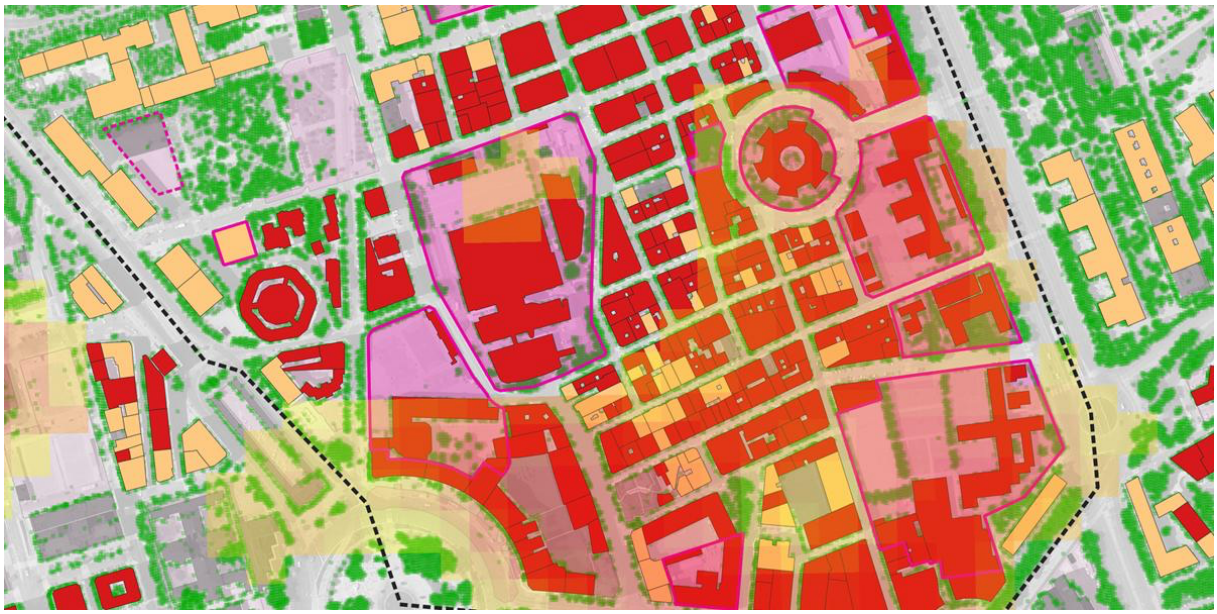
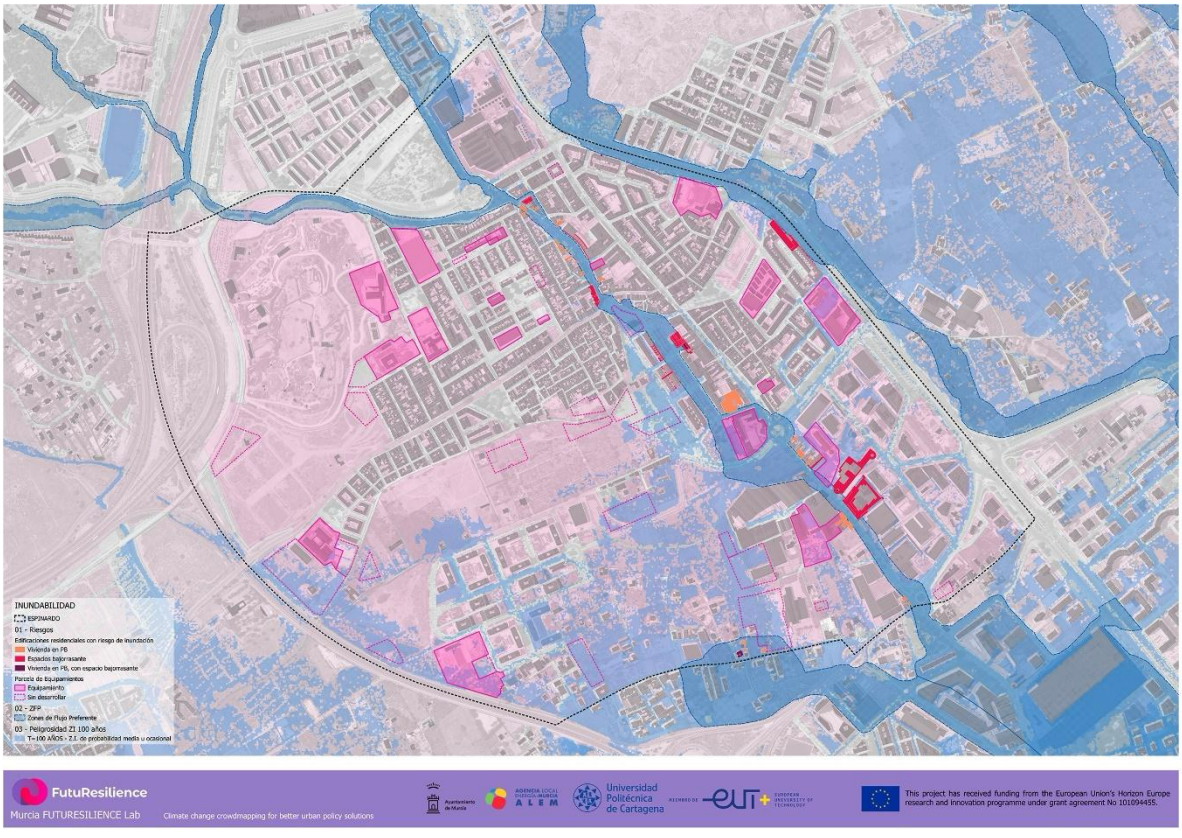


Figure 60: Vulnerability map for heat islands in Vista Alegre. Map and closeup.



This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

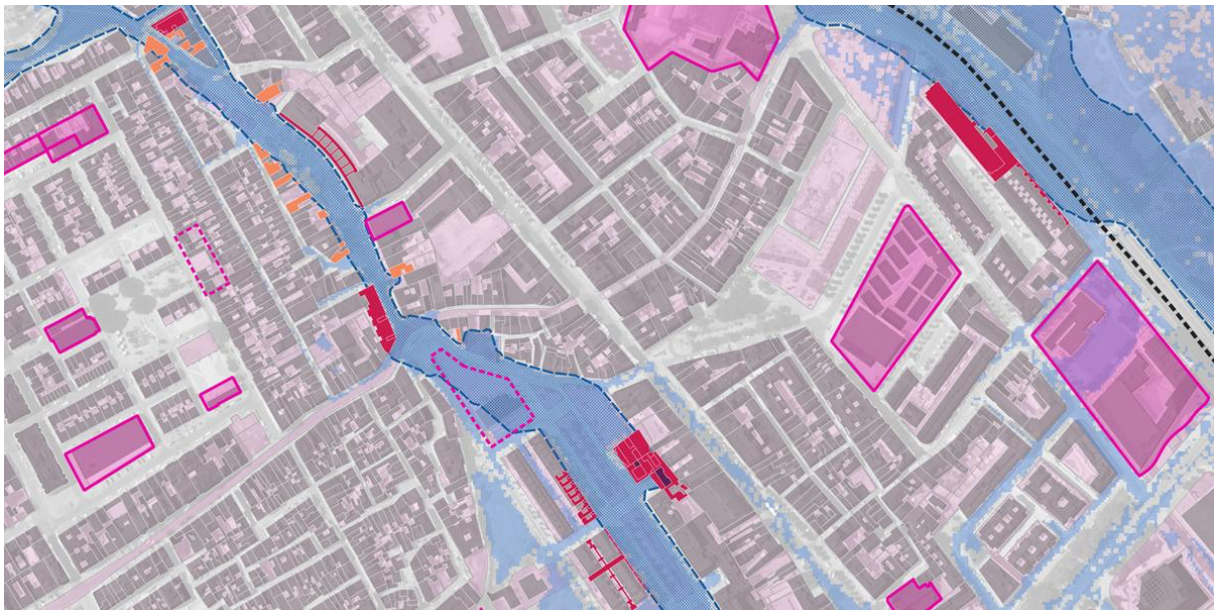
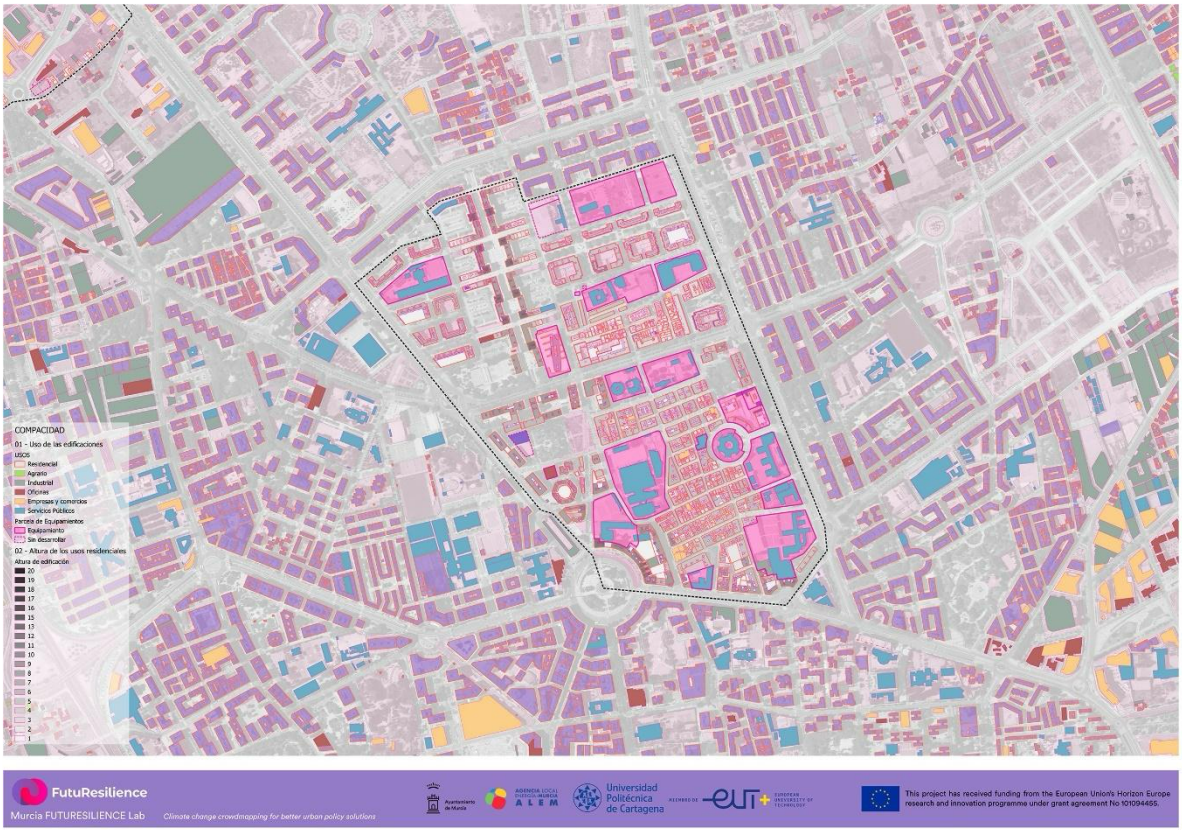


Figure 61: Flood vulnerability map of Espinardo. Map and closeup.



This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

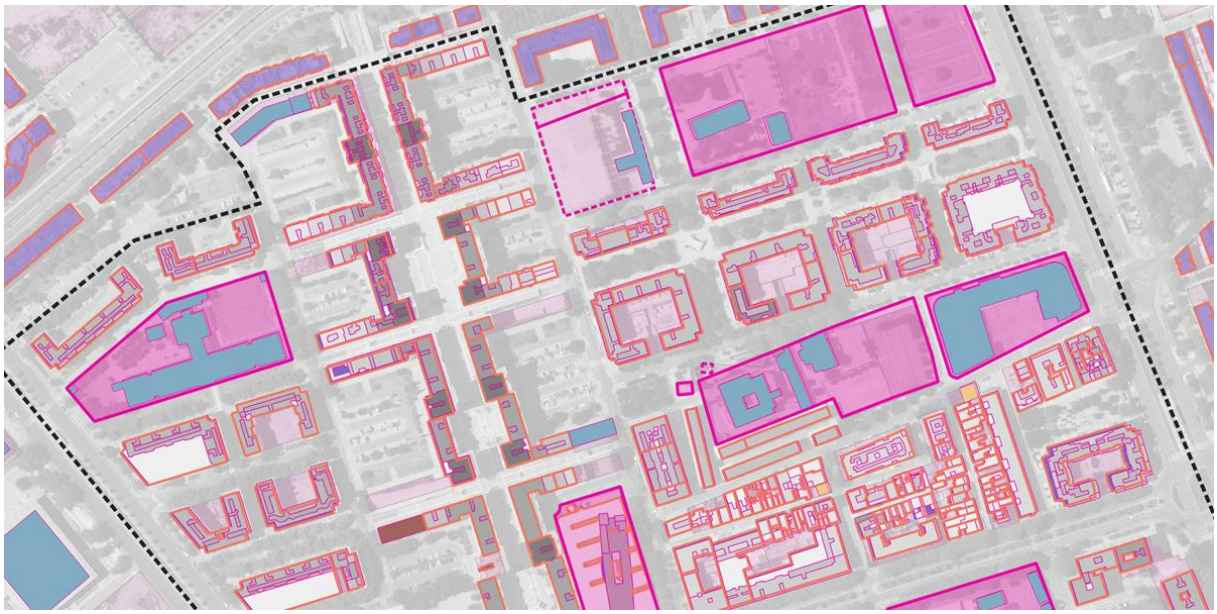


Figure 62: Compactness vulnerability map in Vista Alegre. Map and closeup.

Urban Heat Island citizen crowd-mapping in Vista Alegre

During the problem-framing phase in these neighbourhoods, a citizen workshop was also organized on October 6 and 7 of 2023 in Vista Alegre, focusing on urban heat islands. The event consisted of two parts: first, a presentation to inform residents about the issue of heat islands, and second, a community mapping activity in the neighbourhood to assess different areas based on their vulnerability to this risk. This part of the workshop was conducted using an adapted version of the Place Standard Tool through a questionnaire (visit https://forms.office.com/e/96RijSX8cc) in which participants answered a series of questions about the characteristics of public space design factors that influence the urban microclimate.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

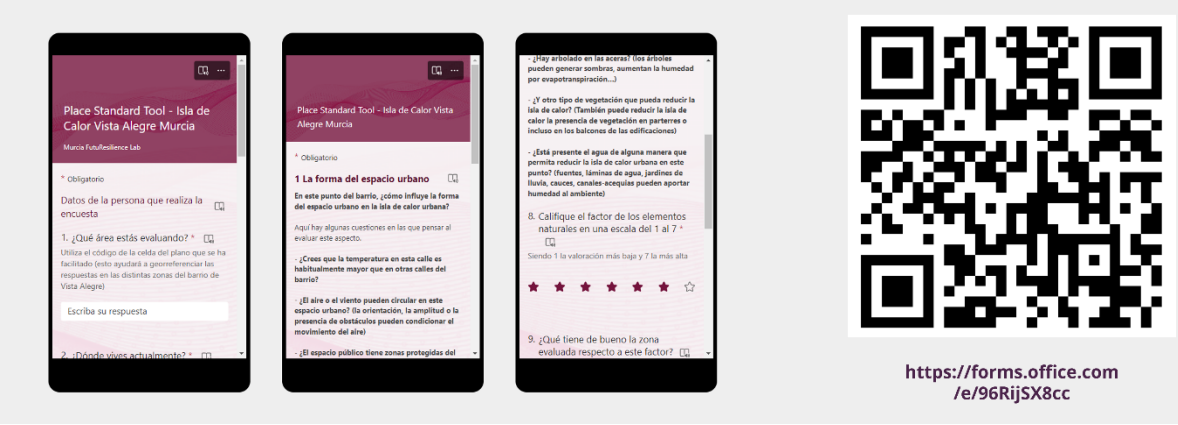


Figure 63: Place Standard Tool adapted to Urban Heat Island analysis.

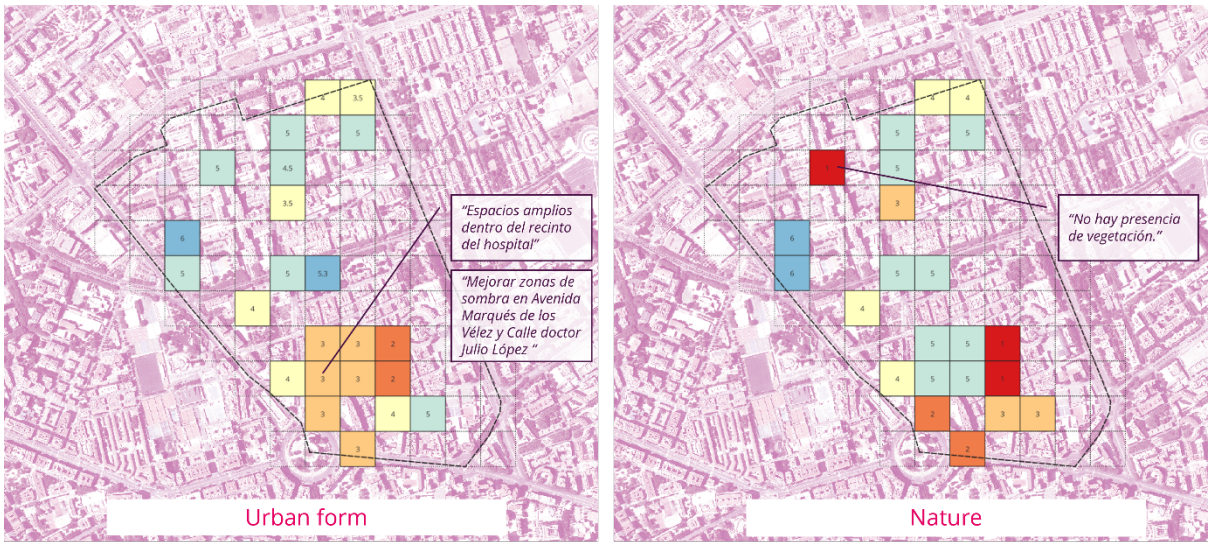


Figure 64: Community mapping results from urban form and presence of nature factors in Vista Alegre

Stakeholder mapping

The UPCT team and the Municipality of Murcia identified the key stakeholders, initially including up to 93 individuals and entities:

- Representatives from administrative sectors involved in enhancing climate change resilience in urban environments. This included technical staff from the following municipal and regional departments: climate change, environment, urban planning, infrastructure, public health, emergency management, and water management.
- Public entities such as the Confederación Hidrográfica del Segura (CHS) and the Agencia Española de Meteorología (AEMET), whose activities are also linked to climate risk response.
- Citizen representatives, including neighbourhood association leaders (local councils) and civil society organizations. Municipal staff from various public facilities (schools, high schools, social centres, cultural centres, etc.) were also involved as liaisons with residents in the study neighbourhoods.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

- Representatives from professional associations whose activities are related to climate change adaptation, including architecture and urban planning, biology, public works, civil engineering, medicine, nursing, and geography.

Workshop 1: Factor selection and projection

On Thursday, May 30, 2024, the first Murcia Lab workshop was held with the primary objective of identifying key factors for urban resilience in response to three main challenges: heat islands, flooding, and urban compactness. The event was aimed at both citizens and technical experts, fostering comprehensive collaboration to address these issues.

Factor longlist

Prior to the workshop, an initial list of factors influencing climate resilience in the urban environments of Murcia (Espinardo and Vista Alegre) was developed based on 10 responses collected through an online survey (see https://forms.office.com/e/92MpzxAjHj).
This survey was designed to gather input from laboratory participants on the factors that contribute to improving resilience in these areas (rather than identifying factors that generate these impacts). It included sections for identifying factors related to reducing the impact of heat islands, mitigating flood risks, and increasing urban compactness.
The survey offered two response paths: one displaying three separate sections, each dedicated to a specific climate change challenge (heat islands, flooding, compactness), and another "I don't have much time" option, which provided a single combined section covering all analysed aspects.
The factors that could be identified included:

- Systemic factors (those related to the society we live in) or contextual factors (those specific to the characteristics of Vista Alegre and Espinardo).
- Permanent factors (related to the physical characteristics of the city) or temporary factors (related to measures implemented during risk events).
- Factors from the fields of urban planning, infrastructure, environment, emergency management, or public health.

The individuals who completed the survey identified themselves as belonging to the following profiles (a person could select multiple profiles): environment (5 people), public health (3 people), urban planning (2 people), emergency management (2 people), infrastructures (1 person), associations and collectives (1 person), citizens (1 person)
The document with all the collected factors was used as a working basis during the first workshop.

Call and attendance to Workshop 1

Invitations were sent to all identified stakeholders. These invitations were sent by both the ALEM team and the UPCT team.
The first workshop was attended by a total of 28 participants, representing: municipal services for environment, urban planning, public health, and energy; regional services for environmental health, emergency management, and climate change; professional

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

associations of geographers, biologists, and technical architects; citizen associations; and universities.

Factor selection

For the selection of relevant factors, an initial activity was conducted in which attendees organised the factors from the longlist and those provided during the session according to the STEAPVL domains. The activity involved identifying factors through an individual brainstorming session by each participant, which were then shared with the rest of the group. Regarding urban heat islands, the following factors were identified:

- **Infrastructure and Urban Planning**: Lack of soil permeability, urban layout, materials used, increase in paved areas within green zones, implementation of green roofs and vertical gardens, use of reflective materials.
- **Environmental and Natural Factors**: Lack of vegetation and tree cover, Mediterranean climate, microclimate of the city of Murcia, implementation of green corridors and shaded areas, tree planting.
- **Social and Political Factors**: Lack of awareness or political interest, education on the impact of climate change, incentives and regulations to promote Nature-Based Solutions (NBS), citizen awareness and sensitization, creation of a network of air-conditioned refuge centres: safe spaces during heatwaves.
- **Energy Efficiency and Technologies**: Use of air conditioning units, lack of renewable energy use, adoption of a temperature monitoring system, promoting energy efficiency in buildings.
- **Urban Planning and Zoning**: Plan and increase tree planting, create and maintain green corridors, specific regulations and ordinances for mitigating the heat island effect, creation of climate shelters, implement sustainable urban development strategies that consider climate impact from the planning phase, develop and update specific contingency plans for heatwaves.

Regarding flooding, the identified factors were:

- **Infrastructure and Urban Planning**: Management of irrigation channels (tubing), poor urban planning practices, highly compacted soils, obsolescence of large flood containment infrastructure, soil permeability, and use of Nature-Based Solutions (NBS).
- **Drainage Systems and Water Management**: Urban Sustainable Drainage Systems (SUDS), water collection reservoirs, efficient stormwater drainage systems, design of parks and open spaces that include retention areas.
- **Mitigation and Adaptation Measures:** Floodable parks, soft pavements, water retention areas, implementation of sustainable drainage systems in green spaces, construction of stormwater tanks, use of permeable elements in urban architecture.
- **Social and Political Factors**: Management of public alerts, foresight of urban growth in flood-prone areas, increased citizen awareness about the effects of climate change, implementation of educational programs to raise public awareness about flood risks.

Regarding urban compactness, the identified factors were:

- **Infrastructure and Transportation**: Improvement of public transportation, park-and-ride facilities, strategies to increase public transport use, electrification of urban transportation, bike lanes, and pedestrianization of streets.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

- **Urban Planning and Development**: Adequacy of appropriate urban planning, the need to prioritize planned development, updating the general plan to reflect current needs, recovery of uses in degraded areas, densifying underutilized or degraded areas.
- **Social and Political Factors**: Addressing social segregation, improving communication and education on urban planning, providing incentives for citizens to use sustainable transportation, increasing citizen awareness and sensitization.
- **Legislation and Regulations**: Relaxing laws to allow sustainable innovations, land-use policies that promote mixed uses, regulations supporting sustainable practices.
- **Culture and Social Habits**: Changing behaviour patterns to encourage the use of public spaces, creating spaces that promote social cohesion.
- **Geography and Topography**: Flat topography facilitates walking and cycling paths, Mediterranean climate offers mild winters and hot summers.

As can be seen from the previous summary of factors, there is repetition of factors that influence several of the aspects analysed, and therefore they appear multiple times.
Additionally, it can also be observed that the implementation or lack of implementation of actions and/or policies could be included as factors. Although this might seem contradictory to the workshop schedule (where policy evaluation occurs at the end), it was assumed that the key to achieving resilience lies in the governance system that enables the adoption of technical solutions that have already been identified as feasible.

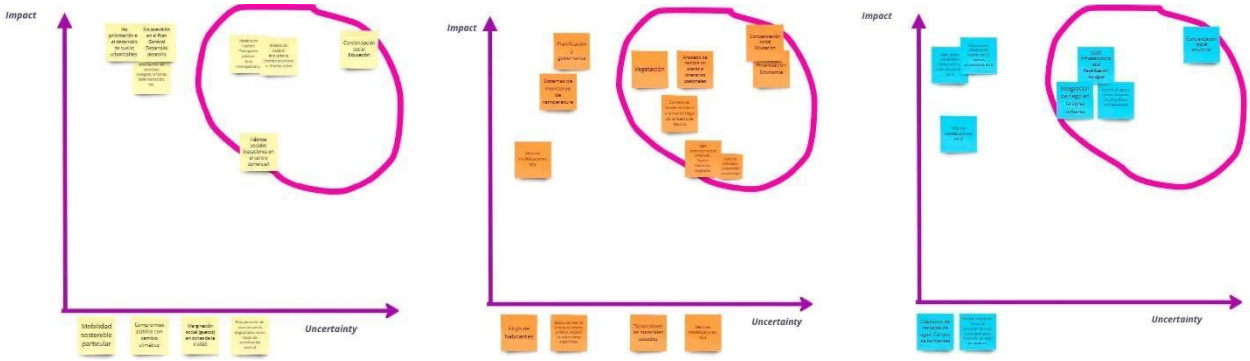


Figure 65: Murcia Lab Impact/Uncertainty Matrix

As the next step in the selection of factors, participants were asked to evaluate each factor, in agreement with the rest of the group, on an impact and uncertainty diagram, separating the diagram according to the climate change challenges: flooding, heat islands, and urban compactness. This final part of the activity was then shared in a plenary session with the other groups, which allowed for the selection of the 8 most relevant factors:

- **Citizen Awareness and Education**: Increase the capacity to understand the risks associated with climate change.
- **Nature-Based Solutions**: Utilize natural processes for climate change mitigation.
- **Increase in Vegetation**: Plant new trees in squares and streets with little shade.
- **Sustainable Mobility**: Improve energy efficiency in citizens' travel, whether through public or private transportation.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

- **Conservation of Traditional Irrigation Networks**: Recover traditional irrigation channels (acequias and azarbes) to improve evapotranspiration and drainage, in conjunction with sustainable mobility.
- **Financing and Economic Sustainability**: Find stable financing methods for the implementation of projects, plans, and pilot programs.
- **Water Management Infrastructure**: Develop infrastructure that allows the closure of the water cycle through reuse, treatment, retention, and detention devices.
- **Resilience-Oriented Governance**: Increase political commitment and direct public policies toward effective planning for climate change adaptation.

Factor projection

In the final part of Workshop 1, participants discussed in their working groups the possible developments of each of the eight relevant factors. To do this, they reflected on the future of each factor under the following scenarios:

A) In a foreseeable future based on the current trend. The expected evolution.

B) In a future that diverges from the current trend. Divergent development.

C) In a future where there is continuity with the current trend, but changes occur that alter it. Hybrid possibilities.

D) In a future completely different from the current situation. Disruptive development.

E) In a future where our way of thinking about this factor has radically changed. Paradigm shift.

In this activity, each of the four tables began working on two of the factors. After a few minutes, the cards on which they had written the possible developments were rotated among the tables, so each table completed the information of the previous group. These rotations occurred twice, meaning that each factor card contains information from three of the four tables. The following tables summarize the development descriptions of each factor based on the information collected on the cards and the comments from each table, as noted by the UPCT team members.

Table 15: Murcia Lab Possibles future development of key-factor identified.

Citizen Awareness and Education: Increase the capacity to understand the risks associated with climate change.	
Expected evolution.	More people will feel directly affected by environmental issues, increasing civic engagement. Future generations will show greater environmental awareness and support green policies.
Divergent development:	Climate denial may rise, with more people rejecting climate change or the need for action, hindering environmental efforts and citizen participation.
Hybrid possibilities	Tensions may grow between climate action supporters and opponents. Yet, education programs and incentives could ease conflicts and enable steady progress.
Disruptive development	Radical political shifts, like scrapping the 2030 Agenda, and widespread disinformation could undermine trust in climate science and weaken environmental policies.
Paradigm shift	Focus could shift to sectors like the economy or security, pushing environmental concerns aside due to crises or global emergencies.

Nature-Based Solutions: Utilize natural processes for climate change mitigation

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

Expected evolution.	Public institutions may promote soft, nature-inspired technologies, favoring solutions compatible with natural systems. Evaporative cooling from vegetation and natural materials like ceramics will be valued.
Divergent development:	More artificial technical solutions may be adopted to mimic natural benefits. This could include removing concrete pipes for natural runoff or increasing shade with low-cost industrial materials.
Hybrid possibilities	This scenario combines desirable and feasible approaches, like integrated water-energy systems and green areas that filter black and grey water for reuse.
Disruptive development	Extensive and coercive measures may emerge, such as mandatory rooftop transformations, ignoring property owners' financial capacity, or misguided urban greening efforts.
Paradigm shift	Society could develop aversion to nature due to health risks (zoonoses, epidemics), or, conversely, adopt a radical pro-nature stance, reserving large lands to ensure biodiversity and ecological continuity.

Increase in Vegetation: Plant new trees in squares and streets with little shade.	
Expected evolution.	Urban areas will see selective planting, while new developments will include more widespread vegetation. This aims to combat climate change, improve air quality, and provide shade and recreation.
Divergent development:	Extreme weather or poor soil conditions may hinder tree planting. Using non-native, poorly adapted species could lead to failure and high maintenance needs.
Hybrid possibilities	Green areas may expand with a mix of native and ornamental plants. Without careful species selection, sustainability could be compromised.
Disruptive development	Urban planning may overly favour vegetation, clashing with other land uses. Poor management might also increase pest outbreaks.
Paradigm shift:	Public rejection of urban greenery could arise due to allergies, mess, or upkeep. Excessive moisture and rising groundwater from dense vegetation could disrupt infrastructure and public health.

Sustainable Mobility: Improve energy efficiency in citizens' travel, whether through public or private transportation.	
Expected evolution.	Bike infrastructure will improve, and public transport will become more reliable and efficient. Traffic will be strategically restricted to ease congestion. Eco-friendly vehicles will be promoted to cut emissions.
Divergent development:	Public transport use may decline due to safety concerns or inefficiency, increasing reliance on private cars and leading to higher emissions and traffic.
Hybrid possibilities	Infrastructure upgrades like shaded bike lanes and reduced car access to pedestrian zones could be paired with incentives such as park-and-ride facilities to cut downtown traffic.
Disruptive development	A sharp rise in oil prices could make private vehicles unaffordable, triggering a sudden shift toward public transport and sustainable alternatives like bikes and electric vehicles.
Paradigm shift:	The widespread implementation of Low Emission Zones (LEZ) could restrict polluting vehicles, encouraging public transport, cycling, and electric mobility, and reshaping urban travel patterns.

Conservation of Traditional Irrigation Networks: Recover traditional irrigation channels (acequias and azarbes).	
Expected evolution.	Irrigation channels will be integrated into green and public spaces. Smart technologies will optimize water use, though full implementation is still in progress.
Divergent development:	The network could expand into all non-built areas, including streets and parks, using local water sources like rivers and acequias to enhance efficiency.
Hybrid possibilities	Pilot projects could test the integration of irrigation in urban zones, alongside gradual expansion of green spaces incorporating these systems.
Disruptive development	Complete unpiping and restoration of acequias could revive old groundwater levels and make traditional wells usable again. Alternatively, severe flooding could force a system overhaul.
Paradigm shift:	Acequias may be revalued as cultural heritage, promoting xerogardening and traditional farming supported by new water-use regulations.

Financing and Economic Find stable financing methods for the implementation of projects, plans, and pilot programs.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

Expected evolution.	Financing is expected to rely heavily on EU urban and environmental policies. Its continuity depends on political alignment across local, regional, national, and EU levels.
Divergent development:	Fiscal and administrative innovations could promote collaboration between businesses, institutions, and property owners. New tax measures might speed up the adoption of sustainable pilot projects.
Hybrid possibilities	In low-resource settings, technically simple innovations could be quickly validated. Funding could come from low-interest loans and mobilizing local assets.
Disruptive development	A global political and economic breakdown could worsen the climate crisis, leading to systemic failures and uneven geographic distribution of impacts.
Paradigm shift:	An unpredictable shift may stem from collective awareness, triggering self-organizing social and environmental responses beyond conventional financial systems.

Water Management Infrastructure: Develop infrastructure that allows the closure of the water cycle.	
Expected evolution.	Priority is given to halting harmful urban hydrology practices, such as building in flood-prone areas, reducing leaks in water and sewage networks, and advancing the reopening of the traditional irrigation system.
Divergent development:	Extreme hydrological events would be accepted, with their impact mitigated locally by reserving land to capture and retain rainwater.
Hybrid possibilities	The strategy would combine measures such as increasing the permeability of urban surfaces to slow runoff.
Disruptive development	It involves drastic actions like demolishing buildings in high-risk areas and considers extreme scenarios such as irreversible aridification with cascading effects on the urban system.
Paradigm shift:	A sense of resigned acceptance emerges toward extreme climate events, accompanied by massive investment in large-scale infrastructure—investments that would be difficult to justify under current technical criteria.

Resilience-Oriented Governance: Increase political commitment and direct public policies toward climate change adaptation	
Expected evolution.	A shift is expected toward externally driven initiatives from EU climate policy, accompanied by declining trust in local or endogenous approaches.
Divergent development:	-
Hybrid possibilities	Governance could evolve toward more participatory, collaborative models, with increased technical specialization and synergies between political and scientific fields.
Disruptive development	-
Paradigm shift:	-

Workshop 1 results document

In the weeks following Workshop 1, the documentation generated during the event was compiled, and a document was created to reflect the workshop's dynamics and the results of its various phases. This document aimed to gather as much information as possible about what happened during the workshop. It was shared with the participants once it was completed.

Workshop 2: Scenario building

On Tuesday, September 24, 2024, the second Murcia Lab workshop was held in the ALEM auditorium in Murcia. The objective of this workshop was to create possible climate change scenarios for the urban environments of the city of Murcia (Espinardo and Vista Alegre). The key factors identified in the first workshop, along with their possible future developments, were used to generate various scenarios.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

Cross impact factor analysis

Few days before Workshop 2, a prioritization of the key factors identified in the first workshop was carried out. Participants received an impact evaluation table for each factor, allowing them to identify the most relevant ones. In this cross-impact table, it was deemed appropriate to include the factor 'Conservation of Traditional Irrigation Networks' within 'Nature-Based Solutions' to avoid redundancies, reducing the total number of factors to seven.
Despite not receiving massive responses, they were considered sufficient to prioritise the factors in the following order:

1. **Citizen awareness and education.**
2. **Financing and economic sustainability.**
3. **Nature-Based Solutions (NBS).**
4. **Increase in vegetation.**
5. **Resilience-Oriented Governance.**
6. **Sustainable mobility.**
7. **Water management infrastructure.**

MATRIZ DE INFLUENCIA									
¿En qué medida los factores de las filas influyen en el factor de cada una de las columnas? Califique en una escala de 0 (sin impacto) a 3 (alto impacto)									
		Sumatorio Pasivo	0,0	0,0	0,0	0,0	0,0	0,0	0,0
			Aumentar la capacidad de entender los riesgos asociados al cambio climático	*Aprovechar los procesos naturales para la mitigación del cambio climático*	*Implantar nuevo arbolado en plazas y calles poco sombreada*	*Mejorar la eficiencia energética en los desplazamientos ciudadanos, ya sea por medio del transporte público o privado*	*Encontrar métodos estables de financiación para la ejecución de proyectos, planes y programas piloto*	*Realización de infraestructuras que nos permitan el cierre del ciclo del agua mediante dispositivos de reutilización, depuración, retención y detención de aguas*	*Aumentar el compromiso político y orientar las políticas públicas a una planificación eficaz para la adaptación frente al cambio climático*
Sumatorio Activo		Factor Pasivo Factor Activo	Concienciación y educación ciudadana	Soluciones Basadas en la Naturaleza	Aumento de vegetación	Movilidad sostenible	Financiación y sostenibilidad económica	Infraestructura de gestión de agua	Gobernanza orientada a la resiliencia
0,0	*Aumentar la capacidad de entender los riesgos asociados al cambio climático*	Concienciación y educación ciudadana							
0,0	*Aprovechar los procesos naturales para la mitigación del cambio climático*	Soluciones Basadas en la Naturaleza							
0,0	*Implantar nuevo arbolado en plazas y calles poco sombreada*	Aumento de vegetación							
0,0	*Mejorar la eficiencia energética en los desplazamientos ciudadanos, ya sea por medio del transporte público o privado*	Movilidad sostenible							
0,0	*Encontrar métodos estables de financiación para la ejecución de proyectos, planes y programas piloto*	Financiación y sostenibilidad económica							
0,0	*Realización de infraestructuras que nos permitan el cierre del ciclo del agua mediante dispositivos de reutilización, depuración, retención y detención de aguas*	Infraestructura de gestión de agua							
0,0	*Aumentar el compromiso político y orientar las políticas públicas a una planificación eficaz para la adaptación frente al cambio climático*	Gobernanza orientada a la resiliencia							

Figure 66: MURCIA Lab Cross impact factor table

Call and assistance to Workshop 2

Invitations were sent to all identified stakeholders. These invitations were sent by both the Municipality team and the UPCT team.
The second workshop was attended by a total of 25 participants, representing: municipal services for environment, urban planning, public health, and energy; regional services for environmental health, emergency management, and climate change; professional associations of geographers, biologists, and technical architects; citizen associations; and universities. 14 of them had participated in workshop 1.

Scenario development

After presenting the results obtained during Workshop 1, the first part of Workshop 2 began, focused on the development of possible future scenarios based on the key factors previously identified.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

Participants, organised into four working groups, used a morphological table as a tool to generate the scenarios. This table included:

- The key factors as columns, ordered from left to right according to the prioritisation resulting from the cross-impact analysis carried out prior to the workshop.
- In each row, a description of a potential future development of each factor was provided. These descriptions were based on the projections generated during Workshop 1 and later refined by the UPCT team.

Using this table, each group was tasked with developing a plausible future scenario as a combination of selected developments for each factor. Each table was asked to create two scenarios by sequentially selecting one projection per factor, moving from left to right. The selection of each projection had to be consistent with the previous ones, to construct a coherent and plausible future scenario.

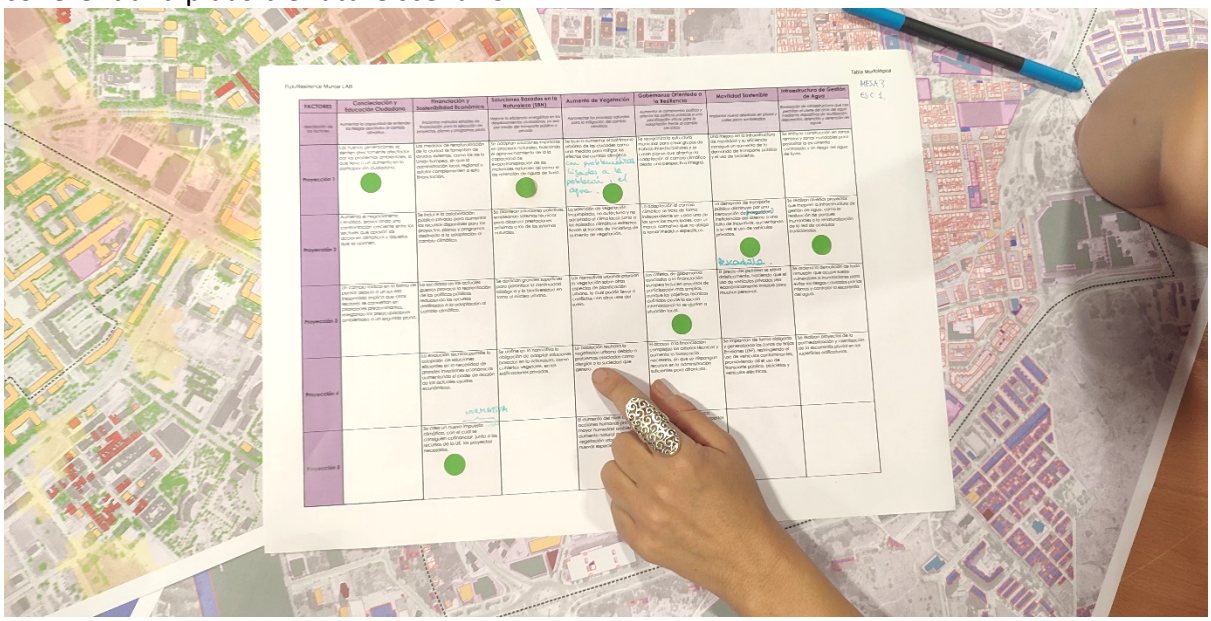


Figure 67: Creating scenarios with morphological table

Scenario refinement

In the second workshop exercise, each table worked on the two scenarios they had previously developed. To do so, they were presented with a series of urban scenes selected by the UPCT team from the target neighbourhoods. Participants were asked to draw how those specific locations in Vista Alegre and Espinardo would look under the future scenarios they had created, based on the combination of factor projections. This activity aimed to visualize and analyse the changes in the neighbourhoods under each scenario. In addition to graphic representation, teams also used small text labels to describe key elements.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

Before sharing their scenarios with the rest of the participants, each group had to identify potential challenges and opportunities that could arise in the futures they had envisioned. Finally, the different scenarios were presented and discussed in a plenary session, which led to strategic conversations among the various stakeholders involved.

Figure 68: Urban scenes from Vista Alegre and Espinardo used for scenario refinement

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

Figure 69: Graphical and textual definition of scenario 1 from table 1 during workshop 2

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

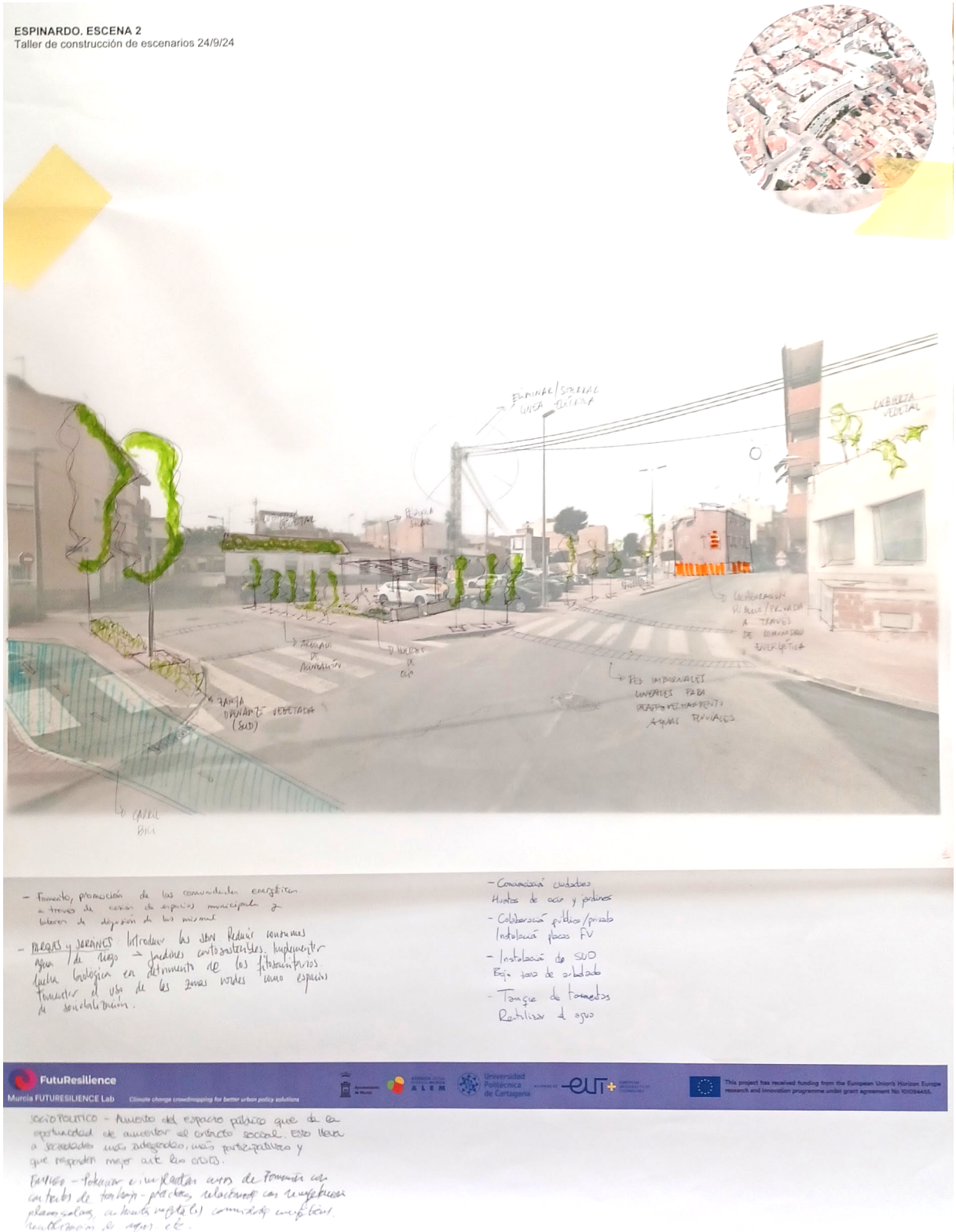


Figure 70: Graphical and textual definition of scenario 2 from table 2 during workshop 2

Scenarios Developed in Workshop 2

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

Post-processing of the scenarios generated during Workshop 2 was carried out by the UPCT team. The results were compiled into summary panels for each scenario, which included:

- A concise textual description of the scenario.
- The morphological table with the projected developments of each factor defining the scenario.
- A graphic representation of an urban scene within the scenario, based on the drawings made by participants during the workshop. These images were produced using a combination of manual collage and a generative raster image model based on neural network diffusion, accessed remotely via an online application.
- A circular matrix summarizing potential actions and policies for climate change adaptation. The urban scene highlights the actions implemented in each scenario.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

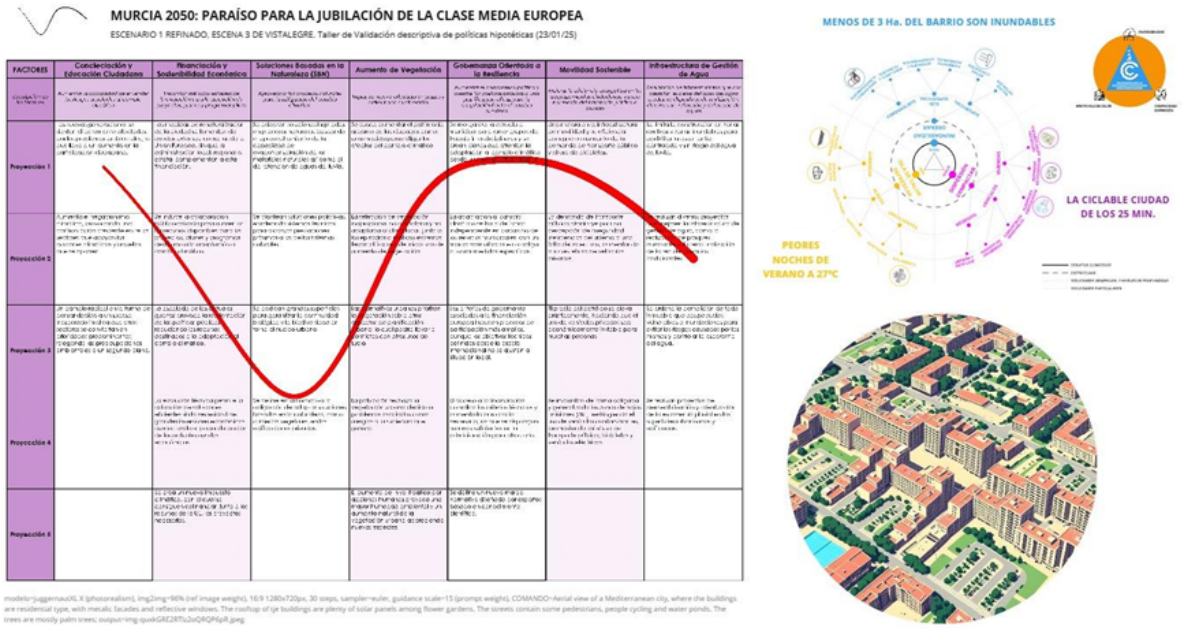


Figure 71: Example of a scenario summary panel

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

SCENARIO 1	
Citizen awareness and education.	New generations feel directly affected by environmental issues, leading to an increase in citizen participation.
Financing and economic sustainability.	Public-private collaboration is encouraged to increase the resources available for projects, plans, and programs aimed at climate change adaptation.
Nature-Based Solutions (NBS).	Large areas are dedicated to ensuring biological continuity and biodiversity around the urban core. Regulations establish the obligation to adopt nature-based solutions, such as green roofs, in private buildings.
Increase in vegetation.	Efforts are made to increase the urban tree canopy as a measure to mitigate the effects of climate change.
Resilience-Oriented Governance.	The municipal structure is reorganized to create interdisciplinary working groups, and plans are developed to address climate change adaptation from an integrated perspective.
Sustainable mobility.	Improvements in mobility infrastructure and efficiency lead to increased demand for public transport and bicycle use.
Water management infrastructure.	Various projects are carried out to improve water management infrastructure, such as the development of floodable parks and the restoration of the traditional irrigation network.

Síntesis literal para el collage asistido por IA: modelo=juggernautXL X (photorealism), img2img=96% (ref image weight), 16:9 1280x720px, 30 steps, sampler=euler, guidance scale=15 (prompt weight), COMANDO=Aerial view of a Mediterranean city, where the buildings are residential type, with metalic facades and reflective windows. The rooftop of tje buildings are plenty of solar panels among flower gardens. The streets contain some pedestrians, people cycling and water ponds. The trees are mostly palm trees; output=img- quxkGRE2RTlz2oQRQP6pR.jpeg

Figure 72: Murcia Lab Scenario 1

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

SCENARIO 2	
Citizen awareness and education.	A radical shift in mindset due to an unexpected event leads other sectors to become predominant priorities, relegating environmental concerns to the background.
Financing and economic sustainability.	Technical advancements enable the adoption of efficient solutions without the need for major economic investment, enhancing the impact of current financial aid programs.
Nature-Based Solutions (NBS).	Solutions inspired by natural processes are adopted, aiming to harness the evapotranspiration capacity of natural materials and the rainwater retention potential of green infrastructure.
Increase in vegetation.	The population rejects urban vegetation due to issues such as allergies or the mess it creates.
Resilience-Oriented Governance.	The municipal structure is reorganized to create interdisciplinary working groups, and plans are developed to address climate change adaptation from a comprehensive perspective.
Sustainable mobility.	Public transport demand declines due to perceived insecurity, system inefficiencies, or a lack of incentives, leading to an increased use of private vehicles.
Water management infrastructure.	Construction is restricted in dry riverbeds and flood-prone areas to allow for controlled and risk-free rainwater runoff.

Síntesis literal para el collage asistido por IA: modelo=juggernautXL X (photorealism), img2img=96% (ref image weight), 16:9 1280x720px, 30 steps, sampler=euler, guidance scale=15 (prompt weight), COMANDO=Aerial view of a Mediterranean city, where the buildings are residential type, with metalic facades and reflective windows. The rooftop of tje buildings are plenty of solar panels among flower gardens. The streets contain some pedestrians, people cycling and water ponds. The trees are mostly palm trees; output=img- quxkGRE2RTlz2oQRQP6pR.jpeg

Figure 73: Murcia Lab Scenario 2

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

SCENARIO 3	
Citizen awareness and education.	Climate change denial increases, leading to growing confrontation between sectors that support climate action and those that oppose it.
Financing and economic sustainability.	City renaturalisation measures are promoted through external funding sources, such as those from the European Union, without additional financial support from local, regional, or national administrations.
Nature-Based Solutions (NBS).	Large areas are dedicated to ensuring biological continuity and biodiversity around the urban core.
Increase in vegetation.	The population rejects urban vegetation due to associated problems such as allergies or the mess it creates.
Resilience-Oriented Governance.	Climate change adaptation is addressed independently by each municipal department, within a regulatory framework that does not mandate specific actions.
Sustainable mobility.	Public transport demand decreases due to perceived insecurity, system inefficiencies, or lack of incentives, leading to increased use of private vehicles.
Water management infrastructure.	Several projects are implemented to improve water management infrastructure, such as the creation of floodable parks or the renaturalisation of the traditional irrigation canal network.

Síntesis literal para el collage asistido por IA: modelo=juggernautXL X (photorealism), img2img=96% (ref image weight), 16:9 1280x720px, 30 steps, sampler=euler, guidance scale=15 (prompt weight), COMANDO=Aerial view of a Mediterranean city, where the buildings are residential type, with metalic facades and reflective windows. The rooftop of tje buildings are plenty of solar panels among flower gardens. The streets contain some pedestrians, people cycling and water ponds. The trees are mostly palm trees; output=img- quxkGRE2RTlz2oQRQP6pR.jpeg

Figure 74: Murcia Lab Scenario 3

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

SCENARIO 4	
Citizen awareness and education.	New generations feel directly affected by environmental problems, leading to increased citizen participation.
Financing and economic sustainability.	Public-private collaboration is encouraged to increase the resources available for projects, plans, and programs aimed at climate change adaptation.
Nature-Based Solutions (NBS).	Regulations establish the obligation to adopt nature-based solutions, such as green roofs, in private buildings.
Increase in vegetation.	Efforts are made to increase the urban tree canopy as a measure to mitigate the effects of climate change.
Resilience-Oriented Governance.	The municipal structure is reorganized to create interdisciplinary working groups, and plans are developed to address climate change adaptation from an integrated perspective.
Sustainable mobility.	The price of oil rises drastically, making the use of private vehicles economically unfeasible for many people.
Water management infrastructure.	The demolition of all buildings located on flood-prone land is mandated in order to avoid associated risks and allow for controlled water runoff.

Síntesis literal para el collage asistido por IA: modelo=juggernautXL X (photorealism), img2img=96% (ref image weight), 16:9 1280x720px, 30 steps, sampler=euler, guidance scale=15 (prompt weight), COMANDO=Aerial view of a Mediterranean city, where the buildings are residential type, with metalic facades and reflective windows. The rooftop of tje buildings are plenty of solar panels among flower gardens. The streets contain some pedestrians, people cycling and water ponds. The trees are mostly palm trees; output=img- quxkGRE2RTlz2oQRQP6pR.jpeg

Figure 75: Murcia Lab Scenario 4

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

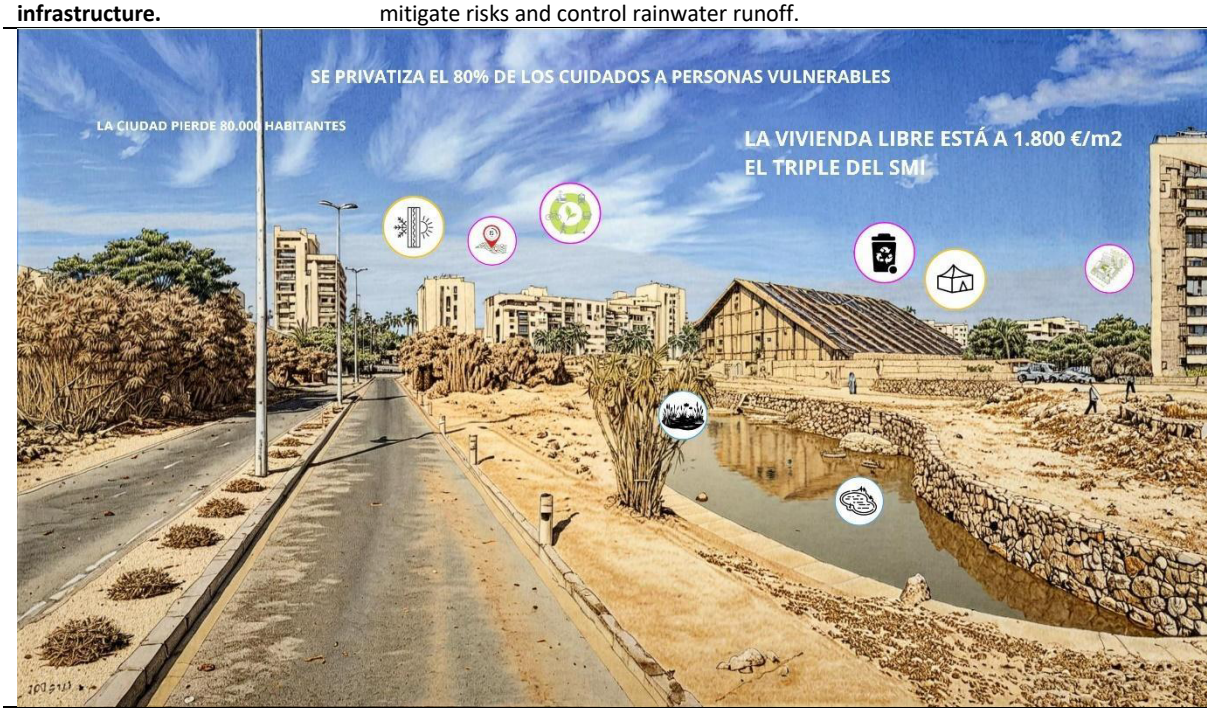
SCENARIO 5	
Citizen awareness and education.	New generations feel directly affected by environmental issues, leading to an increase in citizen participation.
Financing and economic sustainability.	A new climate tax is introduced, enabling the co-financing of necessary projects together with EU resources.
Nature-Based Solutions (NBS).	Solutions inspired by natural processes are adopted, aiming to leverage the evapotranspiration capacity of natural materials as well as their ability to retain rainwater.
Increase in vegetation.	Efforts are made to increase the urban tree canopy as a measure to mitigate the effects of climate change.
Resilience-Oriented Governance.	Governance criteria linked to European funding led to broader participation processes, although the technical objectives defined at the international level do not always align with the local context.
Sustainable mobility.	Public transport demand decreases due to perceived insecurity, inefficiencies in the system, or a lack of incentives, leading to increased use of private vehicles.
Water management infrastructure.	Various projects are implemented to improve water management infrastructure, such as the creation of floodable parks and the renaturalisation of traditional irrigation channels.

Síntesis literal para el collage asistido por IA: modelo=juggernautXL X (photorealism), img2img=96% (ref image weight), 16:9 1280x720px, 30 steps, sampler=euler, guidance scale=15 (prompt weight), COMANDO=Aerial view of a Mediterranean city, where the buildings are residential type, with metalic facades and reflective windows. The rooftop of the buildings are plenty of solar panels among flower gardens. The streets contain some pedestrians, people cycling and water ponds. The trees are mostly palm trees; output=img- quxkGRE2RTlz2oQRQP6pR.jpeg

Figure 76: Murcia Lab Scenario 5

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

SCENARIO 6	
Citizen awareness and education.	A radical shift in thinking, triggered by an unexpected event, leads to other sectors becoming top priorities, relegating environmental concerns to the background.
Financing and economic sustainability.	The escalation of ongoing wars causes a redirection of public policies, reducing the resources allocated to climate change adaptation.
Nature-Based Solutions (NBS).	Palliative solutions are proposed, using technical systems to achieve performances similar to those of natural systems.
Increase in vegetation.	Urban vegetation is rejected by the population due to shifting priorities.
Resilience-Oriented Governance.	A new regulatory framework is established, designed by experts and based on scientific knowledge.
Sustainable mobility.	The price of oil rises dramatically, making the use of private vehicles economically non-viable for many people.
Water management infrastructure.	The demolition of all buildings located on flood-prone land is mandated in order to mitigate risks and control rainwater runoff.



Síntesis literal para el collage asistido por IA: modelo=juggernautXL X (photorealism), img2img=96% (ref image weight), 16:9 1280x720px, 30 steps, sampler=euler, guidance scale=15 (prompt weight), COMANDO=Aerial view of a Mediterranean city, where the buildings are residential type, with metalic facades and reflective windows. The rooftop of the buildings are plenty of solar panels among flower gardens. The streets contain some pedestrians, people cycling and water ponds. The trees are mostly palm trees; output=img- quxkGRE2RTlz2oQRQP6pR.jpeg

Figure 77: Murcia Lab Scenario 6

Workshop 2 results document

In the weeks following the second workshop, the information generated was documented in a report that reflects the dynamics of the session and the outcomes of its various phases. This document aimed to capture as much information as possible about what took place during the workshop. It was shared with the participants once it was completed.

Workshop 3: Policy testing

The third workshop of the Murcia Lab was held on Thursday, January 23, 2025, in the assembly hall of ALEM in Murcia. The objective of this workshop was to evaluate potential policies for climate change adaptation in the urban areas of Murcia (specifically Espinardo and

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

Vista Alegre). The scenarios generated during the second workshop were used as the basis for this evaluation.
This workshop was originally scheduled for late 2024, but it was postponed to distance it from the immediate aftermath and sensitivities following the floods that occurred in Valencia at the end of October that year.

Policy cards

During the period between the second and third workshops, the UPCT team selected a series of policies and actions implemented in various territorial contexts across the European Union aimed at contributing to climate change adaptation in urban environments. In Workshop 3, participants would assess the usefulness of these policies within the different scenarios.
The policies included in the final selection had been identified through the following sources:

- The Knowledge Base of the FUTURESILIENCE project. This database is a comprehensive repository of policy instruments that generate opportunities to enhance various aspects of social resilience. It includes instruments identified and developed through research projects funded by the European Union, featuring analyses, good practices, and useful actions for policymakers and relevant stakeholders.
- Other EU-funded research projects not included in the FUTURESILIENCE project database, but which had been identified by the UPCT team during the development of the Murcia Lab.
- Policies and actions implemented in the Region of Murcia itself or in nearby areas of Spain, which were also identified as relevant references during the development of the lab.

A total of thirty policies were included, classified into the following areas or phases of adaptation:

- **New Data [ND]**: Actions aimed at gathering information and data to more accurately assess risks (exposure and vulnerability).
- **Plans and Strategies [PE]**: Actions focused on developing comprehensive strategies for the adaptation of urban environments to climate change.
- **Projects and Interventions [PI]**: Specific interventions in the city aimed at increasing its resilience to the effects of climate change.
- **Emergency Management [GE]**: Actions designed to improve how society and public administrations respond to events such as floods and heatwaves, to mitigate their impact.
- **Governance and Administrative Organization [GO]**: Actions to adapt governance systems to the challenge of climate change adaptation.
- **Evaluation [EV]**: Actions aimed at assessing the effectiveness of the implemented adaptation policies.

Due to the complexity of the issue and the need to address it from multiple areas of action, the number of possible policies is vast. Therefore, the selected policies did not constitute a comprehensive list, but rather a representative sample of the types of actions possible in each of the above-mentioned phases.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

Table 16: Policy cards list

ID	Política
ND1	Development of detailed flood risk maps of the urban environment at the neighbourhood level
ND2	Modelling of thermal comfort maps
ND3	Improvement of predictive capacity for extreme weather events
ND4	Early warning systems for floods and heatwaves
PE1	Linking regional planning regulations to municipality urban planning
PE2	Regulatory definition of building conditions in flood-prone areas
PE3	Assessment and identification of areas suitable for the implementation of SUDS–NBS
PE4	The eco-neighbourhood as a model of urban resilience
PE5	Construction of shelters for flood situations
PI1	Technical guidelines or instructions for solutions to Urban Heat Island (UHI) and flood risks
PI2	Grants for the naturalization of buildings
PI3	Community participation in the design and implementation of NBS
PI4	Energy rehabilitation of residential and mixed-use blocks / eco-neighbourhoods
PI5	Pilot NBS interventions through tactical urbanism strategies
PI6	Adaptation of infrastructure to climate change risks
GE1	Risk message library
GE2	Signage of flood-prone areas
GE3	Development and promotion of an emergency app
GE4	Rehabilitation of abandoned buildings for post-disaster relocation
GE5	Temporary and removable flood barriers
GO1	Investment strategy for adaptation interventions
GO2	Raise public awareness and promote self-protection
GO3	Policy coherence evaluation tool
GO4	Amendments to the EU Water Framework Directive to adapt it to semi-arid climates
GO5	Mobilization of private sector funding for adaptation
GO6	Integration of NBS into urban planning and regulations
GO7	Preparedness and coordination among organizations in emergency situations
GO8	Inclusion of Nature-Based Solutions in local policies and budgets
EV1	Analytical tools for evaluating urban mobility
EV2	Monitoring of renaturalisation and climate adaptation plans and actions

Each policy was summarized in an individual card that included: a brief description, the location where it had been implemented, the source from which it was identified, and the adaptation phase to which it belonged.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

Participación vecinal en el diseño y ejecución de SBNs.	
Descripción	
Participación de los propios vecinos en el diseño y ejecución de intervenciones locales interconectadas por una estrategia que les dé continuidad física y visual en el espacio público. Colaboración entre ayuntamiento, instituciones culturales, profesionales y ciudadanía para dar sentido y conectar actuaciones piloto basadas en los principios y soluciones basadas en la naturaleza, por ejemplo: huertos urbanos, refugios climáticos, jardines para el drenaje sostenible, peatonalización permeable.	
Lugar de testeo:	Valencia, Milán (Italia), Londres (Reino Unido), Hamburgo (Alemania)
Referencias:	GROWGREEN, FORESTAMI, CLEVER Cities.
Fuente:	FutuResilience Knowledge Base, Proyectos Europeos
Fase:	Proyectos e intervenciones
Comentarios: *(Especificar el escenario para el que se indican)*	

Figure 78: Example of policy card

Below is a list of the selected policies along with a brief description of each.

New data related policies

[ND1] Development of a Detailed Flood Hazard Map of the Urban Environment at Neighbourhood Scale
Preparation of a map showing areas exposed to flooding, including vulnerable buildings and open spaces. The map is based on detailed simulations of water flows, images of past flood events, and other relevant data. It includes information on runoff trajectories and urban micro-watersheds. This tool helps identify areas suitable for coordinated interventions that can be more efficient and sustainable over time.
[ND2] Modelling of Urban Thermal Comfort Maps
Development of thermal comfort maps for urban environments. These maps can be based on modelling using the physical characteristics of the city, generated from multispectral satellite data, or produced through detailed on-site temperature measurements. The resulting map must be reliable and validated with real temperature data collected from each location. It should be made publicly available to both citizens and professionals, with the aim of raising awareness and supporting actions aimed at reducing the urban heat island effect.
[ND3] Improved Predictive Capacity for Extreme Weather Events
Enhancing predictive systems for extreme weather events will lead to better emergency management. With improved forecasting, it will be possible to anticipate heavy rainfall and heatwaves with greater lead time and accuracy, enabling more effective and better-planned emergency responses while also reducing the number of false alarms.
[ND4] Early Warning System for Floods or Heatwaves
Development of systems based on algorithms capable of early prediction of extreme weather events. These systems rely on big data analysis and the application of artificial intelligence to detect patterns in real-time variables, allowing for the early identification of such events.

Strategies and plans related policies

[PE1] Linkage of Territorial Planning Determinations in Urban Soils
The planning of urban soils is carried out in the General Municipal Urban Plans (PGMO) as part of municipal competences in urban planning. However, in the face of risks such as flooding, actions in some urban areas have implications for others located downstream, so it would be advisable for territorial planning instruments to also make decisions regarding urban soils.
[PE2] Regulatory Definition of Building Requirements in Flood-Prone Areas
Establishment of regulations outlining the conditions that buildings in flood-prone areas must meet, including adaptation measures for existing structures. These may include requirements such as mandatory access to rooftops or elevated safe spaces within the building, the orientation of the structure in relation to water flow, among others. These regulations can be set out in territorial or urban planning instruments, or in specific legal frameworks.
[PE3] Assessment and Identification of Areas Suitable for Implementing SUDS and NBS

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

Conducting studies and analyses to identify urban areas suitable for the implementation of Sustainable Urban Drainage Systems (SUDS) and Nature-Based Solutions (NBS). The objective is to enable integrated planning of these interventions within the urban environment. The process helps prioritize actions and establish a timeline for implementation, while also taking into account the economic cost.
[PE4] The Eco-Neighbourhood as a Model of Urban Resilience
An urban development pilot project aimed at transforming climate challenges into a model of urban resilience. This measure involves using the tools provided by urban planning regulations—at the national, regional, or local level—to implement changes in the layout of urban spaces through special plans, partial plans, development units, or detailed studies.
[PE5] Construction of Flood Shelters
Provision of flood-proof refuge spaces either outside flood-prone areas or using techniques and technologies that ensure watertightness. Adaptation of buildings housing critical services (hospitals, airports, government headquarters, etc.) to make them flood-resistant, ensuring uninterrupted supply and continued operation during flood events.

Interventions and projects related policies

[PI1] Technical Guidelines or Instructions for Solutions Addressing UHIE/Flooding
Development of technical guidelines, instructions, and ordinances to assist professionals in designing urban planning projects, buildings, public open spaces, private open spaces, or major infrastructure works. These may be advisory documents or mandatory regulations, but in all cases, they aim to disseminate best practices for implementing projects and interventions.
[PI2] Grants for the Naturalisation of Building Elements
Approval of grants for the naturalization of buildings. These grants can range from financial support to tax benefits or technical assistance. In places such as Barcelona or Madrid, such grants have already been approved in the form of funding a portion of the work to be carried out, with the condition that these works create or increase green spaces on rooftops, facades, private open spaces, or otherwise contribute in a certifiable manner to increasing vegetation in the city.
[PI3] Community Involvement in the Design and Implementation of Nature-Based Solutions (NBS)
Involvement of local residents in the design and implementation of interconnected local interventions through a strategy that provides physical and visual continuity in public spaces. Collaboration between the municipality, cultural institutions, professionals, and citizens to give meaning to and connect pilot actions based on the principles of nature-based solutions, such as urban gardens, climate refuges, gardens for sustainable drainage, and permeable pedestrianization.
[PI4] Energy Rehabilitation of Residential and Mixed-Use Blocks / Eco-Districts
Public funding for the rehabilitation of city blocks and the creation of eco-districts. While there are currently various incentives for private building rehabilitation, in this case, funding would be directed towards interventions on entire blocks aimed at improving the communal living spaces.
[PI5] Experimenting with Nature-Based Solutions through Tactical Urbanism Interventions
In recent years, urbanism has used interventions referred to as "tactical urbanism." These types of actions consist of the temporary implementation of measures, as experiments, to learn from these interventions and make decisions based on the results provided by these temporary experiences. This approach can be very useful when implementing new techniques or introducing nature-based solutions (NBS).
[PI6] Adapting Infrastructure to Climate Change Risks
Adaptation interventions for urban infrastructure in response to extreme climate events. This includes transportation infrastructure (improving crossflow, stabilization during floods) or supply infrastructure (ensuring services continuity).

Emergency management related policies

[GE1] Risk Messaging Library
Development of a library of messages to be issued in an emergency situation. It is prepared with the various emergency services and covers different scenarios. It includes various channels for issuing these messages

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

(mobile alerts, media, social networks, etc.) and specifies the situations in which they should be sent. The goal is to streamline the process of notifying the population.
[GE2] Flood-Prone Area Signage
Placement of signs in flood-prone areas to identify them as such and indicate their risk level to citizens. The signs inform that, in the event of rain (even outside the area), there is a risk to people and property (vehicles) in that location. This signage will be installed in visible locations from various points in the area, ensuring that the information is not lost and that users are made aware of the risk.
[GE3] Development and Promotion of an Emergency App
Development of a mobile application for emergencies that can notify emergency alerts to all citizens. This app could also be used in the opposite direction, allowing for quicker citizen reports of emergencies. This measure is a proposal from the Vega Renhace Plan, and there are already some applications in use in several provinces across the country.
[GE4] Rehabilitation of Abandoned Buildings for Temporary Housing After Disasters
Rehabilitation of abandoned buildings for affordable rental and the relocation of people affected by major floods or residents living in areas especially impacted by the urban heat island effect. An example of application would be the temporary relocation of citizens living in basements, semi-basements, and ground floors located in Preferred Flow Zones to unused buildings previously refurbished for these purposes.
[GE5] Temporary and Removable Flood Barriers
The use of temporary flood barriers to prevent material and human damage in urban areas. These barriers are removable and should be installed at critical points (due to overflow or water runoff) before flooding events occur. The barriers will redirect part of the water to predefined locations where expected damage is minimized.

Governance related policies

[GO1] Investment Strategy for Adaptation Interventions
This measure involves developing an investment strategy for the implementation of any adaptation project. The long-term profitability of the projects or plans is important, so a detailed economic study should be conducted for each adaptation intervention, including a cost-benefit analysis.
[GO2] Raise Public Awareness and Promote Self-Protection
Promote and, if necessary, create citizen movements aimed at adapting the city to climate change. The mission of these movements should be to raise awareness among the public, as well as to create initiatives and activities that contribute to the renaturalisation of the city. Encourage public knowledge about self-protection measures during extreme weather events (where can I take shelter? How should I act? How can I prepare?).
[GO3] Tool for Evaluating Policy Coherence
Application of tools to evaluate the coherence between different policies or public measures. The aim is to assess whether a set of measures are compatible or incompatible with each other. This evaluation allows for a preliminary analysis of measures before their implementation, identifying those that might be counterproductive and prioritizing those that are beneficial to one another, allowing them to reinforce and complement each other to achieve the same goal.
[GO4] Amendments to the European Water Framework Directive for Adaptation to Semi-Arid Climate
Submission of amendments to the European Water Framework Directive (DMA 2000/60/EC) and the Urban Wastewater Treatment Directive (UWWTD 91/271/EEC) to adapt flood and water management criteria to the specificities of semi-arid climates. The aim is to modify this directive and, if approved, review the national regulatory framework derived from it, including the adaptation of the Water Public Domain Regulation (DPH) to the drainage particularities of the Murcia Agricultural Land (Huerta de Murcia).
[GO5] Private Sector Fundraising for Adaptation
Financing is necessary to carry out adaptation projects in public urban land. Although public funds are available, the large number of actions required for effective climate change adaptation means that these funds are insufficient. Raising funds from the private sector or philanthropic initiatives, by seeking interested parties for investment, can help increase the number of interventions.
[GO6] Integrating NBS into Urban Planning and Regulations

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

Integration of Nature-Based Solutions (NBS) and Sustainable Urban Drainage Systems (SUDS) as mandatory techniques and solutions in urban planning, both for new developments and urban rehabilitation projects. This integration would be included in local ordinances (urbanization, building codes, etc.) or in regional or national regulations (such as the Technical Building Code, etc.). These could be regulations that set specific techniques or require measurable objectives.
[GO7] Preparing Coordination Among Organizations in Emergency Situations
An integrated program among various sectorial organizations to improve the capacity for effective response in complex disaster situations and systemic crises. A catalogue of recommendations, best practices, and operational methodologies is made available. This involves coordination between forestry agents, environmental organizations, the municipal government, security forces, and civil protection.
[GO8] Inclusion of Nature-Based Solutions in Local Policies and Budgets
Systematic and long-term integration of Nature-Based Solutions (NBS) interventions into local policies and budgets. This may involve cross-cutting integration in actions carried out by different services (urban planning, green spaces, building, energy, etc.) or allocating an annual percentage of the municipal budget to these interventions.

Evaluation and assessment related policies

[EV1] Analytical Tools for Urban Mobility Evaluation
The use of analytical tools for evaluating urban mobility. It is important that the policies implemented or to be implemented are evaluable. Urban mobility policies are often a subject of debate and confrontation among citizens, so an analytical and objective evaluation is essential for the implementation or continuation of an urban mobility plan.
[EV2] Monitoring of Renaturalisation and Adaptation Plans and Actions
Implementation of monitoring systems for the plans and interventions carried out for renaturalisation and climate change adaptation. The experimental nature of these measures requires tracking their results, which is especially useful for assessing their scaling from initial actions to widespread use. Both qualitative and quantitative monitoring systems (sensors, etc.) can be used.

Call and assistance to Workshop 3

Invitations were sent to all participants from previous workshops. Stakeholders who had not attended other workshops were excluded due to the difficulty of integrating them into the laboratory's dynamics. The invitations were sent by both the City Council team and the UPCT team.
The third workshop was attended by 16 participants, representing: environmental services, infrastructure, and energy of the City Council; regional health and environmental services; professional associations of public works and technical architects; citizen associations; and universities. Twelve of them had participated in previous workshops.

Scenario analysis

At the beginning of the workshop, participants freely divided themselves into three working tables. In general, those who had attended the second workshop tried to sit at the same table as before.

After the welcome session, each table was given a summary panel of two of the scenarios developed during Workshop 2. Participants were given a few minutes to read and absorb the information about the scenarios.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

Wind-Tunnelling policies

The policy evaluation exercise across different scenarios was conducted in three rounds. At the beginning of each round, each table received the policy cards corresponding to two of the six phases (ND, PE, PI, GE, GO, EV). Participants were asked to analyse and discuss all of them and then carry out an individual assessment of each policy within both assigned scenarios.

To record the evaluations, each table was given a large format printed table, with rows listing the 30 preselected policies and columns corresponding to the two scenarios being discussed. To visualize the collective results, participants used color-coded stickers according to the following criteria: green for policies considered valid in the scenario, blue for policies that would be useful if adapted from the original description, and red for policies deemed not useful or potentially counterproductive in the scenario. Green stickers came in different sizes to indicate the relative priority or interest in applying each policy.

Figure 79: Wind-tunnelling policies in workshop 3 of Murcia Lab

In the final part of the workshop, the evaluations from each table were compared, providing an overview of the usefulness of the policies across the six different scenarios. It is worth noting that, because of the morphological table used to generate them, three of these scenarios depicted optimistic futures in which climate adaptation measures had been implemented, while the other three were more pessimistic, reflecting futures with no measures taken and intensified impacts of climate change (floods and heatwaves).
Several key points emerged from the group discussion:

- None of the policies were considered sufficient on their own to achieve climate adaptation in the urban environments of Murcia's neighbourhoods.
- In the evaluation of the policies, it was observed that in the pessimistic scenarios, certain adaptation measures were rated as not very useful compared to the need for reconstruction following dramatic emergency events. This reveals a paradox within adaptation policies that is worth considering when developing strategies.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

- In the optimistic scenarios, some policies were considered less useful because the scenario had already achieved the objectives those policies aim to support. This highlights the importance of periodically updating climate adaptation plans to align the proposed measures with the progress already made.
- Measures aimed at changing the regulatory framework were considered less useful due to the slow pace of legislative processes and the limited change in the range of possible policies.

The table below shows the scores assigned to each of the policies.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

Table 17: Policy assessment in different scenarios [E]. Green indicates valid policies, blue indicates policies that are useful with adaptations, and red indicates policies considered not useful or counterproductive. The number represents the individual vote count.

	TABLE 1						TABLE 2						TABLE 3					
	E3			E6			E2			E5			E1			E4		
POLICY	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
ND1	4			4				1	2	3			3	1		3	1	
ND2	4			4					3	3			3	1		3	1	
ND3	4			4				2	1	3			3	1		3	1	
ND4	4			4			3			3			4			4		
PE1	4			4			1	2			1	2	3	1		3	1	
PE2	4			4			2	1		3			4			4		
PE3	4			4			2	1		3			4				1	3
PE4	4			4				1	2	3			4			4		
PE5	4			3	1		3			3					4			4
PI1	4			4			3			3			5			4		
PI2	4			4			3			3				3	1		4	1
PI3	4			4			3			3			4			3		1
PI4	4			4			2	1		3				1	4		1	3
PI5	4				3	1	3			3			4			5		
PI6	4			4			3			3				4			4	
GE1	4			4			3			3			4			4		
GE2	4			3	1		1	2		2	1		4			4		
GE3	3	1		3	1			3			3		1	3		1	4	
GE4			4		1	3	3			3				1	4		1	4
GE5	2	2		4			2	1		2	1		4		1	3		1
GO1	5			3	1	1	3			3			4			4		
GO2	5			5			3			3			3	1		3	1	
GO3	5			4	1		3			1	2		3	1		3	1	
GO4	1	4			5		2		1	2	1			2	2		1	3
GO5	5			4	1		3			3			3	1		3	1	
GO6	5				2	3	3			3			4			4		
GO7	5			5			3			3			4			4		
GO8	5			3		2	3			3			2		2	1		2
EV1	5				1	3		3		3			3			3		
EV2	5			1	2	1		2	1	3			4			4		

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

Final assessment of Murcia Lab

During the final minutes of the workshop, a general evaluation of the Murcia Lab and its three workshops was carried out. Several notable aspects emerged:

- Workshop 3 was considered the most operative by participants and the one that best met their expectations of the lab. Workshop 2, focused on scenario generation, was perceived as the most unusual, although the scenarios were seen as useful for the policy evaluation process.
- The methodology—identifying factors, generating scenarios, and evaluating policies—was considered valuable and potentially applicable to participants' own professional contexts. It was perceived as a helpful way to take different future scenarios into account.
- The involvement of technical staff from various areas of public administration was viewed positively, as it allowed for the sharing and integration of diverse perspectives.
- The lab was generally seen as having a primarily theoretical scope, without resulting in concrete decisions or measures. In this regard, it was not possible to generate specific solutions for the neighbourhoods of Vista Alegre and Espinardo.

4.8.4 Achievements

In relation to the objectives of the Murcia Lab, the following achievements have been made:

1 | Generate useful knowledge to strengthen resilience to climate change impacts in the urban areas of the municipality of Murcia. On one hand, an assessment of the impact of climate change in the neighbourhoods of Vista Alegre and Espinardo was conducted by identifying the areas most exposed to these effects and the vulnerabilities of the built environment in these areas.

On the other hand, evidence-based policies and actions from other locations were collected. These actions aim to improve climate resilience through the generation of new data, the design of plans and strategies, the execution of intervention projects, emergency management measures, changes in governance systems, and the evaluation of adopted actions.

2 | Evaluate the usefulness of up to thirty different policies and actions in the potential future scenarios of urban areas in the city of Murcia. This evaluation was carried out by the professionals managing these urban environments, considering their various perspectives. A high degree of consensus was observed, with a positive assessment of the complementarity of their visions.

During this process, the need to address the challenge through diverse solutions was confirmed, requiring new governance systems to coordinate the variety of potential measures.

3 | Use of foresight techniques to define these policies, allowing for a long-term view of needs and problems, while also enabling better management of future uncertainty. The use of various future scenarios allowed the identification of the need for continuous updates to adaptation strategies to align them with the actions developed and the evolution of climate changes and extreme rain and heat events.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

Policy Impact

The Murcia Lab facilitated dialogue among up to 15 municipal staff from the City of Murcia and 6 regional officials from the Autonomous Community of the Region of Murcia, representing various departments including environment, urban planning, infrastructure, emergency management, and public health. Additionally, 12 representatives from professional associations, universities, and civic organizations also took part. Throughout the workshop sessions, the complementarity of their expertise and operational fields was clearly demonstrated as an asset in enhancing climate resilience in urban environments.
The process of identifying evidence-based policies and actions resulted in a partial catalogue of good practices tested in other locations. This provided concrete reference points to address local challenges, and participants noted that these examples helped build confidence among technical staff in the potential of such measures.
The outcomes of the Murcia Lab are intended to be shared with political decision-makers to help promote a long-term vision and encourage institutional changes needed to support climate change adaptation in urban areas.

4.8.5 Lessons learnt

The involvement of different stakeholders presented several challenges:

- The most evident was the low level of citizen participation in response to the calls to join the workshops, which led to adjustments in the design of the sessions. To address this, the organising team made a greater effort to involve citizens in the process. However, it also raises broader questions about citizen engagement in processes led by public administrations when there is no direct link to the implementation of concrete measures.
- Regarding the participation of technical staff, it became clear that it is very difficult to ensure the same group of professionals is available across all three workshops. As a result, the composition of participants changed throughout the different sessions.
- It was also observed that maintaining active engagement in longer workshops is challenging (the sessions were held from 9:00 a.m. to 2:00 p.m.). This limitation meant that some of the discussions and analyses had to remain somewhat superficial.

The experience of applying the methodology outlined in the FUTURESILIENCE lab guidelines to the goals of the Murcia Lab has also provided some key lessons:

- The complexity of climate change adaptation led to an increasing number of variables during certain phases of the process (two neighbourhoods, three climate impacts, several working groups, multiple scenarios). As a result, several moments required reducing the number of variables under consideration (selecting key factors, limiting the number of policies, etc.) to keep the workshop dynamics feasible in terms of time and complexity. These necessary reductions led to a simplification of some of the information generated during the workshops.
- Although the results are based on the characteristics of Vista Alegre and Espinardo, the process did not produce specific solutions tailored to these neighbourhoods. Analytical maps of both areas were present throughout the workshops, but the available time did not allow for defining how the

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

identified policies could be applied locally (e.g., identifying target areas or establishing priorities for intervention).

- From the beginning, the process intentionally included climate adaptation actions (such as nature-based solutions projects) as part of the key future factors. This approach helped steer the discussions toward the necessary conditions to implement these solutions systematically, rather than focusing on their technical definition.
- The expectations of participating technical staff were more aligned with the activities of the final workshop. As a result, part of the lab was perceived as having a more theoretical focus, which did not fully match the participants' need for practical solutions.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

4.9 SCRL Lab

Abstract
The Slovenian Cyber Resilience Lab (SCRL), a pilot project under the FUTURESILIENCE initiative, was launched to enhance the cybersecurity resilience of Slovenian small and medium-sized enterprises (SMEs), R&D communities, and start-up ecosystems. Recognising the growing cyber threats faced by SMEs, the project aimed to bridge the gap between the cybersecurity needs of these businesses and the available solutions, while also engaging policymakers to develop effective cybersecurity policies. Throughout the project, SCRL conducted a comprehensive study of Slovenian SMEs and start-ups, identifying critical factors impacting their cybersecurity resilience. The project organised two multi-stakeholder workshops, bringing together representatives from government, academia, industry, and start-up communities to collaboratively identify challenges and develop solutions. This process led to the development of five cybersecurity policy solutions, including guidelines for policymakers and a policy brief draft, providing actionable recommendations for strengthening national cybersecurity. In addition to policy development, SCRL enhanced awareness of cybersecurity issues among SMEs and start-ups through targeted training, public events, and media engagement. By fostering cooperation between diverse stakeholders and focusing on the unique needs of SMEs, SCRL has laid the foundation for more inclusive, effective, and sustainable cybersecurity policies in Slovenia.

- Local Partners: SGB d.o.o; Faculty of Criminal Justice and Security, University of Maribor; IVSR - Institute for Security and Strategic Research; Cresco Innovation d.o.o.; Primorska Technology Park; Chamber of Commerce and Industry of Slovenia
- Mentor: Copenhagen Institute for Futures Studies

4.9.1 Description of the lab

The Slovenian Cyber Resilience Lab (SCRL) is a FUTURESILIENCE lab consisting of six partners: SGB, security consulting, Ltd., Cresco Innovation Ltd., Institute for Security and Strategic Research, University of Maribor's Faculty of Criminal Justice and Security, Chamber of Commerce and Industry of Slovenia and Primorska Technology Park. The consortium was built around the growing need of small and medium sized enterprises (SME), R&D communities and start-up ecosystem for affordable and easy-to-implement/use cybersecurity solutions.

The SCRL started out with the following five objectives:

1st objective: Identify the current state of cybersecurity in Slovenian tech environment by conducting several studies among the representatives of the environment.
2nd objective: Identify the potential solutions, for raising the resilience of Slovenian tech communities from cyberthreats, cyber espionage and other future scenarios, which would be feasible, sustainable, cost efficient and tailored to specific needs of smaller sized tech companies.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

3rd objective: Create guidelines for implementation of identified solutions by policymakers, tech communities and cybersecurity stakeholders into practice and offer continuing support to various stakeholders.
4th objective: Create awareness about cybersecurity as a main technological challenge and make it a part of the agenda for stakeholders including policy makers, industry support organisations, media, and civil society.
5th objective: Secure services and resources of project partners, as well as services and resources of other stakeholders to support and ensure SCRL activities after the end of the FUTURESILIENCE project.

4.9.2 Initial needs and challenges

Cybersecurity is a global challenge that is gaining on relevance and importance by each passing hour. In a world where major parts of our private and professional lives depend on the availability, integrity and confidentiality of ICT systems, cybersecurity serves a critical function. In the past couple of years this has been particularly true for the European Union (EU). EU is on a path of increasing its technological and economic independence, both from the traditional allies in the West and raising powers of the global East. This leaves the EU, its governing bodies, companies and even citizens exposed to ever-growing number of threats, particularly in the cyberspace. While, on the level of an individual companies, cyberthreats can disrupt the normal operations, cause direct or indirect damage and contaminate the reputation of a company, they can also disrupt whole economies and consequently impact economic and social security of a nation.

While a single cyberattack on a large and well-known company might gain public attention, it does not impact our economic systems as much as the cyberattacks that remain hidden – cyberattacks on SMEs. Slovenian economy is largely dependent on SMEs. Slovenian SMEs employ more than 70 % of working population in private sector and create 65 % of all income across the private sector. Slovenian SMEs, R&D organisations and start-ups are also largely responsible for economic growth, technology development and innovation. Thus, it is clear, that to maintain an economically resilient society, SMEs must be protected at every cost – especially in the cyber domain.

Unfortunately, this is not the case in practice. When it comes to protecting themselves in the cyberspace, SMEs, R&D organisations and start-ups are focusing several challenges:

- **Focus on fast R&D and market entry:** Fast-paced and highly competitive modern business environment forces tech companies to bring their product to market as soon as possible, so they pay less attention to security in the process.
- **Lack of human resources:** Tech companies do not have adequate human resources and know-how to implement and manage suitable cybersecurity measures. Outsourcing is usually not an option as they do not have the financial funds.
- **Low perceived vulnerability:** Majority of tech companies still believe that they are not an interesting target to cybercriminals or state actors as they (or their digital footprint) are too small

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

for them to notice. However, it is estimated that more than a half of all cyberattacks is directed at SMEs.

- **Lack of attention from security service providers:** Tech companies are mostly ignored by security services providers, who usually lead the way in development of various cybersecurity solutions. Since tech companies lack financial funds, security service providers are not incentivised to develop tailored solutions.
- **No cybersecurity support from tech and start-up communities:** Slovenian tech companies are not helped by the support environment when it comes to cybersecurity due to low perceived vulnerability, lack of knowledge and expert personnel.
- **No focus on cybersecurity by policymakers:** Protection of tech companies from cyberthreats and cyberespionage is not addressed by Slovenian policymakers. There are no policies put in place that would help or guide Slovenian tech companies to raise their resilience to cyberthreats.

Thus, SCRL set out to complete the five objectives, described in the Chapter 1, with which we aimed to address the presented challenges.

4.9.3 Work done in the lab

SCRL generally followed the Work Plan set out in the SCRL Open Call Application and the FUTURESILIENCE Guidelines for Pilots. However, at this point, we would like to point out that there were some deviations from the Work Plan and Guidelines. This is mostly due to the following facts:

- During the WP 1 (Diagnose and Frame) we decided to broaden our focus from SMEs and tech communities only, to the wider economic system of Slovenia. This decision was made, since we wanted to impact holistic policies on national level, and did not want to exclude other stakeholders who could benefit from the policies as well (such as larger companies, public sector organisations or NGOs).
- In WP 2 (Scenario Building) we decided to deviate a bit from the planned three workshops and divide the planned online scenario building workshop into several brainstorming sessions with individual stakeholders. This was done to mitigate the issues with stakeholder availability. However, to provide final input, scenario refinement was also part of the final, policy building workshop.

The following sections summarises the **main activities** of the Slovenian Cyber Resilience Lab between February 1st 2024 and May 15th 2025.

The SCRL officially launched in February 2024. The first activity carried out by the Lab was stakeholder analysis. The stakeholder analysis was performed to identify all relevant stakeholders, distribute them in a power-interest matrix displayed in Figure 80and create an outreach strategy, to effectively manage all stakeholders.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

SCRL STAKEHOLDER MATRIX		
HIGH P O W E R LOW	• Slovenian Ministry of the Economy, Tourism and Sport. • European Innovation Council. • Government agency SPIRIT Slovenia. • Slovene Enterprise Fund. • Media. • Slovenian Sovereign Holding. • National Council of Republic of Slovenia. • Information Commissioner. • SID Bank.	• Slovenian Ministry of Digital Transformation. • University of Maribor. • University of Ljubljana. • Slovenian Chamber of Commerce. • Government Information Security Office. • Security services providers. • Start-up support organizations. • Chamber of Craft and Small Business of Slovenia.
	• NGOs (such as Safe.si and Varensvet.si). • Local governments and municipalities. • Trade Unions.	• SI-CERT • International Centre for Promotion of Enterprises. • Start-up companies.
	LOW INTEREST HIGH	

Figure 80: SCRL Stakeholder Matrix

The analysis identified 23 relevant stakeholders from public and private sectors, as well as representatives from media space, NGOs and general public. We have managed the relationships with the stakeholders based on their placement in the stakeholder matrix.

The second major activity carried out by the SCRL, was a study in the Slovenian start-up community. The main purpose of the study was to identify the factors that have an effect on a SME's ability to implement a cybersecurity measure. The factors were identified via a systematic literature review, carried out by Faculty of Criminal Justice and Security, University of Maribor, and were distributed into the STEEPL framework. After the identification of the factors, Faculty of Criminal Justice and Security developed a survey, which was then distributed among the Slovenian start-ups and other small tech companies. A total of 25 companies responded to the survey. This enabled us to identify 18 core factors that impact the SME's ability to implement the necessary cybersecurity measures as illustrated in Figure 81.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

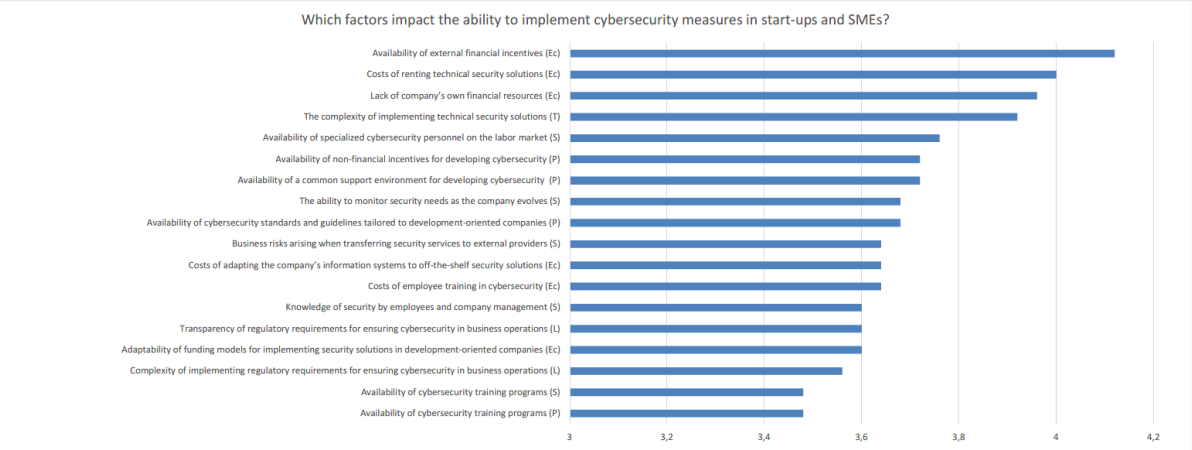


Figure 81: 18 Factors with highest mean importance (5 = Max)

The results of the survey served as a core for the first in-person workshop, organised on 22nd of May, 2024 at Primorska Technology Park in Nova Gorica, Slovenia. The workshop was attended by 25 individuals, representing various groups of stakeholders. This included representatives from:

- Government Information Security Office and other policymakers from public sector.
- Research institutions and academia.
- Security service providers from private sector.
- Start-ups, technology parks and start-up incubators.
- Slovenian Cyber Resilience Lab.

The main purpose of the first workshop was to discuss the results of the survey with the present stakeholders in order to create a consolidated list of factors, assessed by their impact and uncertainty, as well as discuss their potential future development. While 18 factors from the survey results served as a core, several stakeholders pointer out new factors which were then included and discussed in the workshop. Attendees were divided in three groups, paying close attention to divide them in such way that each group had a representative from every stakeholder group. Groups were asked to discuss the factors based on their future impact and uncertainty. Each group was asked to come up with 10 factors with the highest level of projected future impact and uncertainty and create event projections for the development of each factor. While there were a couple of outliers, most factors overlapped across the groups.

After the summer break, SCRL continued with the scenario building phase. Initially, a second scenario building workshop was planned for October. However, due to the issues with stakeholder availability, SCRL together with lab mentor from CIFS decided to combine the scenario building workshop with the final policymaking workshop. Utilising the results from the first workshop, CIFS and SCRL prepared an outline for four general scenarios “Future of Cybersecurity”, revolving around future geopolitical and economic development. The scenario drafts were then consolidated with stakeholders in a series of short, online brainstorming sessions. In these sessions a member of the SCRL team met with representatives from individual stakeholder groups, presented the drafted scenarios and

This project has received funding from the European Union’s Horizon Europe research and innovation programme under grant agreement No 101094455.

gathered the stakeholder's feedback. Based on these sessions a final scenario grid was created by SCRL and CIFS teams. The scenarios first sketch the external contextual environment which is presented in ***Figure 82*** and then the more industry related operational environment Figure 83.

FUTURE OF CYBER				
	Scenario A **Suggestions for titles: The west against the rest/ Cold war 2/**	**Scenario B** **Multicrisis**	**Scenario C** **Japanese EU Scenario/ Old Europe**	**Scenario D** **Peace in our time**
Dynamics of globalisation Vertical Axis *In a global society in flux, what will characterise the global economy, interconnectedness and international relations? Global conflicts/ Proxy cyber-wars/ misinformation campaigns/Interference of foreign countries or peaceful co-existance?*	**Conflict: Regionalisation and disintegration**	**Conflict: Regionalisation and disintegration**	**Globalisation recalibrated**	**Globalisation recalibrated**
Economy Horizontal Axis *Will the lack of EU reform, innovation burden the EU economy, and see FDI move outside of the EU or will EU be able to be competitive in the future?*	**Competitive Slovenia**	**Weak economy/Recession**	**Weak economy**	**Competitive Slovenia**
CONTEXTUAL ENVIRONMENT (external-to-industry)				
Zeitgeist	• The geopolitical situation sees an uptick of misinformation campaigns, and AI being used by foreign powers in a new capacity to create cyber terror. The slow displacement of the USA as the de facto only super factor has created a multipolar world order. The EU finds itself in the midst of a soft powerplay between the two major forces. The EU huddle together as conflict surrounds the Union	• The negative international development with increased protectionism and trade barriers together with proxy wars being fought around the globe, has the world move into a more uncertain political environment. Society has become even more automated and digitised meaning IT is considered a strategic infrastructure to a greater extent. This has set strict restrictions on the parties that can supply hardware in various areas, reducing international trade in the area. AI has become a new arms race. The bad economic situation in the EU is putting a severe toll on the Slovenian economy, causing brain drain.	• EU's hope to become the most competitive regions in the world has failed yet again. Investors are attracted to the USA and the developing world and see little evidence that old Europe is capable of creating the reforms and the business environment needed to meet the challenge of the future. The EU has many visions, but don't want change and is all about preserving existing jobs rather than making room for new ones. A debt-ridden economy, populism and a lack of reform have impacted Slovenia's growth prospects.	Europe has transformed its economy to be a model of sustainable development. The zeitgeist of the era is defined by a collective commitment to sustainability, health, and ethical technology use, fostering a society where progress is balanced with responsibility.
Global aspects	• Thucydides's Trap: With the rise of China the US superpower position is threatened, opening up room for Russia to play destabilizing factor.	• Thucydides's Trap: With the rise of China the US superpower position is threatened, opening up room for Russia to play destabilizing factor.	• Globalization continues, no one stands to win by protectionism and conflict.	• Globalization continues, no one stands to win by protectionism and conflict.
Economy	• Despite the geostrategic landscape EU maintains positive growth.	• Weak EU economy is negatively impacting Slovenia which is increased due to high public debt, an ageing society, high health care cost and low productivity growth. Recession is a recuring reality.	• Weak EU economy is negatively impacting Slovenia which is increased due to high public debt, an ageing society, high health care cost and low productivity growth. Slovenia witnesses low economic growth.	The EU maintains positive growth, inflation is kept in check
Politics and Society	• The war in Ukraine was the start of a prolonged conflict with Russia. Confronted with strong external pressure the EU stand closer together.	• The EU is divided in how to cope with the ongoing crisis, an every country for itself logic seem to prevail.	• After years of conflict and uncertainty the international political climate stabilises. EU still faces and internal political conflict, driven in no small measure by increased populism.	After years of conflict and uncertainty the international political climate stabilises and so does the inter EU conflicts. The EU sees greater harmonization.
Tech and digitisation	• AI is having greater inroads. • The cyberwarfare between Russia and EU has intensified, impacting major industries airports and supply chains.	• AI is having greater inroads • The cyberwarfare between Russia and EU has intensified, impacting major industries airports and supply chains.	• AI is having greater inroads • The Ukrainian crisis ends and so does the cyber war.	• AI is having greater inroads • The Ukrainian crisis ends and so does the cyber war.

Figure 82: SCRL Scenario Elements Contextual Environment

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

FUTURE OF CYBER				
	Scenario A **Suggestions for titles: The west against the rest/ Cold war 2/**	**Scenario B** **Multicrisis**	**Scenario C** **Japanese EU Scenario/ Old Europe**	**Scenario D** **Peace in our time**
Effect on cybersecurity?	• Cyberwarfare is in full effect, however it is not fully visible to the public and is operating in the "grey" areas. Nation state actors and organized criminal groups, sponsored by Russia and China, are targeting critical infrastructure, R&D organizations, national security infrastructure and supply chain with the goal to disrupt and destroy normal operations of organizations. • AI is used to fuel rapidly changing and multifaceted attacks, as well as misinformation campaigns towards public opinion. • Cyberattacks against private sector are more direct, targeting organizations with ties to national security sector, finance, telecommunications, R&D, and industrial complexes. • Due to the positive economic situation and high perceived threat to national security, Slovenia is heavily investing in cybersecurity, which means that organizations can respond to cyberthreats more effectively.	• Due to poor economic situation and lack of employment opportunities, cybercrime presents an attractive option for skilled IT workers. AI is leveraged for various types of cyberfraud and financially motivated attacks against companies. • Nation state actors (and criminal groups backed by them) are targeting Slovenian companies, increasingly with ransomware, to disrupt and destroy, as well as try to extort. • Slovenian companies, lacking human and financial resources are not able to properly protect themselves against cyberattacks, which further deteriorates state of economy, causes disruption in utility services and damages critical infrastructure of the countries. • In combination with misinformation campaigns, this further decreases public trust in technology and authorities, which leads to lower adoption of new (safer) IT solutions, patching of security vulnerabilities and further deteriorates the ability to protect against cyberattacks.	• Due to poor economic situation and lack of employment opportunities, cybercrime presents an attractive option for skilled IT workers. AI is leveraged for various types of cyberfraud and financially motivated attacks against companies. • "Crime as a service" (CaaS) hacker groups shift their focus to the most vulnerable business sectors – SMEs. AI driven ransomware attacks, business frauds and social engineering driven attacks are running rampant. Motivation of CaaS is strictly financial. The cyberattacks are more pragmatic, low effort – high reward based. • Slovenian companies, lacking human and financial resources are not able to properly protect themselves against cyberattacks, which further deteriorates state of economy, as SMEs, who are the driving force of the economy, are starting to close. Trust in technology is deteriorating, lowering the uptake of new cybersecurity solutions, even for those who can afford them.	• A stable political situation in the EU and economic growth have removed the threats of open cyberwarfare conflict. However, countries, who are competing economically are still active adversaries in cyberspace. State actor threats are mostly connected to cyberespionage and intelligence gathering, with an emphasis on covert operations, as countries do not want to disturb the status quo by being detected. • Industrial (corporate) espionage is on the rise, coming from corporations from outside of the EU. CaaS groups are also targeting intellectual property and other data from Slovenian companies and selling it on the darknet markets. • Cybersecurity is a priority of Slovenian companies, meaning that they are investing both human as well as financial resources into it. Cybercriminals are consequently utilizing AI to conduct social engineering and cyberfraud campaigns against the weaker links – employees. The motivation of cybercriminals is mainly financial gain.
Competition, business models, and marketplace	• A favorable economic climate create rapid company growth, but supply chain disruptions remain an issue.	• The recession in Slovenia causes brain drain, cyber attacks continue to disrupt supply chains.	• The low economic growth causes brain drain in Slovenia	• A stable an vibrant economy create rapid company growth
Windtunneling: Adaptation measures	• Create financial incentive to invest in Cyber security • Increase cyber security awareness among politicians and relevant stakeholders • Simplify the legislation	• Create adequate university courses and train specialists • Increase cyber security awareness among politicians and relevant stakeholders	• Create adequate university courses and train specialists	•
Windtunneling: Prevention measures	•	•	•	•

Figure 83: SCRL Scenarios Operational Environment & possible measures

At the same time, SCRL conducted a comprehensive Knowledge Base analysis. The purpose of the Knowledge Base analysis was to identify the policies that could mitigate the barriers to cybersecurity adoption (1st workshop result factors). The analysis resulted in 30 relevant policies, which were then ranked on their relevance and applicability. In the end, 20 most relevant policies were selected and later used at the policy making workshop.

On 20th of November 2024 second and final workshop took place at Institute for Security and Strategic Research in Ljubljana, Slovenia. The workshop was attended by 15 representatives from:

- Government Information Security Office.
- Research institutions and academia.
- Security service providers from private sector.
- International intergovernmental organisation.
- SMEs and start-ups.
- Slovenian Cyber Resilience Lab and CIFS.

As in the first workshop, participants divided in three groups (CIFS represented the fourth group). The workshop was divided into two main sections. The first section was dedicated to refinement of developed scenarios from the scenario grid, as well as threat and weakness identification. In this section each group was given a scenario and was asked to perform a

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

SWOT analysis, focusing on threats and weaknesses sections. The second section was dedicated to the presentation of twenty policies from the knowledge base. Each group then performed a windtunelling exercise for their respective scenario and was also asked to come up with any additional policies. This workshop resulted in the development of the five policy solutions displayed in Table 18 – three of which were brand new, and two were adapted from existing Knowledge Base policies.

Table 18: SCRL Lab Policy Solutions

Policy Solution 1: Joint ventures for R&D
This policy addresses the lack of investments in cybersecurity R&D. This policy proposes joint ventures between the public and private sector to establish high value-added companies, which would operate in the field of cybersecurity R&D. The country of Slovenia would be able to obtain a minority share in R&D start-ups via dedicated funds, by providing starting capital and support from R&D specialists from academia, while the start-up would provide the management, market and main R&D function. Aside from supporting national industry and in-country developed security solutions, long term profits from the state's minority ownership stake would be reinvested in various cybersecurity related public programs, such as education and awareness raising.
Policy Solution 2: Cybersecurity Talent Pool
This policy addresses the lack of cybersecurity expert on the national level. The policy is focused on creating new education programs at all levels of education, however it also includes the measures on the national level. This policy proposes the measures to educate the next generations of cybersecurity experts, provide re-skilling opportunities and prevents brain drain. The policy solution includes collaboration from various stakeholders – from Ministry of Education and universities to Ministry of Finance and private sector. By establishing a holistic national cybersecurity training program, this policy ensures the capabilities for the development of cybersecurity experts and provides an opportunity to re-skill to all who are already working in similar fields. This policy solutions proposes listing cybersecurity among the areas considered as "deficit occupation" areas and offering tax breaks, stipends and other financial incentives for experts to remain in the country and to attract foreign experts.
Policy Solution 3: Small Grants Program
This policy addresses the lack of funding opportunities for start-ups and other SMEs to set up their internal cybersecurity framework. This policy solution proposes an establishment of cybersecurity small grants program, which would subsidize various cybersecurity solutions for start-ups and SMEs. A similar program is currently in place in Slovenia, however it only subsidizes specialized services that are usually not applicable for start-ups and SMEs. The proposed policy solution would connect start-ups with cybersecurity, risk management and compliance experts to help set up a holistic, cost-effective and tailor-made cybersecurity framework in each individual organization. The cybersecurity small grants program would thus solve three major challenges that start-ups face when implementing cybersecurity solutions – lack of funding, lack of experts and lack of knowledge.
Policy Solution 4: SOTER Cybersecurity Competence Training Framework
The SOTER Framework is a Knowledge Base policy, which was identified as one of the core policies for addressing the challenges of the SCRL. This policy is focused on building up cybersecurity competence by providing a cybersecurity training framework. While the framework is tailored to employees in finance, it can be used to train individuals in other business and social sectors. The policy encourages competence-based approach to cybersecurity, meaning that everyone can take part in training, no matter their previous skills. This ensures that everyone can build their cybersecurity skills, reducing the need for broader pool of cybersecurity experts as well as building

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

on societal cyber resilience. The policy also encourages public awareness building on cybersecurity, which helps with incident prevention. The policy, however, does not propose financial mechanisms to fund the training and education. This policy (framework) should be thus implemented in the public education system of Slovenia via micro credentials, with one other possible source of funding coming from private security companies who could offer scholarships or grants, that would partially cover the costs of this program and assure them skilled employees in the long term.
Policy Solution 4: CONCORDIA Cybersecurity Roadmap for Europe
The CONCORDIA roadmap is a Knowledge Base policy, which was identified as one of the core policies for addressing the challenges of the SCRL. This policy is focused on strengthening Europe's cybersecurity capabilities and achieve digital sovereignty. It addresses Europe's dependency on non- European digital technologies by promoting coordinated research, policy harmonization, investment, and cybersecurity education. The roadmap focuses on six key areas: research and innovation, education and skills, legal and policy, economics and investments, certification and standardisation, and community building. It proposes actionable measures such as enhancing threat intelligence, aligning cybersecurity policies, supporting certification frameworks, and fostering collaboration between governments, academia, and industry. By reducing fragmentation and promoting a unified approach, the roadmap aims to boost Europe's cyber resilience, competitiveness, and strategic autonomy. The original policy itself, however, does not address the question of financing in case of economic downturn and relies heavily on cross border cooperation between the EU member states. This policy should be thus amended with scalable funding schemes, which would prioritize funding based on the importance of the area for building cyber-resilience. Mechanisms for rapid policy shifts to respond to sudden geopolitical developments, such as cyber sanctions or supply chain disruptions, should also be included.

Based on the learnings and outcomes of all activities, SCRL also created a document containing the Directions for Policymakers. This document contains the overview of eight societal areas, which policymakers should address when developing policies for cyber resilience of a national economic system as shown in figure below.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

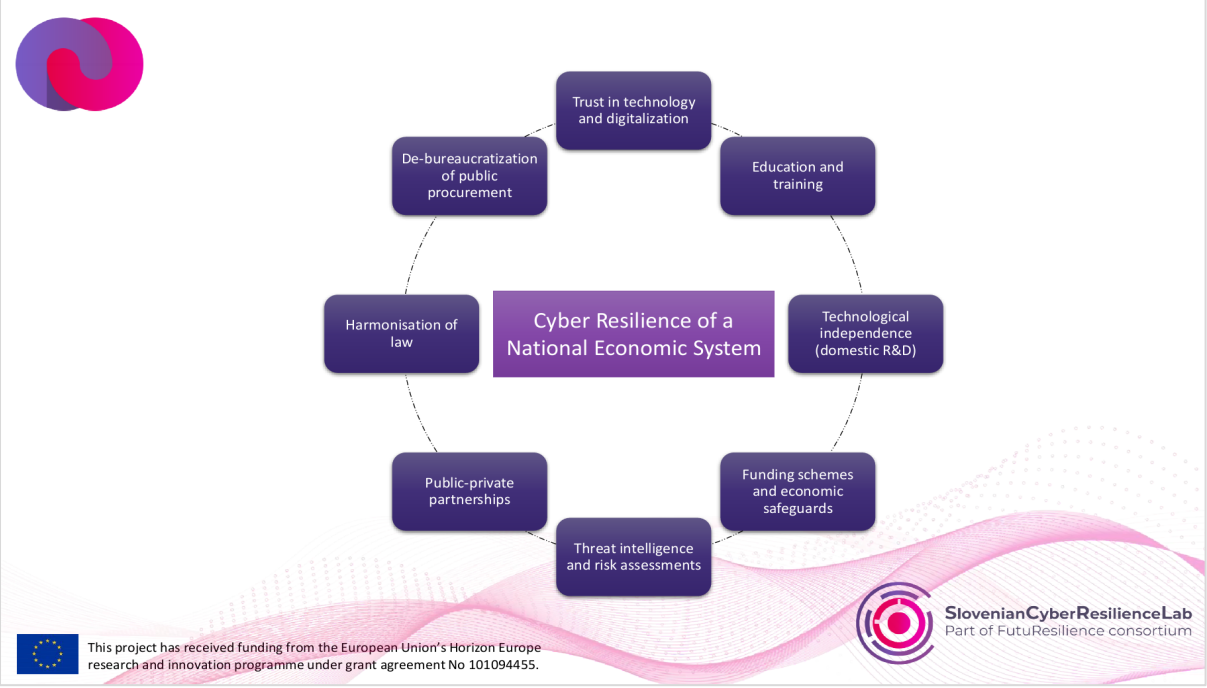


Figure 84: SCRL Eight Areas for Policy Action on Cyber Resilience

The Directions for Policymakers were subsequently used as a base for development of a Policy Brief draft.

4.9.4 Achievements

At the beginning of the project, SCRL had set five objectives (as described in the Chapter 1 of this report). Each objective has produced the following achievements:

1st objective: We have conducted a study among the Slovenian start-up community. We did not aim to identify the current state of cybersecurity, but we did identify the boosters and barriers of cybersecurity solutions adoptions among Slovenian start-ups and SMEs, which we believe is more in line with the FUTURESILIENCE project.

2nd objective: Over the duration of the SCRL project, we have focused on identifying and creating cybersecurity solutions on the policy level. The project resulted in five policy solutions, policy brief and directions for policymakers, which can all be used on the policy level to increase the cyber resilience level of Slovenian start-ups and SMEs.

3rd objective: Directions for policymakers were developed in order to help the policymakers develop holistic cybersecurity policies, solutions and measures on the national level.

4th objective: SCRL has supported several cybersecurity awareness raising initiatives. For example, during the first workshop, we have held a training session for start-ups on cost-effective and easy-to-implement cybersecurity measures. Members of SCRL have also actively participated on several conferences and public speaking events, where they presented the

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

work and results of the Lab. SCRL has also held several official meetings with policymakers, presenting the results of the Lab and consulting them on the implications.

5th objective: SCRL has been actively working with partners, namely Chamber of Commerce and Industry of Slovenia and Government Office for Information Security to develop future projects based on the results of the SCRL project. One project, which is partially based on the findings of SCRL is already underway, as core members of SCRL are part of a team, working on developing a cybersecurity curriculum for primary and secondary schools.

Policy impact

The SCRL project has several policymaking implications. First, as far as we know, this is the first project carried out in Slovenia that connected cybersecurity policymakers with start-up and tech community. This provided an opportunity for both groups of stakeholders to share the challenges and opportunities for solution development. Second, this project has produced several deliverables that could impact the policymaking process in the area of cyber resilience of the Slovenian economic system. The deliverables are a direct result of cooperation between the policymakers and other stakeholders.

- The first policy-relevant deliverable are five policy solutions, which were developed at the final workshop. Three policy solutions were developed from scratch by workshop participants, while the other two are an adaptation of existing policies from the Knowledge Base. The policy solutions cover topics such as public-private partnerships, cybersecurity funding, cybersecurity education and expert pool, capacity building and technology independence.
- The second policy-relevant deliverable are the Directions for Policymakers. The directions outline eight key factors that contribute to national cyber-resilience. Each factor is accompanied by clear rationale and policy recommendation, forming a foundation for cohesive and forward-looking cybersecurity policymaking. It supports the policymakers with insights for creating actionable, inclusive and holistic cybersecurity policies.
- The third policy-relevant deliverable is a Policy Brief. The Policy Brief defines recommendations for policymakers; however it is presented as a formal document, which includes a problem statement, current state-of-the-art, summary of the SCRL activities and methodology and final recommendations. Aside from the national level, the Policy Brief can also be used for the EU level policymaking.

All the deliverables have been shared with the appropriate policymakers in Slovenia. While, to the best of our knowledge, the deliverables have not yet been included in the official policymaking processes, all policymaker stakeholders have provided positive feedback on the content. On the side of public sector policymakers, Government Office for Information Security and SI-CERT provided positive feedback on the policy solutions and Direction for Policymakers. In particular, they welcome the strategic and future-oriented view on cyber resilience of Slovenian economic sector. On the other hand, policymakers from the private sector, such as Chamber of Commerce and Industry of Slovenia particularly welcome the

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

policy solutions that provide effective approaches to public private partnerships and cybersecurity funding schemes.

Overall, the SCRL alone will not solve the cybersecurity challenges that start-ups and SMEs are facing. However, this project has left an impact on several key challenges. SCRL was the first initiative that brought together start-up communities and cybersecurity policymakers, which enabled the policymakers to gain insight into cybersecurity related challenges faced by start-ups. SCRL has also contributed to cybersecurity policy development by shedding a light on different areas that policymakers should consider when creating holistic cybersecurity policies. And by the awareness raising activities, SCRL has contributed to better cybersecurity awareness of Slovenian start-ups, SMEs and even policymakers.

4.9.5 Lessons learnt

Even though the SCRL team consisted of leading experts in cybersecurity and economic resilience in Slovenia, we still underestimated the breadth of factors and implications that are connected with cybersecurity. While our initial focus was strictly on start-up and SME companies, we realised that it is impossible to develop or implement national-level policies, which would strictly benefit only above-mentioned categories. The main practical barrier of the project was connected with the availability of public sector cybersecurity policymakers. There is critical lack of cybersecurity experts in public administration, meaning that it was extremely hard to obtain their participation in the SCRL activities. This is why we had to adjust the scenario building phase from workshop to short brainstorming sessions, which were easier for them to attend. We also recognised the lack of policymakers as an advantage, as they were/are very interested in all SCRL results and deliverables, since they are unable to run similar research projects themselves. Thus, the biggest learning of the SCRL is that stakeholder cooperation is absolutely essential when it comes to cybersecurity policy development. Since factors that impact the cyber resilience of an economic system are so widespread, it is essential that stakeholders work together as much as possible, to cover all possible scenarios and bridge the gap of workforce shortage.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

4.10 TIMES Lab

Abstract
The TIMES Lab, implemented in Cesena, Italy, emerged in response to the severe flooding of May 2023 that affected the Emilia-Romagna region. A key issue was the spontaneous mobilisation of thousands of volunteers—especially youth—whose efforts, though vital, exceeded the operational capacity of the official Civil Protection System. The Lab addressed the urgent need to bridge the gap between institutional crisis response and community self-organisation. The guiding question: how can local authorities engage, coordinate, and support spontaneous civic responses in future emergencies?

The TIMES Lab employed a participatory foresight methodology, rooted in co-creation, storytelling, and scenario thinking. Citizens, associations, municipal staff, and youth co-designed future-oriented solutions for emergency preparedness, structured across "peacetime," "crisis," and "post-crisis" contexts. Tools included interviews, workshops, interactive mapping, persona development, and creative exercises like future newspaper writing. The Lab strongly embraced systemic foresight to identify leverage points for policy and behavioural transformation across sectors such as communication, logistics, digital engagement, and training.

Key outcomes included: a digital platform for managing spontaneous volunteering, including skills mapping; a network of logistical hubs modelled on successful emergency centres; an integrated training programme for civic preparedness across schools, youth, and civil society; updated GIS and Civil Protection Plans incorporating informal networks.

- Local Partners: Municipality of Cesena; Fondazione IU Rusconi Ghigi; Anci Emilia Romagna
- Mentors: University of Ferrara; EFIS Centre; Copenhagen Institute for Futures Studies

4.10.1 Description of the lab

The TIMES Lab responded to a new concrete need of the Municipality of Cesena, born after the serious flood of May 2023 that hit the city and others 44 Municipalities located in 5 provinces of the Emilia Romagna Region (Forlì-Cesena, Ravenna, Rimini, Bologna, Modena and Reggio Emilia).

During the emergency, an unexpected phenomenon occurred within the city: a mass mobilisation of volunteers (mainly young people) spontaneously intervened to support the population, using informal communication channels, and tracing new social dynamics and use of public spaces in the neighbourhoods.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

This phenomenon has shown, on the one hand, an exceptional community resource in terms of solidarity, self-organisation and resilience, and on the other hand the lack of effective tools of the Civil Protection System to communicate and manage with these flows of people.

The strategic aim of the TIMES lab is to design innovative tools and strategies, that bring together the social response in emergencies and the potential interaction with new dedicated strategic and ICT tools to read spontaneous social phenomena of volunteering by making the local community protagonist in the resolution of the crisis, with a collaborative/generative approach and prevent possible social conflicts during crisis events.

The objectives of the TIMES lab include:

OBJECTIVE 1: **Strengthen local community preparedness for future crises**

- analysing the social aspects of risk management at city level;
- mapping the community resources of the civil society;
- strengthening the community skills through capacity building paths “in peacetime”;
- defining emergency response strategies that bridge the perceived and concrete gap between the population, volunteers, rescuers and authorities;
- activating and coordinating the community resources within the Civil Protection system.

OBJECTIVE 2: **Increase the capacity of the local Civil Protection System to engage, manage and communicate with spontaneous volunteer movements**

- Establishing effective governance schemes within the municipality to improve the Civil Protection System in handling spontaneous volunteers;
- Developing inclusive digital tools as accessible interface to improve communication.

The **pilot team** is composed by:

- **Lead partner / Municipality of Cesena** (Civil protection Department, the Eu projects office, the communication office and the Mayor's staff);
- **Partner / Fondazione IU Rusconi Ghigi** (private law entity not-for-profit, from Bologna, expert in civic participation and innovation processes in real-life communities on sustainability and resilience);
- **Partner / ANCI EMILIA-ROMAGNA:** the National Association of Italian Municipalities coordinates local authorities in developing sustainable local policies.

4.10.2 Initial needs and challenges

Needs

The **initial analysis of the TIMES Lab needs** highlighted how during the flood of May 2023, the Municipality of Cesena and more generally the Civil Protection System at local level, did not have adequate tools to communicate and manage spontaneous volunteers.

This caused, in some cases, situations of potential danger for the volunteers and people safety and a slowdown in making official rescuers intervene in the affected areas, especially in the first 48-72 hours after the catastrophe.

This project has received funding from the European Union’s Horizon Europe research and innovation programme under grant agreement No 101094455.

In the middle of emergency, the Municipality was provided by a private donor, with a digital platform called “S.O.S. Volontari'' where to collect registrations from volunteers before they got into action. The platform was then extended by the other affected cities of the Romagna Area. Again, the difficulty was to treat all these data, parallelly to the emergency, and convey thousands of registered candidates to the most affected areas. An analysis after the emergency tells us that most of the spontaneous volunteers did not register to the platform and did not go through the physical official points created to welcome volunteers in the city.

Key questions

The **key questions of the TIMES Lab** to frame the initial problem were therefore:

Who are these people? Why, where and how did they intervene in the city? How did they communicate with each other and with the institutional channels? How can we reach and train them in “peacetime” to strengthen a collective civic sense to face new future emergencies? How can we efficiently manage and be in contact with them, during another crisis event?

Key challenges

Starting from this framework of needs analysis and questioning, TIMES Lab addressed the following key challenges, crossing the 3 main areas of **civil protection, social and community welfare**, **digital and communication:**

- Lack of effective, innovative, inclusive digital tools in the Civil Protection system, at local level, to attract and manage voluntary civilian population during a crisis event
- Lack of tools to analyse the social aspects of risk management at city level and to map and valorising the community resources of civil society, in order to be able, in times of crisis, to activate and coordinate them within the Civil Protection system
- Lack of a methodology to build social vulnerability future scenarios at city level and build an effective response able to activate community resources.

4.10.3 Work done in the lab

The TIMES Lab was designed with a strong participatory approach, applying different tools and proposing different community activities to develop a real community capacity building process, in which the Municipality of Cesena was also one of the key players, together with citizens, associations, Institutions.

The main activities therefore included: on one hand the development of scenario co-design workshops starting from the Foresight methodology; on the other a series of free seminars open to citizens and activities with schools to activate a collective training path on the themes of resilience and the ability to respond to future crises in a collaborative way.

Activities developed

1. **Stakeholder mapping (May-October 2024)**

A stakeholder matrix has been identified by type of actors. Identifying key actors was also a fundamental activity to define individuals, associations spokesperson and key representative within the community to interview and involve in the focus groups. This was done starting from the presidents of the 3 flooded neighbourhoods, consulting the Municipality databases

This project has received funding from the European Union’s Horizon Europe research and innovation programme under grant agreement No 101094455.

collected during the emergency, collecting information from the Municipality people also involved as volunteers.

Within TIMES Lab one of the key players is the Municipality that needs to improve its capacity building in dealing with future crises. To ensure that the transversal view of the Municipality departments can also be included in the process, the **5 Specialist Support Units for Civil Protection** representatives have been incorporated. These are public employees from different municipal sectors who were volunteers during the emergency and are now part of specialised units that are continuously trained in peacetime. In particular, some members of the Units have participated in TIMES activities (Infoday, workshops, seminars) and the municipal department of personnel recognises these hours as training hours. This is an important incentive to recognise this type of capacity building activity.

2. **Data collection (May-October 2024)**

Focus Groups and interviews (May-June 2024)
The initial phase involved extensive data collection through focus groups and interviews. Between May and June 2024, 4 focus groups were conducted with key stakeholders who played an active role during the May 2023 flood involving n.16 participants.

1. Focus Group / Associations and volunteers
Interviews to volunteers and associations that were activities within the DON MILANI HUB, the main coordination centre for spontaneous volunteers during the flood emergency.
2. Focus Group / Flooded Neighbourhoods
Interviews to presidents of the Oltresavio, Ravennate, and Dismano districts, the most affected areas of the city. These stakeholders were engaged in a variety of emergency tasks such as managing civil volunteers, communicating with citizens, distributing material aid, and coordinating with institutional actors and the Civil Protection system.
3. Focus Group / 5 Specialist Support Units for Civil Protection
4. Focus Group / Communication-ICT/GIS municipal Department
Interviews to technicians who deal with municipal website management, social media, press relations, preparation of GIS maps, ICT tools, Apps, Connectivity.

On-Line Questionnaire (October 2024)
Additionally, an on-line questionnaire was disseminated to the local community to capture data on the phenomenon of spontaneous volunteering. A total of 142 questionnaires were collected. The questionnaire was organised into 6 main thematic sections:

- Emotions and memories of the 2023 flood
- Experiences of volunteering during the 2023 emergency
- Newly acquired skills during the volunteer's experience
- Communication informal tools utilised (both on-line and offline)
- Volunteering experiences prior to the flood
- Expectations and visions for future volunteering.

3. **Public call and Info-Day (10.10.2024)**

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

A public call to citizens, associations and municipal employees involved as volunteers during the emergency has been launched through the Municipality's web channels.
The participatory process kicked off with an Info Day aimed at both informing citizens about the project's process and collecting their personal experiences through a mapping of memories, landmarks and informal relationships, developed as volunteers during the emergency.
Key activities during the Info Day included:

- **Reading:** *FANGO - Storia di un'alluvione* (Mud - History of a flood), by Marco Cortesi and Mara Moschini, from a podcast developed from 250 testimonies of volunteers from Romagna area, during the flood in May 2023.
- **Postcards:** Participants were invited to share positive memories of the flood experience on postcards, thereby contributing to the creation of a collective narrative focused on community resilience and the psychological aspects of emergency management.

Mapping: Participants identified and marked key spaces/locations (public and private, formal and informal) that served as reference points for the volunteer network during the emergency. Using three large maps representing the 3 areas of Cesena most affected by the flood (Oltresavio-Centro, Ravennate, and Dismano), participants placed post-its (see Figure 85) and filled out cards detailing the support provided, roles played, and communication methods used (Figure 86). These cards were subsequently assembled on a board to analyse relational dynamics and proximity levels among the actors involved.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

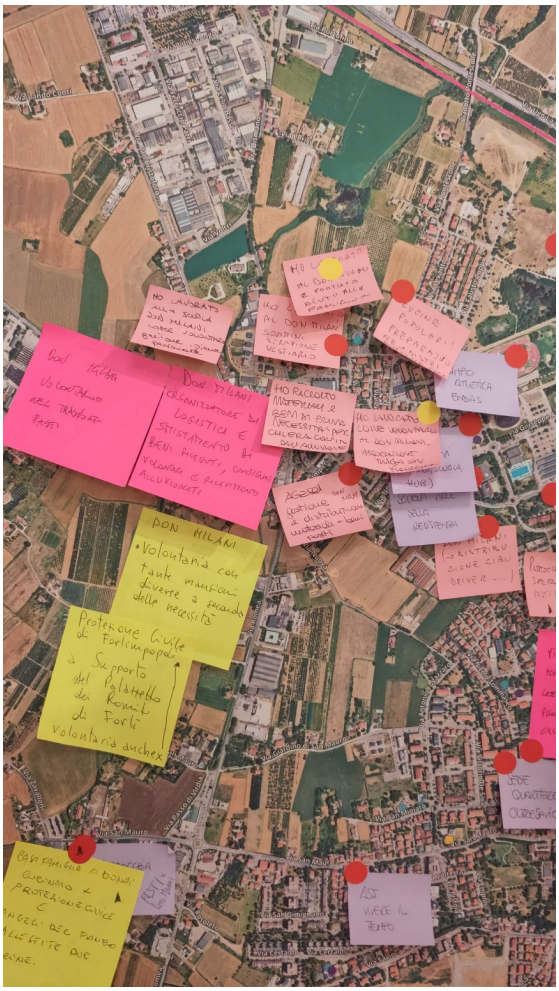


Figure 85: TIMES Lab Impression from Info Day Mapping Activity

Figure 86: TIMES Lab Card for Capturing Experiences at Info Day

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

4. **Internal technical workshop (31.10.2025)**

Following the InfoDay, an internal technical meeting was convened involving employees of the Municipality of Cesena and representatives from Civil Protection. Its main purpose was to identify the working tracks and the framework in which solutions are needed. Drawing on the data collected and the mapping exercise from the InfoDay, **5 thematic areas** were identified:

- Management of spontaneous volunteering
- Communication between the Municipality and the network of informal spaces
- Communication and collection of assistance requests between the Municipality and citizens
- Support and logistics for spontaneous volunteering
- Training for both volunteers and citizens.

5. **First co-design workshop (05.12.2025)**

The primary objectives of the first workshop were to:

- Engage the community in the co-creation process aimed at developing 'desirable futures' aligned with the project objectives
- Validate and integrate the initial mapping of community experiences established during the InfoDay.

During the workshop, participants were divided into small groups (of up to five individuals) and provided with a thematic brief describing the current context of the 2023 flood. They were then prompted with guiding questions designed to stimulate brainstorming and steer discussions toward envisioning a desirable future. The key thematic areas addressed were those identified during the internal meeting:

- **Management of spontaneous volunteering:** strategies for managing and valorising the competencies of spontaneous volunteers while enhancing their sense of security
- **Communication between the Municipality and the network of informal spaces:** approaches to improve the communication channels between the Municipality and the informal network of community spaces
- **Communication between the Municipality and the citizens and collection of requests for help:** enhancing the effectiveness of public communication to facilitate the collection of citizens' assistance needs
- **Logistics and Support:** organising logistical support for spontaneous volunteers during emergencies
- **Training Initiatives:** developing community training systems during peacetime to better prepare for future crises.

Furthermore, each thematic area was further explored with specific questions addressing linguistic accessibility, gender inclusion, intercultural and intergenerational aspects, as well as digital accessibility for people with disabilities or those affected by the digital divide. The Journal Article activity was structured as followed:

- **Individual ideation:** participants first responded individually to inspirational questions by noting their ideas on post-it notes.
- **Group discussion:** ideas were then shared within the group, leading to a collective discussion on the envisioned desirable future.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

- **Co-creation of a newspaper article:** each group collaboratively drafted a newspaper article, telling their desirable future and complete with a title and a subtitle as illustrated Figure 88.

Finally, to further validate and expand the mapping of community experiences, participants were given the opportunity to integrate additional reference points and positive memories into the existing maps and postcards.

Figure 87: TIMES Impression from 1st Co-design Workshop Mapping Experiences

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

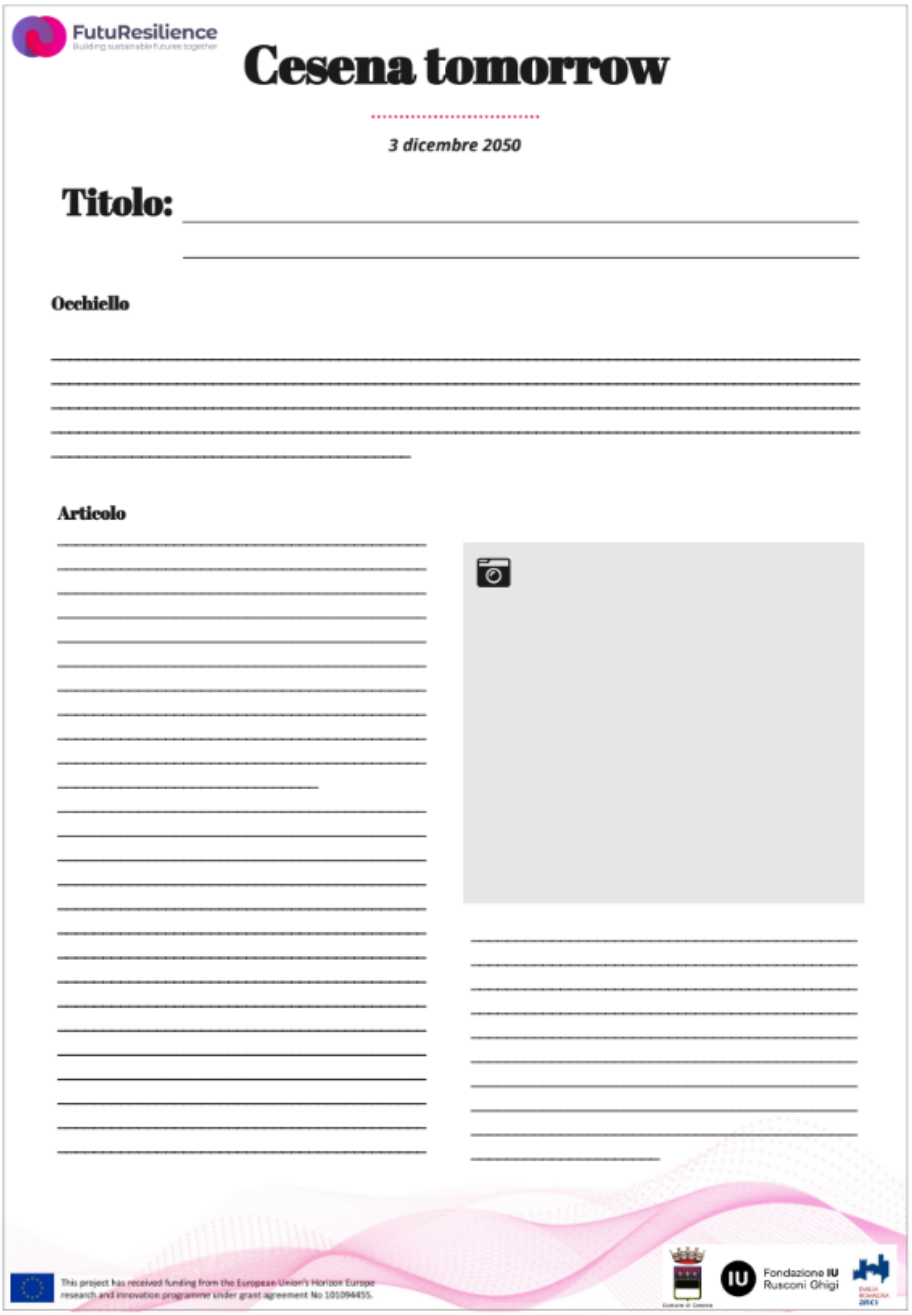


Figure 88: TIMES Lab 1st Co-Creation Workshop Template for Journal Article from 2050

6. Second co-design workshop (30.01.2025)

The second workshop was designed to refine and consolidate the project ideas emerging from the first workshop's newspaper articles. In preparation for this session, the project team, comprising staff from the Fondazione IU Rusconi Ghigi and the Municipality of Cesena, reviewed the six desirable futures and consolidated them into four key project ideas:

- **One-stop portal:** to manage spontaneous volunteering and enhance their competencies, boosting their sense of security
- **Logistical Bases:** to organise logistics and support for volunteers during emergencies

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

- **Communication tools:** to strengthen communication between the Public Administration and the informal network of community spaces
- **Integrated training program:** to create a comprehensive training program to effectively prepare the community for future crises.

The workshop was structured in three phases:

1. **Needs and competencies analysis:** groups selected three personas (from a set of seven) and, in subgroups, identified the needs and competencies of each persona to define the necessary characteristics for their group's project idea.
2. **Ideation:** building on the identified characteristics, groups outlined the fundamental elements of their project idea, also considering existing local opportunities that could facilitate implementation.
3. **Operational functioning:** each idea was analysed across three operational contexts - peacetime, emergency, and post-emergency - to clearly define its role within the overall crisis management system.

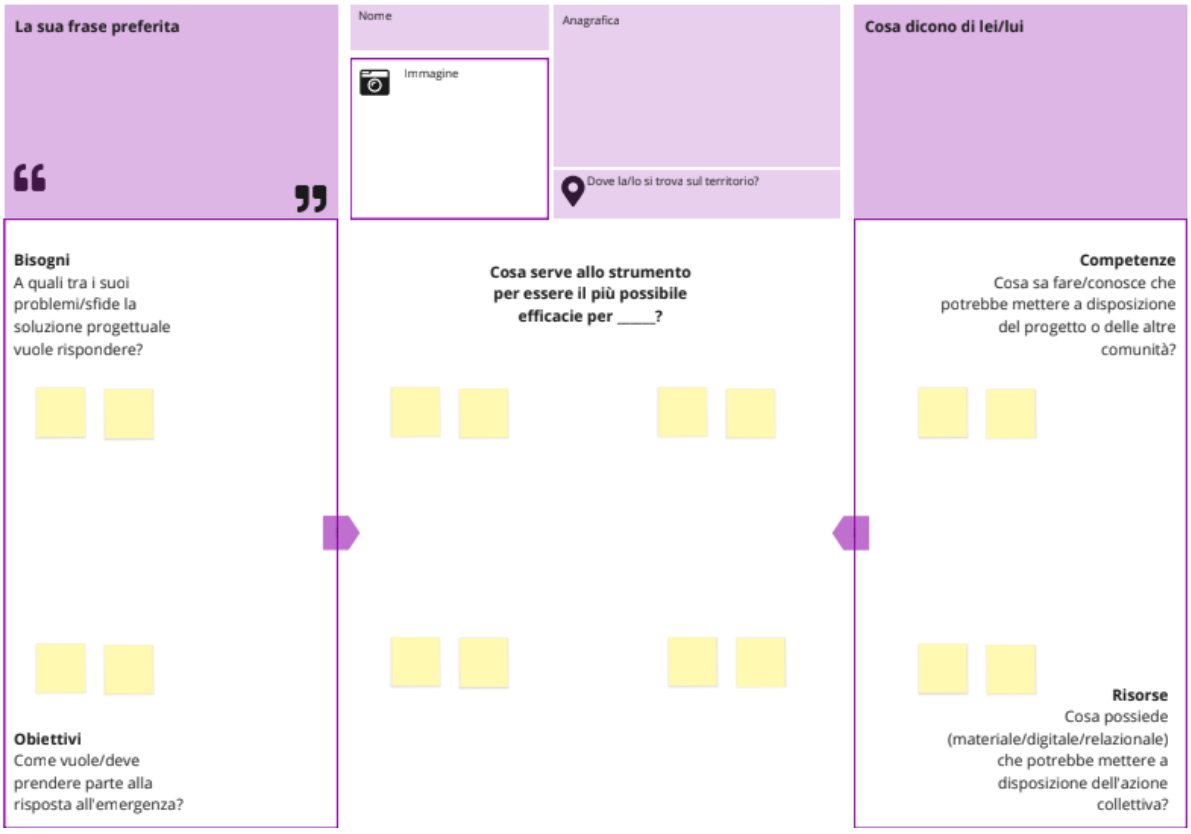


Figure 89: TIMES Lab 2nd Co-Creation Workshop Persona template

Each group concluded the session by presenting their refined project idea, highlighting its core components and operational mechanisms in the different contexts.

7. Third co-design workshop (27.02.2025)

The third workshop focused on validating the solutions developed in the previous sessions. Participants were organised into groups based on their role during the May 2023 flood or their daily life perspective, which included:

- Municipality of Cesena

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

- Civil Protection
- Volunteer
- Person directly affected by the extreme event
- Association
- Representative of “Specialist Support Units for Civil Protection”.

Each group was provided with two dossiers summarising the detailed characteristics and operational functioning of the proposed project solutions across the three contexts (peacetime, emergency, post-emergency) as displayed in Figure 90.

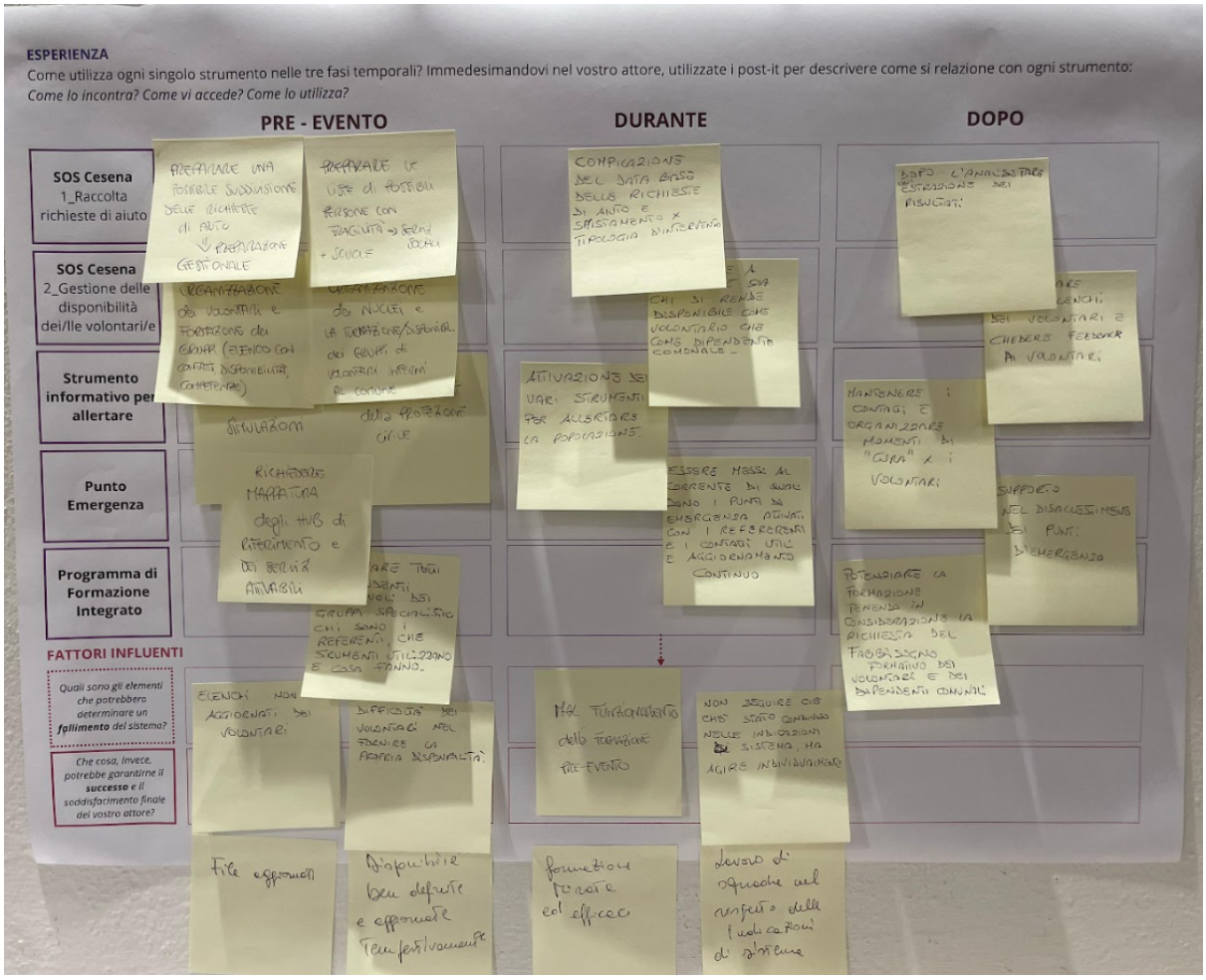


Figure 90: TIMES Lab 3rd Co-Creation Workshop Mapping of actor roles across the three phases of an emergency

The groups were tasked with reviewing these solutions, discussing how they would be used by their respective actors, identifying the roles that each actor could play in the overall system. This exercise involved a comprehensive analysis of the solutions within each operational context. Furthermore, groups reflected on which factors could determine the success or the failure of the solutions system within each operational context.

This project has received funding from the European Union’s Horizon Europe research and innovation programme under grant agreement No 101094455.

During the presentation of each group's findings, was presented a visual synthesis of the outcomes through the creation of three system maps (Figure 91)- one for each operational context - to illustrate the interrelationships among the various actors and project solutions.

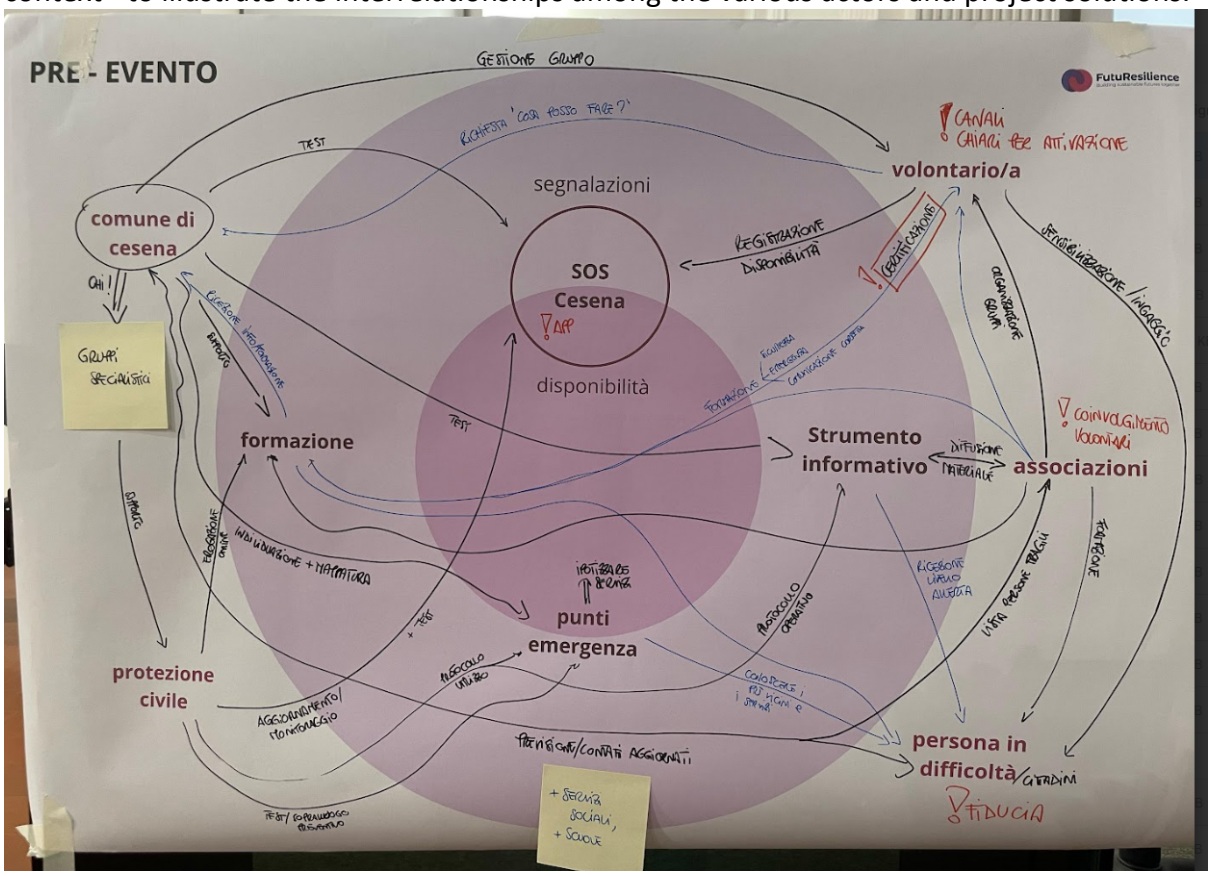


Figure 91: TIMES Lab 3rd Co-Creation Workshop Example System Map (Pre-Event)

8. Final internal meeting to present the results (10.04.2025)

A final meeting with the group of local actors was also added to the 3 workshops to present the details of the solutions, collect feedback on the overall process through an on-line evaluation questionnaire and invite the actors to the final public event planned in May**.**

9. Public seminars (Nov 2024 – Apr 2025)

To increase the impact of the TIMES Lab and broaden the capacity building action with the city, four open seminars has been organised, in parallel of the co-design workshops, with the title: *"Climate, territory, emergencies: understanding to act together"*, involving several national and regional experts on climate crisis and civic preparedness.

30 Nov 2024/ Resilience in Emergency Situations: Understanding and Coping with Psychological Trauma
Dr. Massimo Monti, trainer and psychologist expert in emergency psychology

15 Feb 2025 / IT HAS ALWAYS RAINED! Reading climate change, weather and warnings
Carlo Cacciamani of the ItaliaMeteo Agency
Gabriele Antolini of the Arpae Climate Observatory

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

Claudia Casadei of the Regional Agency for Territorial Security and Civil Protection

15 Mar 2025 / *ONCE HERE IT WAS ALL COUNTRYSIDE! Landslides, floods, planning: knowledge and management of the territory for risk mitigation*
Andrea Colombo – Po River Basin Authority
Paride Antolini – President of the Emilia Romagna Order of Geologists
Andrea Nardini – Engineer, founding member CTS AGIRE

5 April 2025 / GET READY! / Volunteers and citizens active in the Civil Protection system
Cristina Ceccarelli - Civil Protection Department of Cesena

10. Activities with high schools

Multiplier event with ERASMUS + Flood Stopping project (17.12.2025)
TIMES Lab together with Area Europa, the Italian partner based in Bologna of the ERASMUS + Flood Stopping project, organised a cross-dissemination event with 4 classes of the Cesena high school Comandini institute. Flood stopping project, has the aim of implementing innovative training material for teachers and students to reflect and prepare for the climate crisis and in particular on floods. The event involved n. 50 students and proposed the realisation of a theatrical/musical reading on floods and a talk of good practices with testimonials that were active during the floods of May 2023 in the region.

Info-Day at Renato Serra Institute (20.02.2025)
n. 800 students in turn participated in a workshop on the TIMES Lab and good practices of Civil Protection. During the lab we worked on spontaneous volunteering and on the students perception of the experience. A creative writing activity was then organised to collect "messages in the bottle" starting from the flood experience of the students, than present in the final event.

Final Event for High Schools (16.05.2025)
n. 200 students attended the final event organised for the second anniversary of the flood at the Eliseo cinema in Cesena. The 2-hour event included readings, speeches by experts and a talk with spontaneous and organised volunteering of Cesena during the flood.

4.10.4 I.10.4 Achievements

For the first time since the flood of May 2023, TIMES Lab has allowed the city of Cesena to analyse what happened during the flood of May 2023, both at social level analysing the phenomenon of spontaneous volunteering and at scientific level, focused on the concrete causes linked to the climate crisis in the affected areas.

TIMES Lab has placed at the centre of the process the real experience and knowledge acquired by local actors during the flood of 2023. The first major achievement is, therefore, that of a more general awareness at city level of the extraordinary capacity put in place by the volunteers but, also, of what has not worked and what has instead worked well and can be replicated as a model to prepare for future crisis.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

The data collected through interviews, focus groups, and questionnaires confirmed that spontaneous volunteering played a crucial role, while also revealing significant challenges in its management and coordination. These initial needs and challenges, which also encompassed broader issues such as accessibility (linguistics, physics, intergenerational), have been directly addressed by the Lab outcomes.
The project's results specifically targeted these requirements through a suite of first **solutions** designed to enhance the coordination and management of spontaneous volunteering. These solutions include:
A) Information tool for alerting
An easily accessible tool designed to inform and alert the population in emergency situations. Combining digital and analogue tools, such as sound alarms, it ensures widespread dissemination.

B) A dedicated web portal for managing spontaneous volunteering
This solution responds to the initial needs of an effective, innovative, inclusive digital tools in the Civil Protection system to attract and manage voluntary civilian population during a crisis event. A series of actions are also planned for the "peacetime" (such as the pre-registration of volunteers to the platform with the detail of their skills/competences through a communication campaign and a physical mapping of their location by districts)

C) A network of logistical hubs to support volunteers
These hubs represent a physical point, activated in the case of an emergency, to provide logistical assistance for volunteers, psychological support and essential services to the affected population. The hubs are equipped with the necessary material to deal with the first critical phases, facilitating volunteer operations and optimising the distribution of resources. The Hubs are based on the model and good practice of the Don Milani Hub which during the emergency of May 2023 functioned as a coordination centre for volunteers and the distribution of goods to affected population.
The idea is to create these hubs within the neighbourhood offices.
A first mapping of these places has been included in the GIS map of the Civil Protection.

D) Integrated training programme for civic preparedness for future crisis
The long-term and continuous training program will improve the community preparedness and resilience for future adverse events, ensuring effective and accessible preparation on safety, emergency management and public health issues through innovative and engaging methods, combining theory and field experience. The training program is customised for different targets including university students, high schools, seniors, families and includes various incentive actions and tools such as public recognition, prizes, recognition of university credits etc.

Policy impact

TIMES LAB has contributed to policymaking at local level by developing specific results that will help the Municipality of Cesena to develop long-term actions and policies to manage and

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

communicate with citizens and spontaneous volunteers during emergencies but first of all in peacetime.

In particular these results are:

- *GIS MAPPING for Civil Protection updated*

The GIS map of the Civil Protection of the Municipality of Cesena has been updated and implemented with the community places of spontaneous volunteering. The network of informal places within the neighbourhoods constitutes the basis for implementing the HUBs to support volunteering which in times of peace will also be places to train the population.

- *COMMUNICATION PLAN inserted in the CIVIL PROTECTION PLAN*

A Draft of the Communication Plan has been inserted in the Civil Protection municipal Plan and will be implemented starting from next year with dedicated actions to build a communication system that considers the needs and requests and the data collected during the process.

- feasibility study to design *EMERGENCY PORTAL*

The inter working group involved in TIMES Lab activities (focus group of GIS and ICT department) are currently conducting a feasibility study to implement the Municipality portal used during the 2012 snowstorm to design a web portal dedicate to the emergency and to manage volunteers.
Another result is the strengthening of internal governance with the formalisation of specialised support units for Civil protection. Thanks to TIMES Lab, they have started a training course on civic preparation issues and have actively contributed to the solution co-design applying the Foresight method.

Another key political impact was the active involvement of ANCI which allowed to strengthen the relationship with the Regional Civil Protection Agency. The regional agency was involved in some phases of the process, and a dedicated meeting was organised to present methods and results of the TIMES Lab to transfer this approach in the near future also to the other municipalities of the Romagna area.

Finally, thanks to the visibility generated by the TIMES Lab at a local level, the Mayor of Cesena has decided to formally set a day dedicated to civic preparedness and civil protection on May 16th of each year.

4.10.5 Lessons learnt

CITIZEN ENGAGEMENT
One challenge faced during the Lab implementation was citizen engagement.
Engagement levels varied depending on the local context and the specific topic of the participatory process. Initially, we assumed that the theme would be particularly compelling for citizens, as it related to a major event that had occurred just a year earlier and had significantly impacted the city and its inhabitants. However, engaging participants proved more difficult than expected, and the Municipality of Cesena made significant efforts to reach

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

as many volunteers as possible. Despite these initial difficulties, we are satisfied with the overall level of participation achieved across all meetings and workshops.

Practical tips

- being ready to modify the engagement plan is essential
- use informal contacts to reach local actors
- consider more time for this preparatory engagement phase
- use creative messages guided by communication experts could help to reach more public

UNIVERSITY ENGAGEMENT

Another challenge was to activate the youth and especially the university students. Several high school classes were involved in the Lab thanks to direct contact with some schools that work with the Civil Protection. While it was difficult to reach the university students; this was due to the lack of time and previous relationships with the Campus that recently changed Rector and also the presence of student associations that are not so active in the city.

Practical tips

- to engage university students, it is necessary to think of detailed activities that require time and a specific approach
- also using other languages and performances inside and outside the spaces of the Campus, connecting to the university calendar
- use creative messages guided by communication experts could help to reach this target.

POLITICAL COMMITMENT

When planning similar initiatives, it is essential to have a strong political and institutional commitment from the beginning and in all process steps to:

- demonstrate to citizens that preparing for future crises involves everyone, each in their own role, and first of all the institutions
- build a solid regulatory framework from the beginning (the civil protection system is a complex and highly codified system)
- clarify what the Municipality can do and what citizens can do within the process (this also serves to avoid frustrations/ misunderstandings during the participatory process);
- facilitate the collection and good quality of data
- ensure visibility of the process at others institutional level.

Practical tips

- organise meetings with policy makers in parallel to the co-design process is essential to involve politicians
- involve different departments is essential to broaden the political consensus (in the case of TIMES Lab we worked with the Councillor for Environmental Sustainability, Councillor for European and Youth Policies, Mayor's Staff).

THE MUNICIPALITY as active stakeholder

In this type of process, the Municipality should be an active stakeholder to actively participate in the process with a critical analysis of the municipal tools. This creates a horizontal relationship with the other local actors and a sense of community.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

Practical tip

- create a formal cross-sector working municipal group that participates in the workshops to maintain a horizontal and transparent exchange with the stakeholders.

THE PIVOTAL ROLE OF EMOTIONS

From the early phases of interviews and data collection, the emotional dimension of the experience clearly emerged as central. For this reason, the InfoDay began with a performance of *FANGO*, and the emotional aspect was revisited multiple times in the workshop, using tools such as Mentimeter. This focus allowed participants to process and share their experiences, making the process more engaging and meaningful. It is clear that emotional and psychological dynamics should be carefully considered when designing participatory processes related to extreme events that have affected a specific community.

Practical tips

- create tools to analyse the change of emotions during the process
- create moments in which emotions can also convey difficult and complex contents
- in the case of environmental disasters, knowing that you are not alone is an important positive starting point.

STORYTELLING FOR A POSITIVE FUTURE

When we talk about civic preparedness for future crises, it is essential to use a first positive approach in local actors to avoid feeding fear, anguish and eco-anxiety.

The approach of imagining positive futures in which our contribution today has given positive results, helps the co-design activity and creates a collaborative work environment.

Practical tips

- the newspaper of tomorrow tool for imagining positive futures is a good solution for then delving into scenarios and solutions
- using images, photos, postcards, messages in bottles and other creative tools to tell the good things I learned from a traumatic experience is a useful tool.

THE TIMES OF A CRISIS

During the development of the solutions, a complex and time-consuming activity was the description of the different functionalities of the solutions.

Finally, the description of the individual tools was based on the time of the future crisis:

- Peacetime
- During the Crisis
- After the Crisis

This has proven to be a good method to help local actors think about different aspects of functioning and validate a solution.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

5 Appendix II LAB specific ABM Models

In this appendix, we provide the open-source ABM codes on Net-Logo, which we have developed for the 3 partners in the FUTURESILIENCE project. These codes (also explained in detail in the main text) can be used to run the simulations developed for ABMs for BAPEMED, CHIOS and MURCIA labs.

5.1 BAPEMED Lab

```
globals [
 tick-counter
 total-treated
 total-deaths
 total-overload
 total-stranded
 total-treated-attempts
]

breed [patients patient]
breed [hospitals hospital]

patients-own [
 health-status
 wealth
 illness-duration
 in-treatment
 treatment-time
 insurance-status ;;boolean
]

hospitals-own [
 types
 capacity
 workload
 daily-cost ;; Cost per day for treatment (private hospitals are more expensive
 insurance-status ;; if a hospital accepts insured/uninsured patients
]

to setup
 clear-all
```

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

```
 import-pcolors "/Users/habincho/Desktop/BAPEMED/NetLogo/Bulgaria Map.png"
 setup-public-hospitals
 setup-private-hospitals
 setup-patients
 reset-ticks
 set total-treated 0
 set total-deaths 0
 set total-overload 0
end

to-report valid-hospital-locations
 report patches with [pcolor = 28.1] ;; Only allow hospitals on valid terrain
end

to setup-public-hospitals
 let valid-patches valid-hospital-locations
 let num-hospitals public_hospitals
 ask n-of num-hospitals valid-patches [
  sprout-hospitals 1 [
   set shape "house"
   set size 10
   set types "public"
   set color yellow
   set capacity 20 + random 10 ;; capacity is always at least 20 and can go up to 30 --> might need to be adjusted
   set workload 0
   set daily-cost 50 ;; daily costs are lower compared to private hospitals --> might need to be adjusted
  ]
 ]
end

to setup-private-hospitals
 let valid-patches valid-hospital-locations
 let num-hospitals private_hospitals
 ask n-of num-hospitals valid-patches [
  sprout-hospitals 1 [
   set shape "house"
   set size 10
```

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

```
    set types "private"
    set color blue
    set capacity 10 + random 5 ;; capacity is always at least 10 and max 15 --> might need to
be adjusted
    set workload 0
    set daily-cost 100 ;; daily costs are 2x from the public hospitals --> might need to be
adjusted
   ]
 ]
end

to setup-patients
 let valid-patches patches with [pcolor = 28.1]
 if any? valid-patches [
   ask n-of patient_number valid-patches [
    sprout-patients 1 [
     set shape "person"
     set size 9
     set health-status one-of ["healthy" "mild-illness" "severe-illness"]
     set wealth random 1000 ;; wealth is random between 0 and 1000
     set insurance-status ifelse-value (random-float 1 < 0.88) [true] [false] ;; 12% of
population is uninsured
     set color ifelse-value (health-status = "healthy") [green]
              [ifelse-value (health-status = "mild-illness") [yellow] [red]]
     set illness-duration 0
     set in-treatment false
    ]
   ]
 ]
end

to go
 update-stranded-metric
 move-patients
 patient-treatment
 update-visuals
 health-update
 tick
end
```

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

```
to move-patients
 ask patients [
  if health-status != "healthy" and not in-treatment [
   let nearest-hospital min-one-of hospitals with [distance myself < 25] [distance myself]

   if nearest-hospital != nobody [
    face nearest-hospital

    ;; Check if the next patch is walkable
    let next-patch patch-ahead 0.5
    if next-patch != nobody and [pcolor] of next-patch = 28.1 [
     fd 0.5
    ]

    ;; If patient reaches hospital
    if distance nearest-hospital < 1 [
     move-to nearest-hospital
     ask nearest-hospital [
      if workload < capacity [
       set workload workload + 1
       ask myself [
        set in-treatment true
        set treatment-time (ifelse-value (health-status = "mild-illness")
                          [3 + random 3]
                          [8 + random 4])
       ]
      ]
     ]
    ]
   ]
  ]
 ]
end


to update-stranded-metric
```

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

```
 set total-stranded 0
 ask patients with [health-status != "healthy" and not in-treatment] [
  let my-wealth wealth
  let reachable-hospital any? hospitals with [distance myself < my-wealth]
  if not reachable-hospital [
    set total-stranded total-stranded + 1
  ]
 ]
end

to patient-treatment
 ask hospitals [
  if workload > capacity [
    set total-overload total-overload + 1
    set color red
  ]
  set color ifelse-value (types = "public") [yellow] [blue]
 ]

 ask patients with [in-treatment] [
  set treatment-time treatment-time - 1

  if treatment-time <= 0 [
    let my-hospital one-of hospitals-here
    if my-hospital != nobody [
      let success-rate ifelse-value ([types] of my-hospital = "public")
                  [0.8]
                  [0.85 + (wealth / 1000)]

      ifelse random-float 1 < success-rate [
        ;; Successful treatment → patient recovers
        set health-status "healthy"
        set color green
        set in-treatment false

        ;; Respawn in a valid area
        let valid-patches patches with [pcolor = 28.1]
        if any? valid-patches [
          move-to one-of valid-patches
```

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

```
  ]

  set total-treated total-treated + 1
  ask my-hospital [ set workload max list 0 (workload - 1) ]
 ]
 [
  ;; Failed treatment → retry logic
  ifelse [types] of my-hospital = "private" [
   ifelse wealth > 20 and [workload] of my-hospital < [capacity] of my-hospital [
    set treatment-time 2 + random 4
   ]
    [
    set health-status "severe-illness"
    set color red
    set in-treatment false
    ask my-hospital [ set workload max list 0 (workload - 1) ]
   ]
  ]
   [
   ifelse [workload] of my-hospital < [capacity] of my-hospital [
    ifelse random-float 1 < 0.7 [
     set treatment-time 2 + random 5
    ]
     [
     set health-status "severe-illness"
     set color red
     set in-treatment false
     ask my-hospital [ set workload max list 0 (workload - 1) ]
    ]
   ]
    [
    set health-status "severe-illness"
    set color red
    set in-treatment false
    ask my-hospital [ set workload max list 0 (workload - 1) ]
   ]
  ]
 ]
]
```

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

```
  ]
 ]
end

to update-visuals
 ask patients [
  set color ifelse-value (health-status = "healthy") [green]
            [ifelse-value (health-status = "mild-illness") [yellow] [red]]
 ]
end

to health-update
 ask patients with [health-status = "healthy"] [
  if random-float 1 < 0.05 [
   set health-status "mild-illness"
   set color yellow
  ]
 ]
 ask patients with [health-status = "mild-illness"] [
  if random-float 1 < 0.10 [
   set health-status "severe-illness"
   set color red
   set illness-duration 0
  ]
 ]
 ask patients with [health-status = "severe-illness"] [
  set illness-duration illness-duration + 1
  if illness-duration > 50 [
   set total-deaths total-deaths + 1
   die
  ]
 ]
end
```

5.2 CHIOS Lab

```
breed [humans human]
breed [trashcans trashcan]
breed [litter-items litter-item]
```

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

```
humans-own [speed trash done angle-of-vision depth-of-vision target-trashcan cautious-level]
trashcans-own [cap current radius sum-trash]

to setup
 clear-all
 import-pcolors "C:/NetLogo Chios/chios no labels.png"

 set-default-shape trashcans "square"
 set-default-shape humans "person"
 set-default-shape litter-items "circle"

 setup-human
 setup-trashcan

 reset-ticks
end


to setup-trashcan
 set-default-shape trashcans "square"

 create-trashcans number-of-trashcans [
  let t-size 5
  let t-cap 5
  if trashcan-size = "medium (10)" [
   set t-size 7
   set t-cap 10
  ]
  if trashcan-size = "large (15)" [
   set t-size 9
   set t-cap 15
  ]

  set color grey
  set size t-size
  set cap t-cap
  set sum-trash 0
```

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

```
  move-to one-of patches with [pcolor = white]
 ]
end

to setup-human
 set-default-shape humans "person"
 create-humans number-of-humans [
  set size 12
  set color red
  set speed 1
  move-to one-of patches with [pcolor = white]
  set angle-of-vision 90
  set depth-of-vision 5
  set trash false
  set target-trashcan nobody

  ; Assign cautious-level randomly
  let choice random 3
  if choice = 0 [ set cautious-level "not" ]
  if choice = 1 [ set cautious-level "somewhat" ]
  if choice = 2 [ set cautious-level "very" ]
 ]
end


to go
 ask humans [
  move 1
  produce-trash

;   if random 5000 < 1 [
;     hatch 1 [
;       move-to one-of patches with [pcolor = white]
;       set color red
;       set trash 0
;     ]
;   ]
  if trash = 1 [
    set color green
```

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

```
  ]
 ]

 ask trashcans [
  if sum-trash = cap [
   set color brown
  ]
 ]
 tick
end


to empty-trashcans
 ask trashcans [
  set sum-trash 0
  set color grey
 ]
end

to produce-trash
 if random 10000 < 1 [
  set trash 1
 ]
end

to add-n-trashcans
 create-trashcans add-trashcan-count [
  let t-size 5
  let t-cap 5
  if trashcan-size = "medium (10)" [
   set t-size 7
   set t-cap 10
  ]
  if trashcan-size = "large (15)" [
   set t-size 9
   set t-cap 15
  ]

  set color grey
```

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

```
  set size t-size
  set cap t-cap
  set sum-trash 0
  move-to one-of patches with [pcolor = white]
 ]
end



; if person has trash, it looks for a trashcan within distance of 10
to check-for-trashcan
 if trash = 1 [
  let nearest-trashcan min-one-of trashcans with [pcolor = white] [distance myself]
  ifelse nearest-trashcan != nobody and distance nearest-trashcan <= 10 [ ; Adjust proximity
as needed
    set target-trashcan nearest-trashcan
  ] [
    set target-trashcan nobody ; Ensure target-trashcan is reset if no suitable trashcan is
found
  ]
 ]
end

; when person walks to trashcan, he puts the trash in the bin and then dies
to deposit-trash
 ;while [target-trashcan != nobody] [
 ;if target-trashcan != nobody [ ;-> while makes more sense
 ask target-trashcan [
  if sum-trash < cap [
    set sum-trash sum-trash + 1
    ask myself [
      die
    ]
  ]
 ]
 ;]
end

; movement function just for agents which move to trashcans
```

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

```
to move-towards [target dist]
 face target
 ifelse [pcolor] of patch-ahead dist = white [
  forward dist
 ] [
  right random 360 ; Turn randomly if the path is blocked
 ]
 if distance target < 10 [ ;distance to interact
  deposit-trash
 ]
end


to drop-trash-on-ground
 ask patch-here [
  sprout-litter-items 1 [
   set color orange       ; a noticeable color for trash
   set size 2             ; larger size for visibility
  ]
 ]
 set trash 0
 set color green
end

to decide-if-drop-trash  ;; turtle procedure
 if cautious-level = "not" [
  ; Not cautious: always drop immediately if no trashcan nearby.
  drop-trash-on-ground
 ]

 if cautious-level = "somewhat" [
  ; Somewhat cautious: only drop if the nearest trashcan is farther than a threshold.
  let threshold 5 ;; Adjust this threshold as desired.
  let nearest-trashcan min-one-of trashcans with [pcolor = white] [distance myself]

  if (nearest-trashcan = nobody) or (distance nearest-trashcan > threshold) [
   drop-trash-on-ground
  ]
 ]
```

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

```
 if cautious-level = "very" [
   ; Very cautious: only drop if the nearest trashcan is much farther away.
   let threshold 15 ;; A larger threshold, adjust as desired.
   let nearest-trashcan min-one-of trashcans with [pcolor = white] [distance myself]

   if (nearest-trashcan = nobody) or (distance nearest-trashcan > threshold) [
     drop-trash-on-ground
   ]
 ]
end


to kill-n-humans
 ; Check if we have enough humans
 ifelse remove-humans > count humans [
   user-message "Not enough humans!"
 ] [
   ask n-of remove-humans humans [ die ]
 ]
end


;moves humans --> if they have trash, they move to a trashcan
;otherwise, looks for clear path or the "whitest" path in its vision cone, if they dont find
anything, they turn (random 360)
to move [dist]
 ; If the human has trash but no target trashcan, decide if they drop it.
 if trash = 1 and target-trashcan = nobody [
   decide-if-drop-trash
 ]

 ifelse trash = 1 and target-trashcan != nobody [
   move-towards target-trashcan dist
 ] [
   ifelse [pcolor] of patch-ahead dist = white [
     forward dist
   ] [
     let visible-patches patches in-cone depth-of-vision angle-of-vision with [pcolor = white]
```

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

```
    if any? visible-patches [
      let destination max-one-of visible-patches [pcolor]
      face destination
      forward min (list dist distance destination)
    ]
    if not check-front [
      right random 360
    ]
  ]
  check-for-trashcan
]
end


to clean-streets
 ask litter-items [
   die
 ]
end

;front is white?
to-report check-front
 report [pcolor] of patch-ahead 1 = white ; This should return true or false
end

;right is white?
to-report check-right
 let right-patch (patch-right-and-ahead 90 1)
 report [pcolor] of right-patch = white ; This should also return true or false
end


to-report full-trash
 let counter 0
 ask trashcans [
   if cap = sum-trash [
     set counter counter + 1
   ]
 ]
```

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

```
 report counter
end
```

5.3 MURCIA Lab

```
globals [
 year
 car-users
 bike-users
 walk-users
 public-transport-users
 avg-commute-time
 total-car-users
 total-bike-users
 total-walk-users
 total-public-transport-users
]

turtles-own [
 transport-mode ; "car", "bike", "walk", or "public-transport"
 home-location
 work-location
 eco-inclination ; probability to prefer sustainable transport
]

patches-own [
 has-bike-lane?
 has-tram-stop?
 is-pedestrian-zone?
]

; SETUP PROCEDURE

to setup
 clear-all
 set year 0

 ask patches [
  set has-bike-lane? false
```

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

```
  set has-tram-stop? false
  set is-pedestrian-zone? false
 ]

 create-turtles number-of-residents [
  setxy random-xcor random-ycor
  set home-location patch-here
  let possible-work-places patches in-radius work-radius
  if any? possible-work-places [
    set work-location one-of possible-work-places
  ]
  set eco-inclination random-float 1.0
  set transport-mode "car"
 ]

 recolor-city
 reset-ticks
end

; MAIN GO PROCEDURE

to go
 if year = simulation-years [ stop ]

 move-residents
 update-transport-modes
 implement-policies
 improve-eco-inclination
 calculate-stats
 plot-transport-stats
 tick
 if ticks mod 365 = 0 [ set year year + 1 ]
end

; MOVEMENT SIMULATION

to move-residents
 ask turtles [
  move-to work-location
```

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

```
  move-to home-location
 ]
end

; UPDATE TRANSPORT MODES

to update-transport-modes
 ask turtles [
  let dist distance work-location
  let choice "car"

  ifelse use-in-radius? [
   if dist < walk-distance-max and (eco-inclination > 0.3 or [any? patches in-radius 2 with [is-pedestrian-zone?]] of home-location) [
    set choice "walk"
   ]
   if dist >= walk-distance-max and dist < bike-distance-max and ([any? patches in-radius 3 with [has-bike-lane?]] of home-location) and (eco-inclination > 0.2) [
    set choice "bike"
   ]
   if ([any? patches in-radius 5 with [has-tram-stop?]] of home-location) and (eco-inclination > 0.5) [
    set choice "public-transport"
   ]
  ]
  [
   if dist < walk-distance-max and (eco-inclination > 0.3 or [is-pedestrian-zone?] of home-location) [
    set choice "walk"
   ]
   if dist >= walk-distance-max and dist < bike-distance-max and ([has-bike-lane?] of home-location) and (eco-inclination > 0.2) [
    set choice "bike"
   ]
   if ([has-tram-stop?] of home-location) and (eco-inclination > 0.5) [
    set choice "public-transport"
   ]
  ]
```

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

```
  if dist >= bike-distance-max and eco-inclination > 0.5 and [any? patches in-radius 5 with
[has-tram-stop?]] of home-location [
    set choice "public-transport"
  ]

  if random-float 1.0 < 0.05 [
    set choice "car"
  ]

  set transport-mode choice
 ]
end

; POLICY CHANGES EVERY YEAR

to implement-policies
 if year mod 1 = 0 [
  let potential-bike-patches patches with [ not has-bike-lane? and count turtles-here > 0 ]
  if (count potential-bike-patches > 0) and (count patches with [has-bike-lane?] < count
patches * 0.6) [
    ask n-of (min (list bike-lane-investment count potential-bike-patches)) potential-bike-
patches [
      set has-bike-lane? true
    ]
  ]

  let potential-pedestrian-patches patches with [ not is-pedestrian-zone? and count turtles-
here > 0 ]
  if (count potential-pedestrian-patches > 0) and (count patches with [is-pedestrian-zone?] <
count patches * 0.5) [
    ask n-of (min (list pedestrian-zone-investment count potential-pedestrian-patches))
potential-pedestrian-patches [
      set is-pedestrian-zone? true
    ]
  ]
 ]

 if year mod 3 = 0 [
  let potential-tram-patches patches with [ not has-tram-stop? ]
```

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

```
  if (count potential-tram-patches > 0) and (count patches with [has-tram-stop?] < count
patches * 0.2) [
    ask n-of (min (list tram-stop-investment count potential-tram-patches)) potential-tram-
patches [
      set has-tram-stop? true
    ]
  ]
 ]

 recolor-city
end

; CALCULATE STATISTICS

to calculate-stats
 set car-users count turtles with [ transport-mode = "car" ]
 set bike-users count turtles with [ transport-mode = "bike" ]
 set walk-users count turtles with [ transport-mode = "walk" ]
 set public-transport-users count turtles with [ transport-mode = "public-transport" ]

 set total-car-users car-users
 set total-bike-users bike-users
 set total-walk-users walk-users
 set total-public-transport-users public-transport-users

 let commute-times []

 ask turtles [
  let dist distance work-location
  let speed 1

  if transport-mode = "car" [ set speed car-speed ]
  if transport-mode = "bike" [ set speed bike-speed ]
  if transport-mode = "walk" [ set speed walk-speed ]
  if transport-mode = "public-transport" [ set speed pt-speed ]

  let time (dist / speed) * 60
  set commute-times lput time commute-times
 ]
```

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

```
 set avg-commute-time mean commute-times

 if ticks mod 365 = 0 [
  show (word "Year " year ": Car: " car-users ", Bike: " bike-users ", Walk: " walk-users ", PT: "
public-transport-users)
  show (word "Avg commute time (min): " avg-commute-time)
 ]
end

; PLOT

to plot-transport-stats
 set-current-plot "Mobility Modes Over Time"
 set-current-plot-pen "Car"
 plot total-car-users
 set-current-plot-pen "Bike"
 plot total-bike-users
 set-current-plot-pen "Walk"
 plot total-walk-users
 set-current-plot-pen "PublicTransport"
 plot total-public-transport-users

 set-current-plot "Average Commute Time"
 set-current-plot-pen "default"
 plot avg-commute-time
end

; RECOLOR CITY

to recolor-city
 ask patches [
  set pcolor gray
  if has-bike-lane? and has-tram-stop? and is-pedestrian-zone? [ set pcolor pink ]
  if has-bike-lane? and has-tram-stop? and not is-pedestrian-zone? [ set pcolor cyan ]
  if has-bike-lane? and is-pedestrian-zone? and not has-tram-stop? [ set pcolor lime ]
  if has-tram-stop? and is-pedestrian-zone? and not has-bike-lane? [ set pcolor sky ]
  if has-bike-lane? and not (has-tram-stop? or is-pedestrian-zone?) [ set pcolor green ]
  if has-tram-stop? and not (has-bike-lane? or is-pedestrian-zone?) [ set pcolor violet ]
```

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.

```
  if is-pedestrian-zone? and not (has-bike-lane? or has-tram-stop?) [ set pcolor yellow ]
 ]
end

; IMPROVE ECO INCLINATION

to improve-eco-inclination
 ask turtles [
  if eco-inclination < 1.0 [
    set eco-inclination eco-inclination + 0.0005
  ]
 ]
end
```

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094455.