



## Climate-Resilient Development Pathways in Metropolitan Regions of Europe

Joint activities with other R&I projects – Version 1

January 2025

## Grant Agreement Number 101137851

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## Disclaimer

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## Abbreviations and Glossary

| Abbreviations | Full wording                                                     |
|---------------|------------------------------------------------------------------|
| CEN           | European Committee for Standardisation                           |
| Climate-ADAPT | European Climate Adaptation Platform                             |
| CoP           | Community of Practice                                            |
| CSA           | case study area                                                  |
| CSS           | Civil Security from Space                                        |
| DEC           | Dissemination, Exploitation, and Communication Strategy          |
| DG-CLIMA      | Directorate-General for Climate Action                           |
| DoA           | Description of Action                                            |
| DRR           | Disaster Risk Reduction                                          |
| DSDS          | Decision Support and Dissemination System                        |
| DT            | Digital Twin                                                     |
| DT-HEAT+      | Integrated Heat Resilience for Tomorrow's Cities Digital Twin    |
| EEA           | European Environment Agency                                      |
| EGD           | European Green Deal                                              |
| ENoLL         | European Network of Living Labs                                  |
| EO            | Earth Observation                                                |
| ESA           | European Space Agency                                            |
| ESRIN         | European Space Research Institute                                |
| EW4All        | Early Warnings for All initiative                                |
| EWS           | Early Warning Systems                                            |
| GAW           | Global Atmosphere Watch                                          |
| GCF           | Green Climate Fund                                               |
| G3W           | Global Greenhouse Gas Watch                                      |
| GIS           | Geographic Information System                                    |
| ICSD          | International Conference on Sustainable Development              |
| IDSS          | Impact-based decision support system                             |
| IPCC          | Intergovernmental Panel on Climate Change                        |
| IoT           | Internet of Things                                               |
| IUS           | Integrated Urban Services                                        |
| M&A           | Mitigation and Adaptation                                        |
| M&E           | Monitoring and Evaluation                                        |
| MACC          | Mission on Adaptation to Climate Change                          |
| MRE           | Metropolitan Region in Europe                                    |
| MoU           | Memorandum of Understanding                                      |
| NASA-JPL      | National Aeronautics & Space Administration - Jet Propulsion Lab |
| NbS           | Nature-based Solutions                                           |
| NDC           | Nationally Determined Contribution                               |
| NGO           | Non-Governmental Organisation                                    |
| OGC           | Open Geospatial Consortium                                       |
| RA            | Regional Association                                             |
| R&I           | Research and Innovation                                          |

|        |                                                                  |
|--------|------------------------------------------------------------------|
| SACC   | EU Strategy on Adaptation to Climate Change                      |
| SDG    | Sustainable Development Goal                                     |
| SERI   | Swiss State Secretariat for Education, Research and Innovation   |
| TG     | Target Group                                                     |
| UKRI   | UK Research and Innovation                                       |
| UN     | United Nations                                                   |
| UNDRR  | United Nations Office for Disaster Risk Reduction                |
| UNEP   | United Nations Environment Programme                             |
| UNESCO | United Nations Educational, Scientific and Cultural Organization |
| UNFCCC | United Nations Framework Convention on Climate Change            |
| WP     | Work Package                                                     |

## Executive Summary

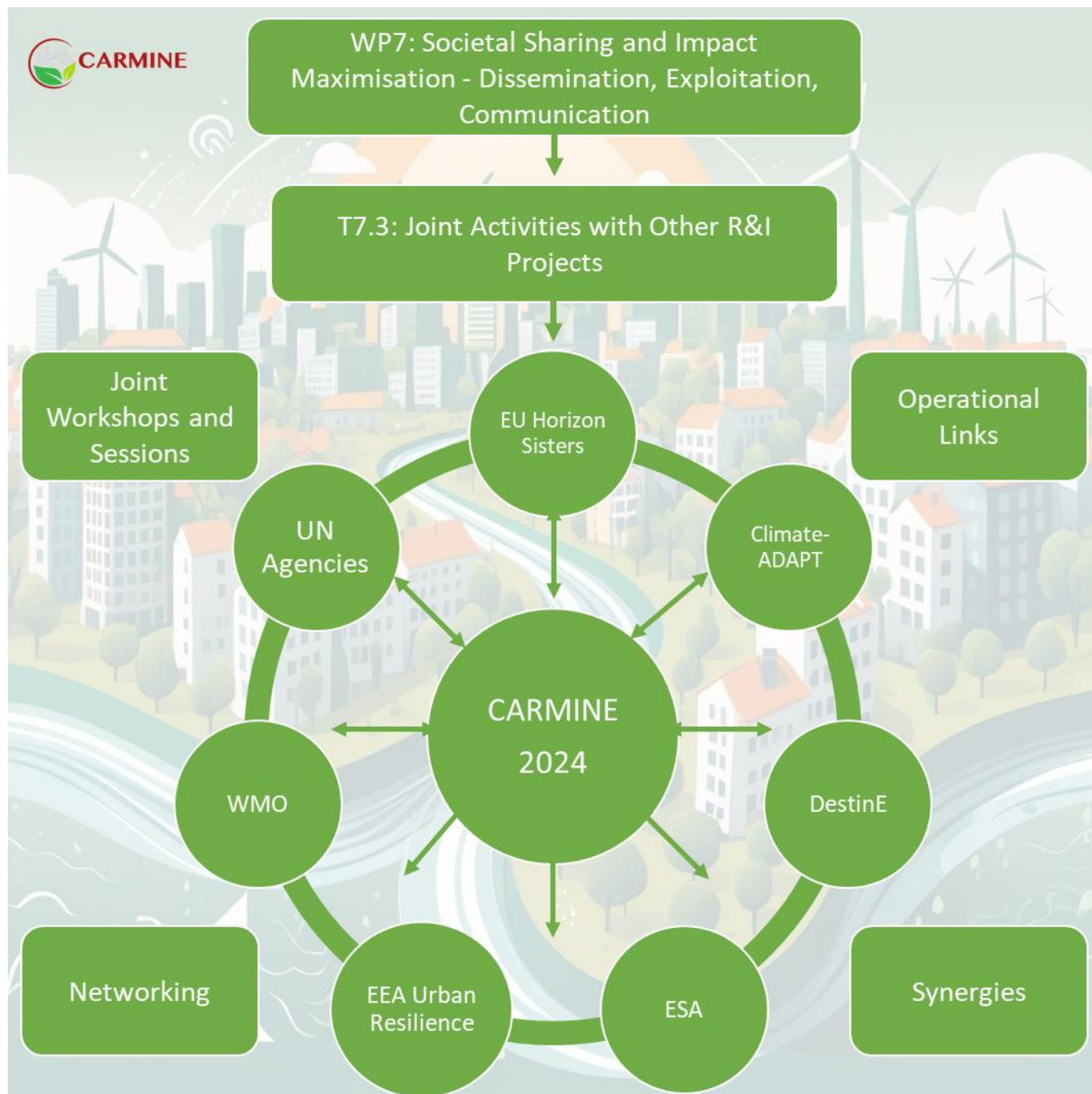
This report – **Joint activities with other R&I projects: version 1** – focuses on documenting the synergies and collaborative activities between CARMINE and related EU R&I Projects and Global Initiatives up to 31 January 2025. It is the first iteration of a deliverable to be updated annually over the four year project. The deliverable also describes relationships, activities, and synergies that have been identified, should be actioned over the remaining three years of the project, and documented in later versions of this deliverable.

CARMINE seeks to advance climate resilience in metropolitan regions through the development and implementation of innovative adaptation strategies. By integrating participatory approaches in eight Case Study Areas (CSA) across Europe, including planned Living Labs (LL) in each CSA, advanced climate modelling, and digital twin (DT) technologies, CARMINE aims to enhance decision-making processes and provide actionable insights tailored to complex urban environments. Central to this effort is a planned Impact-based Decision Support Service (IDSS), which supports policymakers, practitioners, and local stakeholders in addressing interconnected challenges around urban mitigation, adaptation, and resilience. DTs will be developed in each of the eight CSAs.

During its first year, CARMINE has forged significant synergies and collaborations with key European and global initiatives. Partnerships initiated include with the Climate-ADAPT platform, discussions regarding the use of satellite data and environmental monitoring tools from the European Space Agency's (ESA) SmartConnect and R3 Accelerator programmes, the alignment of project methodologies with insights from the European Environment Agency's (EEA) report *Urban Adaptation in Europe: what works?*, and strategic engagements with highly complementary EU Horizon R&I projects such as ICARIA, CLIMAAX, RISKADAPT, PATHWAYS2RESILIENCE, MIRACA and others. These collaborations will, over the next three years, strengthen CARMINE's ability to deliver innovative solutions that are robust, scalable, and context specific. CARMINE will also ensure that its solutions are shared via pan-European platforms on scalable cities and nature-based solutions (NbS).

The project's ongoing interactions extend to international and global frameworks, including the UN's Early Warnings for All initiative and the Sustainable Development Solutions Network. In all cases, CARMINE's results are expected to evidence and provide both policy support and practical tools to underpin urban adaptation measures. Coordination with the European Union's Destination Earth (DestinE) digital twin programme will position CARMINE prominently in the fast-expanding European DT community. As CARMINE progresses, the project focuses on scaling successful interventions and deepening collaborations with European and global initiatives, including DestinE (Task 4.5) and the UN's Early Warnings for All. Through the integration of advanced tools, stakeholder-driven strategies, and robust partnerships, the project is poised to set a new standard for effective, inclusive, and scalable urban adaptation. The foundations laid in this first year set the project on a transformative pathway toward building climate-resilient metropolitan regions across Europe and beyond.

## GRAPHICAL ABSTRACT



## 1. INTRODUCTION

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This CARMINE report – Joint activities with other R&I projects: version 1 – documents the synergies and collaborative activities between CARMINE and related EU R&I Projects and Global Initiatives during the first year of CARMINE (to 31 January 2025). It is the first iteration of a deliverable to be updated annually over the four-year project. The deliverable reports on the networking, operational links and synergies established with other on-going and parallel similar EU R&I projects and global initiatives.

CARMINE aims to prioritise collaboration and networking to:

1. Establish operational links with similar EU and global initiatives.
2. Share knowledge, tools, processes, and methodologies and enhance project outputs.
3. Promote scalability, transferability, and replicability of successful adaptation strategies.

These objectives are in line with the Horizon Europe Work Programme's emphasis on international cooperation and the development of climate change risk assessments in European regions and communities.

## 2. ENGAGEMENT ACTIVITIES AND STRATEGIC COLLABORATIONS

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Looking ahead, the project plans to expand its presence at relevant fora in 2025 and beyond to further share insights and build collaborations. This expansion strengthens CARMINE's dissemination efforts, enabling the project to share its progress and contribute to global dialogues on urban resilience.

### 2.1. Destination Earth Initiative

The Destination Earth<sup>1</sup> (DestinE) initiative represents a transformative step in leveraging digital twin (DT) technology for climate resilience, societal well-being, and sustainability in Europe. DestinE's ambition is to create highly interactive and accurate digital replicas of the Earth, integrating real-time data, advanced models, and artificial intelligence to predict and mitigate the impacts of natural and human-induced phenomena. By focusing on a user-centric and decentralised approach, DestinE seeks to provide decision-makers, urban planners, and researchers with actionable insights tailored to local, regional, and global scales.

CARMINE has a dedicated task in WP4 T4.5 and the deliverable D4.6 'Specification of linkages to DestinE infrastructure'. The connection to DestinE started early in CARMINE's history with the submission of a proposal based on DT-HEAT (WP4) to the 2<sup>nd</sup> Innovation Prize launched by ESA in which the proposal (conceived and submitted by NOA and co-authored by many CARMINE partners) won the 'Most Promising Proposal' award. The reviewers were from ESA, ECMWF, and EUMETSAT (the three DestinE partners). The proposal was presented to the DestinE community during the award. Part of the prize was an online info day and one online workshop with DestinE experts. WP7 and T7.3 specifically will work in support of this parallel activity, ensuring networking and alignment between CARMINE, DestinE and related activities by CARMINE beneficiaries including WMO.

#### *European Space Agency*

The European Space Agency (ESA), through its civil security from space (CSS), R3 Accelerator<sup>2</sup> and SmartConnect<sup>3</sup> programmes, offers potential opportunities to interact with CARMINE in the context of the project's resilient communities aiding in disaster management strategies. WMO's formal relationship with ESA underscores a shared commitment to leveraging space-enabled solutions for climate adaptation and disaster risk reduction. WMO's existing relationship with ESA is being explored to potentially drive a fruitful partnership that can enhance CARMINE's ability to access advanced data, technologies, and methodologies, fostering synergies between ESA's initiatives and CARMINE's objectives.

The ESA R3 Accelerator focuses on integrating space-based, aerial, and ground-based resources to improve resilience and crisis response. It seeks to combine ESA's strengths with connections to international entities and the EU, develop partnerships and build communities.

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<sup>1</sup> <https://destination-earth.eu/>

<sup>2</sup> [https://esamultimedia.esa.int/docs/corporate/FS-R3\\_122023.pdf](https://esamultimedia.esa.int/docs/corporate/FS-R3_122023.pdf)

<sup>3</sup> <https://connectivity.esa.int/news/european-space-agency-introduces-industrydriven-partnership-resilient-connectivity-during-disasters>

SmartConnect, ESA's IoT-enabled environmental monitoring programme, complements this by providing cutting-edge tools for real-time data collection and connectivity. These capabilities align closely with CARMINE's Work Package 5 (WP5), focused on IDSS development, and offer opportunities for piloting advanced monitoring systems in CARMINE's Living Labs. WMO has ensured interaction between SmartConnect (Sistema, based in Vienna) and CARMINE's WP5 leaders (October 2024) and it is expected that further collaboration will continue through the remaining three years of CARMINE. Future engagement opportunities include capacity building and resources mobilisation, and potential scaling of CARMINE's digital twins.

In addition, a key synergistic milestone between CARMINE and ESA is the HEATWISE (High-resolution Enhanced Analysis Tool for Urban Hyperspectral and Infrared Satellite Evaluation) project, funded by ESA which runs between 2024 and 2026. The project runs in the framework of Sentinel User Preparation (SUP) program. CARMINE and HEATWISE share the Athens area as a case study (both led by NOA). The kick-off HEATWISE user requirements meeting was held in December 2024, back-to-back with the 1<sup>st</sup> CARMINE LL in Athens on 'Urban Heat Resilience: Pioneering Solutions for a Cooler Athens'.

The CARMINE Living Lab provided a dynamic platform for participants to discuss and map key urban heat risks, underlying risk drivers, and solutions for heat-health adaptation and mitigation, while also identifying barriers and enablers for implementing these solutions. Building on the momentum of the Living Lab, the HEATWISE session introduced stakeholders to the HEATWISE objectives, emphasising its focus on leveraging future Copernicus Expansion missions (CHIME and LSTM) to develop novel products for urban resilience. This integration of HEATWISE into the CARMINE framework demonstrated the value of cross-project synergies in addressing climate adaptation challenges.

## 2.2. Key Stakeholder Engagement Efforts

Several modes of activity were implemented throughout 2024 to engage relevant stakeholders with the work of the CARMINE project. These were done as part of T7.3 efforts to complement work conducted in WP1, through interacting with similar EU Horizon funded R&I projects and other initiatives.

In support of the existing DEC (Dissemination, Exploitation and Communication) strategy and WP1 efforts and deliverables, CARMINE's focus for this report is on:

1. Highlighting **specific activities** that demonstrate the operationalisation of these strategies.
2. Identifying opportunities for enhancing stakeholder collaboration as the project progresses.
3. Documenting emerging lessons from the integration of stakeholder feedback into CARMINE's methodologies.

CARMINE's interactions with other Horizon funded projects with complementary goals can deliver inclusive and actionable solutions for urban resilience. Future efforts will continue to adapt and evolve through the next three years, incorporating lessons learned and feedback from a diverse range of stakeholders.

Table 1 provides details on the conducted engagement activities.

*Table 1: List of key stakeholder engagements conducted in 2024*

| Date           | Activity                                          | Location                  | Stakeholders Engaged                     | Focus and Outcomes                                                                                                                      |
|----------------|---------------------------------------------------|---------------------------|------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| March 2024     | Initial Pilot City Workshops                      | Bologna, Barcelona        | Municipal planners, local policymakers   | Co-designed initial objectives and methodologies for pilot Living Labs, aligning project goals with city needs.                         |
| June 2024      | Stakeholder Mapping Sessions                      | Online                    | Regional and local authorities, NGOs     | Identified critical actors and gaps in existing adaptation efforts, establishing key priorities for engagement.                         |
| June 2024      | Introducing CARMINE project to local stakeholders | On-site (Brasov, Romania) | Regional and local authorities, NGOs     | Purpose and ambitions of the CARMINE project and identification of the stakeholders' availability to be involved in the CARMINE project |
| September 2024 | Conference presentation at URBIS24 Conference     | ESA/ESRIN, Italy          | Earth Observation experts, city planners | Presented digital twin concepts for urban heat risk assessment, to an audience of city stakeholders and EO researchers.                 |

Other examples of valuable stakeholder engagement direct with entities in CSAs have also been conducted, with one example being the CARMINE CSA and LL in Prague. These direct interactions have ensured that CARMINE is embedded in the adaptation strategies of CSAs, even with the project yet to produce its main outputs (DTs, IDSS). The metropolitan administrative body (Prague Council), at its meeting on 16 Dec 2024, approved an Implementation Plan (IP) for the Strategy for Adaptation of the Capital City of Prague to Climate Change for the years 2025-2029<sup>4</sup> (available only in Czech). Within this strategy, CARMINE is one of the three "promising projects" with the potential to help achieve the IP's aims. In addition, CARMINE was also introduced to The Prague Institute of Planning and Development<sup>5</sup> resulting in a project with high potential for further cooperation. The ongoing collaboration means that CARMINE, and its Prague CSA-LL, will have many more 'open doors' in 2025 and 2026.

<sup>4</sup> [Resolution text 2584 \(in Czech\)](#)

<sup>5</sup> <https://ippraha.cz/en/>

### 3. OPERATIONAL LINKS

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CARMINE is constantly establishing and building operational connections with key platforms and organisations to enhance its impact on metropolitan climate resilience. These efforts are designed to align with existing frameworks and leverage collaborative opportunities over the project's duration, which extends to January 2028. This version 1 (D7.8) of the deliverable reports on activities conducted during the first year of CARMINE, to 31 January 2025.

#### 3.1. Integration with Climate-ADAPT Platform

The European Climate Adaptation Platform<sup>6</sup> (Climate-ADAPT) serves as a vital resource for sharing knowledge on climate adaptation across Europe. CARMINE aims to contribute to this platform by:

- **Developing Urban Heatwave Impact Datasets:** Creating comprehensive datasets that detail the effects of heatwaves in metropolitan areas, which can inform adaptation strategies.
- **Enhancing Vulnerability Assessment Tools:** Integrating methodologies that assess socio-economic vulnerabilities specific to urban settings, aiding policymakers in identifying and prioritising adaptation measures.

These contributions are planned for the upcoming phases of the project, with the goal of enriching the resources available on Climate-ADAPT and supporting evidence-based decision-making. In January 2025, CARMINE secured access to Climate-ADAPT and is in dialogue with Climate-ADAPT/EEA partners to develop CARMINE inputs to the Platform. Further updates will be stated in subsequent versions of this deliverable.

#### 3.2. WMO: beyond Science and Innovation

WMO, a partner in CARMINE, through its Global and European activities, plays a pivotal role in advancing urban resilience by leveraging its global network, technical expertise, and initiatives designed to address the multifaceted impacts of climate change on urban areas.

CARMINE is engaging with WMO beyond its Science and Innovation Department to explore whether and how to incorporate advanced meteorological data and services into its IDSS. Key potential areas of collaboration include:

- **Early Warnings for All (EW4All)<sup>7</sup>:** this UN Initiative can underpin the inclusion of national hydromet service warnings into urban agency responses via CARMINE's IDSS
- **Guidance on Integrated Urban Hydrometeorological, Climate and Environment Services<sup>8</sup>:** this WMO report (published 2019) was designed to support WMO Members to develop and implement urban climate services to address the needs of metropolitan

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<sup>6</sup> <https://climate-adapt.eea.europa.eu/en>

<sup>7</sup> <https://earlywarningsforall.org/site/early-warnings-all>

<sup>8</sup> [https://urban-climate.org/wp-content/uploads/2023/10/WMO\\_2019\\_1234\\_en.pdf](https://urban-climate.org/wp-content/uploads/2023/10/WMO_2019_1234_en.pdf)

stakeholders. The guidance has valuable insights relevant to CARMINE around protecting urban infrastructures from the impacts of climate change.

- **Global Atmosphere Watch<sup>9</sup>:** Leveraging GAW's expertise in urban air quality, heat health, and sand and dust storms to enhance the IDSS's predictive capabilities and provide timely advisories to urban populations.
- **Global Greenhouse Gas Watch (G3W)<sup>10</sup>:** Utilising G3W's data on greenhouse gas concentrations to inform urban mitigation strategies and support the development of low-carbon initiatives within metropolitan regions.
- **Regional Office for Europe<sup>11</sup>:** Engaging with the WMO's Regional Office for Europe to align CARMINE's activities with regional climate priorities. CARMINE has actively participated in both the Regional Climate Centre User Forum and the WMO Regional Office for Europe Scientific Forum, with a presentation by CARMINE at the latter bi-annual event scheduled for October 2025.

These collaborations aim to integrate WMO's global and regional expertise into CARMINE's framework, enhancing the project's ability to address urban climate challenges effectively. The project's close engagement with the WMO RA-VI (Europe) regional research programme for 2024-25 and beyond will ensure that WMO members in the CARMINE case study areas will have an opportunity to weave CARMINE's IDSS and DTs into national level policy-relevant science advances<sup>12</sup>.

### 3.3. Alignment with Regional and National Climate Policies

CARMINE will ensure, through its connection with WMO and its member states, that its methodologies and tools are compatible with existing climate policies at both regional and national levels. Within WMO's Region VI (Europe), much of this effort is delivered through the Regional Climate Centre User Forum, and specific activities are expected to include:

- **Explore engagement with National Adaptation Plans:** Aligning project outputs with (for example) Italy's National Adaptation Plan and Spain's Urban Climate Action Guidelines to ensure relevance and applicability within these countries' policy frameworks.
- **Contribution to the EU Strategy on Adaptation to Climate Change:** Ensuring that CARMINE's findings and tools support the broader European objectives for climate adaptation, facilitating the integration of project outcomes into EU-wide initiatives.

By aligning with these policies and in particular working closely with the WMO Regional Office for Europe, CARMINE aims to facilitate the adoption of its tools and methodologies, promoting sustainable urban resilience across Europe – beyond its target case study areas.

<sup>9</sup> <https://wmo.int/activities/global-atmosphere-watch-programme-gaw>

<sup>10</sup> <https://wmo.int/activities/global-greenhouse-gas-watch-g3w>

<sup>11</sup> WMO Regional Office for Europe website: <https://wmo.int/about-us/regions/europe>

<sup>12</sup> WMO RA-VI (Europe) – Scientific Forum: Bridging Research and Operations – [decision note](#)

## 4. SYNERGIES WITH SIMILAR EU R&I PROJECTS

During its first year, the CARMINE project has initiated discussions led by WMO with several Horizon Europe Research and Innovation (R&I) projects to explore synergies and potential collaborations. A number of these projects are funded under two calls (HORIZON-MISS-2021-CLIMA-02-03 “Towards asset level modelling of climate risks and adaptation”<sup>13</sup>, and HORIZON-MISS-2021-CLIMA-02-01 “Development of climate change risk assessments in European regions and communities based on a transparent and harmonised Climate Risk Assessment approach”<sup>14</sup>). CARMINE is explicitly required by its call scope to incorporate results from projects funded by these two calls into its outputs.

Introductory meetings with many of the projects identified here have been conducted during late 2024, and have established a foundation for continued interaction, results sharing, capacity building, mutual progress and shared outcomes. As CARMINE and these projects evolve in parallel, the exchange of methodologies, tools, and data will remain a priority, fostering a collaborative environment to address shared climate resilience challenges.

In addition to the projects funded by HORIZON-MISS-2021-CLIMA-02-03 and HORIZON-MISS-2021-CLIMA-02-01 (ICARIA, CLIMAAX, RISKADAPT, and MIRACA), this section expands on proposed and potential collaborations and mutual knowledge exchange with Horizon Europe R&I projects focused on nature-based solutions. UNESCO’s involvement in NBSINFRA and ALBATROSS through its Natural Sciences branch provides an additional layer of synergy, linking CARMINE’s objectives to these complementary initiatives through the inclusion of UN agencies in both projects.

There are several other parallel Horizon Europe projects of considerable relevance to CARMINE. These include – among others – CROSSEU (which, like CARMINE, is co-ordinated by MeteoRomania), MedEWSa (sharing common partners, among those, JLU that coordinates the project), AGORA, and HARMONIA.

### 4.1. ICARIA

The ICARIA<sup>15</sup> (Improving ClimAte Resilience of critical Assets) project specialises in real-time hazard monitoring through the integration of satellite and ground-based observation systems. Initial discussions with ICARIA highlighted the potential for leveraging their techniques to enhance urban heat island mapping and early detection of climate-related risks. Despite concerted efforts from CARMINE there has not yet been an exchange of ideas and potential synergies with ICARIA, which is entering its final year of activities. CARMINE will seek to learn

<sup>13</sup> Call text: <https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/horizon-miss-2021-clima-02-03>

<sup>14</sup> Call text: <https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/horizon-miss-2021-clima-02-01>

<sup>15</sup> Project website: <https://www.icaria-project.eu/>

from ICARIA during 2025 as it finalises its outputs, and details will be provided in subsequent iterations of this deliverable in M24 and beyond.

#### 4.2. CLIMAAX

CLIMAAX<sup>16</sup> (CLIMATE risk and vulnerability Assessment framework and toolbox) addresses cascading climate risks, such as the compounding effects of heatwaves, flooding, and infrastructure disruptions. An initial meeting between the two projects in December 2024 emphasised the shared goal of equipping policymakers with robust tools to manage systemic vulnerabilities and discussed concrete collaborative actions to be scheduled. The CLIMAAX team will host their digital festival (“webstival”) on 28-29 January 2025, titled ‘From Insights to Action, Advancing Climate Resilience’, curated by EURADA (the European Association of Development Agencies) and the CLIMAAX team. This webstival will offer a platform for regions and stakeholders to connect, share experiences, and learn from each other’s progress. An initial meeting led to an invitation for CARMINE to take up a presentation slot at the event, to showcase the CARMINE Living Labs. Additionally, there will be an opportunity to meet with the CLIMAAX pilot studies, with a focus on the overlaps in Barcelona (CARMINE Living Lab) and Catalunya (CLIMAAX focus region). CARMINE will also join the CLIMAAX Community of Practice (CoP), ensuring that knowledge generated by CLIMAAX can directly inform the development of CARMINE tools (IDSS, DTs) and policy relevant insights.

#### 4.3. RISKADAPT

RISKADAPT<sup>17</sup> (Asset Level Modelling of RISks in the Face of Climate Induced Extreme Events and ADAPtation) focuses on evaluating the cost-effectiveness of adaptation and risk measures, primarily in the context of critical infrastructure such as major transport structures (bridges), power networks, or healthcare facilities (for example, hospital buildings) using case studies from a range of European contexts. Early interactions have identified the potential for resource allocation tools generated by RiskAdapt to inform CARMINE’s planned IDSS and DT tools to be used in its CSAs. Initial meetings took place in November 2024 between the two projects, and it was agreed to keep each other updated with project progress and arrange to conduct future meetings between relevant work package leaders, specifically between the RISKADAPT pilot leads and the CARMINE IDSS WP leads.

#### 4.4. MIRACA

MIRACA<sup>18</sup> (Multi-hazard Infrastructure Risk Assessment for Climate Adaptation) expects to deliver advanced frameworks for monitoring and evaluating climate adaptation risks across European regions and systems (considering both systemic and cascading risks). While CARMINE has a focus on specific metropolitan regions, MIRACA offers a broader country-level or regional perspective. Introductory discussions have identified areas where MIRACA’s methodologies can strengthen CARMINE’s Living Labs. An initial meeting took place in

<sup>16</sup> Project website: <https://www.climaax.eu/>

<sup>17</sup> Project website: <https://riskadapt.eu/>

<sup>18</sup> Project website: <https://miraca-project.eu/>

November 2024 between the projects. It was agreed to keep each other updated with project progress and arrange to conduct future meetings between relevant work package leaders

#### 4.5. NBSINFRA

NBSINFRA<sup>19</sup> (Citynature-Based Solutions Integration To Local Urban Infrastructure Protection For A Climate Resilient Society) emphasises the integration of nature-based solutions into urban infrastructure protection, enhancing resilience to climate impacts. UNESCO's involvement in NBSINFRA establishes a shared platform for advancing climate resilience goals and aligns opportunities between NBSINFRA and CARMINE based on a shared access to the United Nations system.

#### 4.6. RESILIAGE

RESILIAGE<sup>20</sup> (Advancing holistic understanding of community RESILience and heritAGE drivers through community-based methodologies) focuses on community-driven approaches to resilience by integrating cultural heritage into adaptation planning. The project's methodologies emphasise participatory design, aligning closely with CARMINE's stakeholder engagement strategies.

#### 4.7. SYNERGIES

SYNERGIES<sup>21</sup> (Innovating Preparedness by Leveraging SYNERGIES and Enhancing Results of DRM Projects) focuses on disaster risk management by leveraging innovative preparedness tools and fostering collaboration among Disaster Risk Management (DRM) projects. Its methodologies for enhancing readiness align with CARMINE's goal of integrating early warning systems.

#### 4.8 Albatross

ALBATROSS<sup>22</sup> (Advancing knowledge for Long-term Benefits and climate Adaptation ThRough hOlistic climate Services and nature-based Solutions) advances knowledge on climate adaptation through holistic services and nature-based solutions and extends its area of interest beyond Europe to east Africa. With UNESCO as a partner, the project complements CARMINE's focus on NbS and digital twin technologies.

While formal collaborations with these Horizon R&I projects which include UNESCO as a beneficiary and consortium member (NBSINFRA, RESILIAGE, SYNERGIES, and ALBATROSS) are still under development, initial interactions mediated by WMO and UNESCO's Natural Sciences team have established a valuable framework for knowledge exchange. CARMINE will continue to engage with these projects, leveraging shared

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<sup>19</sup> Project website: <https://nbsinfra.eu/>

<sup>20</sup> Project website: <https://resiliage.eu/>

<sup>21</sup> Project website: <https://synergiesproject.eu/>

<sup>22</sup> Project website: <https://albatross-project.eu/>

methodologies, tools, and insights to advance its objectives. The mutual involvement of UNESCO provides additional opportunities for collaboration, particularly in the realm of nature-based solutions and cultural resilience. Potential future activities could encompass joint workshops, data integration, and ultimately fruitful cross-fertilisation and even co-development of scalable, transferable solutions for urban climate resilience, such as the CARMINE IDSS and DTs.

#### 4.9 Pro-Climate

The Pro-Climate<sup>23</sup> (Proactive community adaptation to climate change through social transformation and behavioural change) project centres on fostering behavioural change to achieve transformative climate adaptation and mitigation outcomes. Its focus on community-driven actions, social innovation, and behavioural interventions at a community level offers valuable insights into enhancing public engagement and co-design processes for climate resilience. Pro-Climate's methodologies for behavioural change and social inclusion align with CARMINE's objectives of engaging diverse stakeholders in Living Labs.

#### 4.10 Pathways2Resilience

The Pathways2Resilience<sup>24</sup> (Co-developing pathways towards climate resilient regions in Europe) project aims to strengthen the adaptive capacity of European regions by fostering regional collaborations, capacity-building initiatives, and multi-level governance structures. Its primary tool by which it aims to achieve these goals is by awarding competitive funding for applicant regions to follow an 18 month 'Regional Resilience Journey' programme. This approach complements CARMINE's mission to integrate urban adaptation strategies into regional and national policy frameworks. Across two calls in 2024 and (planned for) mid 2025, the project expects to support 100 European (Member State + Associated Country) locations.

An introductory meeting was held in December 2024 between the co-ordinators of the two project consortia and WMO, and further interaction is expected to be based around the initial application of CARMINE Living Labs to the mid-2025 call for Pathways2Resilience's programme. Both projects have a strong focus on alignment with, and contributions to, the Climate-ADAPT programme.

#### 4.11 CROSSEU

The CROSSEU<sup>25</sup> (Cross-sectoral Framework for Socio-Economic Resilience to Climate Change and Extreme Events in Europe) project aims to provide stakeholders with tools and insights to adapt to climate risks and reduce their impacts. The project's focus is on evaluating socio-economic risks associated with climate change, developing climate-sensitive frameworks, and creating a Decision Support System (DSS). This DSS integrates data and modelling to calculate costs, improve adaptation strategies, and manage uncertainties.

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<sup>23</sup> Project website: <https://pro-climate.eu/>

<sup>24</sup> Project website: <https://www.pathways2resilience.eu/>

<sup>25</sup> Project website: <https://crosseu.eu/>

CROSSEU is working on eight (topic-based) case studies that explore the impact of different climate hazards, including storms, heatwaves, droughts, and snow, on socio-ecological systems in various EU and UK contexts.

### Synergies with CARMINE

- **Multi-Level Governance:** Both CROSSEU and CARMINE recognise the importance of aligning local, regional and national climate adaptation strategies.
- **Collaborative Platforms:** Both projects **make use of** a multi-stakeholder approach to climate resilience, including workshops and meetings in case study regions to gather data and feedback.
- **Capacity Building:** Both CROSSEU and CARMINE work to improve the skills and knowledge of stakeholders through capacity-building programmes.
- **Decision Support Tools:** Both projects focus on providing decision support tools (DSS) that integrate complex data to improve adaptation strategies.
- **Modelling and Simulation:** Both projects use modelling and simulation techniques, such as CARMINE's digital twin approach, to understand climate risks and how to adapt to them.

With both CROSSEU and CARMINE being co-ordinated by the same entity (MeteoRomania – itself a member of WMO as Romania's national hydromet service), there are many opportunities for knowledge exchange and mutual capacity building between the projects, especially where there are geographic, sectoral or other aspects of commonality between the project case study areas. It is most likely that CROSSEU results will be used to inform the development of the CARMINE IDSS and DTs, since CROSSEU's three-year duration means that the project will terminate as CARMINE reaches its final year of activity. Members of the CARMINE consortium serve as members of the Advisory Board of CROSSEU.

### 4.12 MedEWSa

Both MedEWSa<sup>26</sup> (Mediterranean and pan-European forecast and Early Warning System against natural hazards) and CARMINE focus on the development of advanced decision support systems to support mitigation and adaptation action against climate change driven (extreme) events. MedEWSa emphasises Early Warning Systems (EWS) for Euro-Mediterranean-Northern African regions, targeting climate-related risks such as extreme weather events, droughts, wildfires, and floods to provide timely, precise, and actionable early warnings of natural hazard and extreme weather event impacts. MedEWSa also plans to develop a DSDS (decision support dissemination system) to be used to rapidly deploy first responders to areas in need. CARMINE complements this focus by addressing urban-specific challenges such as heatwaves and urban flooding across a range of European metropolitan contexts. MedEWSa's geographic focus on the Mediterranean offers a complementary perspective to CARMINE's pilot cities in broader European contexts, enabling cross-project learning and potential scalability of solutions. There are commonalities between the projects, with Barcelona (Catalunya) and Athens (Attica) featuring as case studies/pilots in both.

<sup>26</sup> Project website: <https://www.medewsa.eu/>

In both projects, WMO holds a similar role, acting as a mechanism to connect the projects to the wider international organisation and policy ecosystem, using its channels to amplify the efficacy, reach, and impact of the work conducted, and tools delivered.

### Synergies with CARMINE

- MedEWSa shares critical parallels with CARMINE. Both projects emphasise the development of **decision support systems (DSS)** to reduce vulnerability to climate-related hazards. Key areas of alignment include:
- **Urban Resilience Focus:** MedEWSa's scope includes creating early warning systems for flash floods, heatwaves, and other natural hazards in Mediterranean cities. CARMINE adapts similar methodologies, such as the development of Decision Support Systems, to focus on metropolitan regions across Europe, particularly through its Living Labs.
- **Technology-Driven Solutions:** Both projects emphasise leveraging digital tools to enhance risk assessment and decision-making. MedEWSa's DSS integrates meteorological, hydrological, and environmental data to deliver localised and actionable multi-hazard and cascading effects early warnings. This approach complements CARMINE's IDSS, which also integrates multi-hazard risk assessments tailored to urban contexts.
- **Inclusive Strategies:** MedEWSa prioritises equitable access to early warnings, targeting vulnerable populations and under-resourced regions, especially in Africa. This commitment mirrors CARMINE's emphasis on ensuring that urban resilience solutions are co-created with local stakeholders, particularly those in high-risk or marginalised areas.

### 4.13 Adaptation AGORA

The Adaptation AGORA<sup>27</sup> (A Gathering place to co-design and co-create Adaptation) project has the main ambition to promote societal transformational processes in different social, economic and political contexts across Europe through transdisciplinary tools and approaches. AGORA will promote democracy, climate justice, gender equality, equity, and foster adaptive capacity and citizens' empowerment to pro-actively support decision-making processes. AGORA aims to develop a collaborative platform on which citizens, scientists, and a wide range of stakeholders can co-design and implement climate adaptation strategies. By fostering community engagement and leveraging digital tools, AGORA aims to build a just and inclusive climate-resilient Europe through participatory approaches.

### Synergies with CARMINE

- **Community Engagement:** Adaptation AGORA's emphasis on participatory processes aligns with CARMINE's objective to involve local communities in climate adaptation planning. Insights from Adaptation AGORA's pilot studies can inform CARMINE's Living Labs, enhancing stakeholder involvement.

<sup>27</sup> Project website: <https://adaptationagora.eu/>

- **Digital Tools:** Adaptation AGORA's development of digital platforms for knowledge sharing complements CARMINE's IDSS. Connecting these tools can provide comprehensive resources for urban resilience planning.
- **Policy Integration:** Adaptation AGORA's work in co-developing policy frameworks offers valuable lessons for CARMINE's efforts to improve synergies and complementarities among urban, regional and national policies.

### Collaborative Potential

In 2025 CARMINE will seek to explore a collaboration with Adaptation AGORA by sharing methodologies for stakeholder engagement and co-creation processes. Potentially, future joint workshops and knowledge exchange sessions can facilitate the integration of Adaptation AGORA's participatory approaches into CARMINE's urban resilience initiatives, ensuring that adaptation strategies are both community-driven and scientifically sound.

## 4.14 HARMONIA

The HARMONIA<sup>28</sup> (Development of a Support System for Improved Resilience and Sustainable Urban Areas to Cope with Climate Change and Extreme Events Based on GEOSS and Advanced Modelling Tools) project aims to enhance urban resilience against climate change by integrating existing tools, services, and technologies into an Integrated Resilience Assessment Platform (IRAP), designed to enable stakeholders to visualise and understand climate change impacts, thereby improving cities' preparedness for events like floods and dust storms. It uses four different EU city pilots.

### Synergies with CARMINE

- **Decision Support Systems:** HARMONIA's IRAP offers decision support tools for urban planning and health risk assessments, in a similar vein to CARMINE's planned IDSS. Integrating these tools and lessons learned as CARMINE develops its IDSS can help ensure comprehensive resources for metropolitan policymakers to develop effective adaptation strategies.
- **Stakeholder Engagement:** HARMONIA's collaboration with pilot cities like Milan, Piraeus, Sofia, and Ixelles demonstrates effective stakeholder involvement. CARMINE can leverage these experiences to enhance its own community engagement initiatives across its CSAs and Living Labs.

### Collaborative Potential

As HARMONIA concludes, CARMINE can build upon its outcomes by learning from the IRAP platform as a 'sibling' decision support tool. Joint efforts in data sharing, tool development, and stakeholder engagement can lead to more robust urban resilience frameworks across Europe.

<sup>28</sup> Project website: <https://harmonia-project.eu/>

## 5. SYNERGIES WITH UNESCO PROJECTS – UN ENTITIES AND POLICY IMPACT

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### 5.1 Synergies with UNESCO-Partnered Projects

UNESCO's membership of consortia delivering projects such as **NBSINFRA** and **ALBATROSS** aligns with CARMINE's Objective #3, which emphasises the development of NbS for metropolitan resilience.

- **NBSINFRA** focuses on integrating NbS into urban infrastructure protection, an approach that complements CARMINE's initiatives in pilot cities such as Barcelona. By leveraging methodologies from NBSINFRA, CARMINE can enhance its frameworks for designing green infrastructure that mitigates urban heat and flood risks.
- **ALBATROSS** advances NbS strategies with a focus on scalability and digital twin integration, mirroring CARMINE's efforts to use data-driven tools for urban climate modelling.

UNESCO's focus on cultural heritage and community resilience in projects such as **RESILIAGE** is well aligned with CARMINE's Living Lab approach. RESILIAGE's community-driven approaches can enrich CARMINE's stakeholder engagement practices, particularly in addressing socio-cultural dimensions of climate adaptation.

- Joint efforts could be structured to explore how climate change impacts on cultural heritage can serve as a catalyst for building community resilience, expanding the scope of adaptation strategies to include intangible assets like identity or social cohesion, even at a metropolitan scale.

In projects such as **SYNERGIES**, UNESCO fosters innovative preparedness tools for disaster risk reduction. CARMINE could seek to integrate or learn from these tools in its IDSS to improve resilience in its targeted urban areas.

- SYNERGIES' cross-project collaboration model aligns with CARMINE's multi-stakeholder approach, creating opportunities for shared workshops and knowledge exchange on disaster resilience strategies.

UNESCO's involvement in **ALBATROSS** underscores the potential of digital twin technologies for climate adaptation. This complements CARMINE's work in developing digital twins for metropolitan resilience, offering opportunities to co-develop methodologies for modelling NbS impacts and testing scenarios in urban contexts.

UNESCO's broader focus on education and capacity building (at a global scale) can support CARMINE's efforts to train stakeholders in make use of the IDSS or implementing NbS strategies and techniques in Living Labs. Collaborative capacity-building initiatives could help ensure that local governments and communities are equipped with the skills and knowledge necessary for effective adaptation planning.

## 5.2 Opportunities for Collaboration

- **Joint Workshops and Events:** Hosting co-branded events to share progress, tools, and methodologies related to NbS, community resilience, and digital twin integration.
- **Co-Development of Tools:** Collaborating on frameworks that integrate cultural and natural assets into urban resilience planning.
- **Data Sharing:** Leveraging UNESCO's networks and resources to enrich CARMINE's IDSS and DTs, particularly by incorporating learnings from UNESCO's expertise in urban cultural heritage and NbS implementation.
- **Scalability and Transferability:** Developing joint case studies or guidelines for scaling NbS solutions across diverse urban contexts, drawing on the successes of both CARMINE and UNESCO projects.

The synergies between CARMINE and UNESCO-partnered projects such as NBSINFRA, RESILIAGE, SYNERGIES, and ALBATROSS are further enhanced by the broader influence and convening power of UN system entities. These partnerships contribute not only to the scientific and policy outputs of EU Horizon-funded projects but also to their ability to inform and shape international and country-level policy frameworks beyond Europe. This alignment is particularly critical in addressing urban resilience to climate change and will be progressed by direct discussion between CARMINE and these projects, introduced and mediated by the existing relationships between SDSN and WMO Science and Innovation (WP7 and T7.3 leaders respectively) and UNESCO's Natural Sciences division.

## 5.3 Expanding International and Country-Level Policy Impacts

The involvement of WMO, UNESCO and other UN agencies in Horizon projects provides a strategic channel for connecting local and regional research outputs to global policy objectives and international diplomacy efforts. For example, UNESCO's expertise in leveraging cultural and natural heritage for resilience aligns with global frameworks like the United Nations Framework Convention on Climate Change (UNFCCC) and the Sendai Framework for Disaster Risk Reduction<sup>29</sup>. Through its partnerships in NbS-focused projects, UNESCO bridges the gap between academic research and practical implementation, ensuring that findings and innovations contribute directly to shaping policies at the international, national, and municipal levels. For example:

- **Urban Resilience to Climate Risks:** Projects such as NBSINFRA and ALBATROSS can inform guidelines on NbS implementation in urban contexts, feeding into country-level adaptation plans under the Paris Agreement's Nationally Determined Contributions (NDCs).
- **Cultural Asset Preservation:** RESILIAGE's focus on integrating cultural heritage into resilience planning resonates with UNESCO's work in protecting cultural assets from climate impacts, offering tools and methodologies that can be adopted in municipal climate adaptation strategies globally.

<sup>29</sup> Sendai Framework – [https://unfccc.int/sites/default/files/resource/UNDRR\\_Presentation\\_Sendai\\_Framework-GGA6\\_%281%29.pdf](https://unfccc.int/sites/default/files/resource/UNDRR_Presentation_Sendai_Framework-GGA6_%281%29.pdf)

- **Data-Driven Decision-Making:** By collaborating with CARMINE on integrating digital twin technologies, UNESCO can support the translation of high-resolution climate models into actionable insights for urban policymakers.

#### 5.4 Influence on Urban Climate Adaptation Priorities

UNESCO's direct involvement ensures that resilience-building efforts driven by Horizon Work Programmes are not only technologically robust but also inclusive of social, cultural, and equity dimensions. This holistic approach is also espoused by WMO's focus on equitable approaches to mitigation and adaptation to anthropogenic climate change and enhances the relevance of projects like CARMINE to urban areas where the intersections of climate change, infrastructure vulnerability, and socio-economic inequality are most pronounced. The collaborative frameworks fostered by UN system entities can drive and facilitate several valuable outcomes:

- **Policy Coherence:** Aligning EU project outputs with international frameworks strengthens policy coherence, ensuring that urban adaptation strategies contribute to the broader goals of the Sustainable Development Agenda even beyond Europe.
- **Scalability and Transferability:** WMO and UNESCO's global reach, driven (for example) by WMO's network of national Permanent Representatives, enables the scaling of successful NbS and resilience infrastructure strategies from EU cities to comparable urban contexts worldwide, particularly in vulnerable regions.
- **Stakeholder Engagement:** The credibility and convening power of UN entities attract diverse stakeholders, including national governments, municipalities, and civil society, fostering a more inclusive and collaborative approach to urban resilience.

Through its collaboration with UNESCO and other UN system entities (mediated by WMO), CARMINE can expand the reach and impact of its research, contributing to the global dialogue on urban resilience to climate change. By addressing policy gaps in urban heat health, air quality, flooding, resilient infrastructure, and cultural asset protection, these synergies amplify the capacity of EU-funded projects to deliver transformative outcomes. This integration of scientific excellence, policy relevance, and community engagement positions CARMINE as a vital contributor to sustainable urban development in the face of a changing climate.

## 6. ENGAGEMENT WITH GLOBAL INITIATIVES

CARMINE's synergies extend beyond Europe, leveraging connections with global initiatives to strengthen its methodologies and enhance its contributions to urban climate resilience. By aligning with global frameworks such as the UN's Early Warnings for All initiative and international agreements brokered by UNFCCC, CARMINE can ensure its outputs are applicable on all scales, well beyond its case study areas and Europe, into metropolitan regions elsewhere. By 2050, the UN predicts<sup>30</sup> that over two-thirds of the world's population will live in urban areas, making CARMINE's outputs of global value and significance.

### 6.1. UN Early Warnings for All Initiative

The UN's Early Warnings for All (EW4All) initiative<sup>31</sup> seeks to ensure universal access to effective early warning systems (EWS) by 2027. Its focus on multi-hazard early warnings, equity, and actionable dissemination directly aligns with CARMINE's objectives of creating urban resilience frameworks that are inclusive, and data driven. Within Early Warnings for All, CARMINE partner WMO leads on Pillar 2<sup>32</sup> (Detection, observation, monitoring, analysis, and forecasting), components of which will be used in the development of CARMINE products (DTs, IDSS). WMO's role in CARMINE WP7, and the activities to be conducted in WP7, will ensure that CARMINE can support and inform the attainment of Early Warnings for All.

WMO will play a key role in fostering collaboration between CARMINE and EW4All. Key synergies include:

1. Sharing best practices in multi-hazard risk assessment and scenario modelling.
2. Co-developing frameworks for integrating DSS outputs into urban planning processes.
3. early warning efforts with urban adaptation strategies.

### 6.2. Collaboration with UNFCCC and International Frameworks

The most recently submitted Nationally Determined Contribution (NDC) of the EU<sup>33</sup> reflects the bloc's ambitions around climate mitigation and adaptation (M&A).

This target is to be achieved through the 'Fit for 55'<sup>34</sup> legislative package, a comprehensive set of policies aimed at overhauling various sectors, including energy, transport, and industry. Key measures include strengthening the EU Emissions Trading System (EU ETS) to further limit emissions from power generation and industry, setting more stringent CO<sub>2</sub> emission

<sup>30</sup> World population trends according to the UN: <https://www.un.org/uk/desa/68-world-population-projected-live-urban-areas-2050-says-un>

<sup>31</sup> EW4All website: <https://www.un.org/en/climatechange/early-warnings-for-all>

<sup>32</sup> Early Warnings for All – Pillars – <https://wmo.int/activities/early-warnings-all/wmo-and-early-warnings-all-initiative>

<sup>33</sup> EU NDC – <https://www.consilium.europa.eu/en/press/press-releases/2023/10/16/paris-agreement-council-submits-updated-ndc-on-behalf-of-eu-and-member-states/>

<sup>34</sup> Fit for 55 – [https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/delivering-european-green-deal/fit-55-delivering-proposals\\_en](https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/delivering-european-green-deal/fit-55-delivering-proposals_en)

standards for vehicles and transition to electric mobility, and promoting renewable energy and energy efficiency improvements (both for industry and domestic dwellings).

With an emphasis on leveraging insights from this NDC, CARMINE can bridge the gap between urban resilience at merely local or metropolitan levels and climate adaptation strategies at national and international scales. This integration ensures that CARMINE's methodologies are scalable, impactful, and aligned with global climate goals.

### 6.3. Alignment with UN SDGs

The United Nations' Sustainable Development Goals (SDGs)<sup>35</sup> offer a universal framework for addressing critical global challenges, including climate change, urbanisation, and socio-economic inequalities. CARMINE, through its focus on urban resilience and use of impact-based decision-support systems, can contribute directly to several SDGs, notably SDG 13 on Climate Action<sup>36</sup>, for which WMO is a co-custodian. In addition, CARMINE WP7 is led by the UN Sustainable Development Solutions Network (SDSN), established in 2012 to mobilise universities, think tanks, and national laboratories worldwide for action on the Sustainable Development Goals (SDGs) and the Paris Agreement. With a network of over 2,000 member institutions, SDSN convenes key events such as the annual International Conference on Sustainable Development (ICSD). SDSN is also active in major international fora, including the UN General Assembly and COPs, where it hosts several side events. CARMINE is expected to contribute to the ICSD (discussions for participation in 2025 are currently underway), while also exploring opportunities to engage in the other events (such as, a side event to the UN High-Level Political Forum (HLPF)). Additionally, SDSN produces the Europe Sustainable Development Report (ESDR)<sup>37</sup> annually, which provides an in-depth analysis of the EU's progress towards achieving the SDGs – highlighting successes, challenges, and actionable solutions. SDSN (as CARMINE WP7 lead) intends to incorporate CARMINE into events surrounding the launch of the ESDR, further showcasing its contributions to sustainable development.

#### Relevance of CARMINE to SDG 13: Climate Action

SDG 13 emphasises strengthening resilience and adaptive capacity to climate-related hazards, integrating climate policies into national frameworks, and improving education and awareness. CARMINE's alignment with SDG 13 includes:

- **Building Adaptive Capacity:** The IDSS being developed under CARMINE empowers urban planners and decision-makers with tools to simulate climate risks and design context-specific adaptation strategies.
- **Urban Modelling:** CARMINE integrates detailed modelling for urban hazards such as heatwaves, air quality, and flooding, contributing to global targets under SDG 13.1 to reduce vulnerability to climate-related disasters and supporting WMO's role in the UN Early Warnings for All Initiative.

<sup>35</sup> SDGs homepage – <https://sdgs.un.org/goals>

<sup>36</sup> SDG 13 details – <https://sdgs.un.org/goals/goal13>

<sup>37</sup> Sustainable Development Report: <https://sdgtransformationcenter.org/reports/europe-sustainable-development-report-2023-24>

- **Policy Integration:** By aligning its methodologies with National Adaptation Plans (NAPs) and EU frameworks, CARMINE supports SDG 13.2, which calls for the integration of climate measures into policy and planning.

### Connections to Other SDGs

While SDG 13 is the keystone for CARMINE's climate resilience objectives, the project also intersects with other SDGs due to its focus on sustainable urban development. Key connections include:

#### SDG 11: Sustainable Cities and Communities

- **Urban Resilience:** CARMINE's Living Labs address challenges like urban flooding, heat stress, and air quality, contributing to SDG 11.5, which targets disaster risk reduction in cities.
- **Inclusive and Green Urban Spaces:** The promotion of nature-based solutions (NbS) aligns with SDG 11.7, which advocates for safe, inclusive, and accessible green spaces in urban areas.

#### SDG 6: Clean Water and Sanitation

- **Water Management:** CARMINE's methodologies for managing urban flooding and integrating water-sensitive design contribute to SDG 6.5 on implementing integrated water resource management.
- **Urban Water Quality:** By addressing runoff and pollution control in urban areas, CARMINE supports SDG 6.3, focusing on improving water quality.

#### SDG 3: Good Health and Well-Being

- **Heat and Air Quality:** Urban heatwaves, air pollution and wildfire smoke are major threats to public health, as are water and soil pollution and contamination from floods and wildfire disasters. CARMINE's IDSS incorporates these risks, addressing SDG 3.9, which targets reducing deaths and illnesses from environmental hazards.
- **Community Resilience:** Engaging stakeholders in co-designing solutions fosters community resilience, indirectly supporting SDG 3.D, which emphasises health risk management, early warnings, and risk reduction.

#### SDG 9: Industry, Innovation, and Infrastructure

- **Innovative Urban Infrastructure:** CARMINE promotes smart, climate-resilient urban infrastructure, contributing to SDG 9.4, which focuses on upgrading infrastructure for sustainability and resilience.
- **Decision-Support Tools:** CARMINE's IDSS exemplifies technological innovation, aligning with SDG 9.5 on enhancing research and innovation.

#### SDG 1: End Poverty

- **Reducing Vulnerability:** By providing tools and strategies for adapting to climate change, CARMINE helps to reduce the vulnerability of economically disadvantaged urban populations to extreme events.

## Cross-Cutting Impacts

CARMINE's participatory approach ensures that its outputs are socially inclusive, addressing equity and justice dimensions inherent in the SDGs. This aligns with:

- **SDG 10:** Reduced Inequalities through ensuring vulnerable urban populations are prioritised in climate adaptation strategies.
- **SDG 12:** Responsible Consumption and Production by advocating for resource-efficient urban designs and NbS that enhance ecosystem services.

## Future Opportunities for Alignment with SDGs

As the project evolves, future CARMINE activities could consider to:

- **Broaden Stakeholder Engagement:** Collaborate with international urban networks and UN system entities to amplify the impacts of urban adaptation measures on SDGs.
- **Quantify Impacts:** Develop metrics within the IDSS to measure progress against specific SDG targets, such as reductions in urban heat-related mortality (SDG 3.9) or increased access to green spaces (SDG 11.7).

### 6.4. NASA-JPL: multi-hazard complexity

CARMINE's urban resilience initiatives, particularly the development of digital twins (WP4) and the Impact based Decision Support Service (IDSS) (WP5), align strongly with cutting-edge research led by NASA's Jet Propulsion Laboratory (JPL). Recent insights from NASA-JPL's focus on multi-hazard complexity, presented at the December 2024 AGU session "**Resilience Through Complexity: Unravelling Multi-Hazard Complexity with Network Analysis and AI**", highlight innovative methodologies with clear synergies for CARMINE's objectives. This connection underscores the potential for leveraging JPL's advanced expertise in Earth system science, network analysis, and AI to strengthen CARMINE's contributions to urban climate adaptation and has been explored in a series of virtual discussions between WMO and NASA.

A possible future collaboration in which NASA-JPL's work informs the development of CARMINE's IDSS also aligns with international resilience frameworks, such as the **Sendai Framework for Disaster Risk Reduction** and the **EU Mission on Climate Adaptation**, ensuring that its outputs contribute to both European and global adaptation priorities.

## 7. SCOPE: FUTURE VERSIONS OF THIS DELIVERABLE

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As the CARMINE project progresses through its four year timeline, subsequent annual versions of this deliverable will reflect the evolution of collaborations, refined methodologies, and enhanced insights derived from ongoing activities. This section outlines the planned additions and updates for future iterations, which will be published annually in M24, M36, and M48 (at the end of January 2026, 2027, and 2028 respectively). To date, not all the networking opportunities identified (for example, in table 2.3 of D7.1) have yet been addressed.

### 7.1. Progress on Collaborations and Networking Activities

Future deliverables will document ongoing, planned and newly emerging collaborations, highlighting their contributions to CARMINE's objectives and methodologies. Key areas of focus are expected to include:

- **Active EU R&I Projects:** Engagement with projects such as CLIMAAX, ICARIA, RISKADAPT, MIRACA, NBSINFRA, and RESILIAGE will continue and will be tracked, with a focus on their inputs to the CARMINE IDSS. Specific outputs, such as co-developed tools or shared datasets, will be showcased.
- **Emerging Collaborations:** Partnerships with Pathways2Resilience, Pro-Climate, and CLIMAAX will be developed using a variety of mechanisms. Activities will include participation in knowledge-sharing platforms or opportunities to amplify existing CARMINE activities, such as the Pathways2Resilience spring 2025 call, involvement of CARMINE in Communities of Practice from other projects, and the co-creation of participatory governance frameworks inspired by Pro-Climate's methodologies.
- **Global Initiatives:** Collaboration with **Horizon-funded projects** like MedEWSa, and the UN Early Warnings for All Initiative, will continue to focus on aligning methodologies, particularly around ensuring the capture of state-of-the-art knowledge and best practice around decision support systems **to support** urban resilience goals.

### 7.2. Results from IDSS Deployment in Living Labs

As the IDSS is deployed across the eight CARMINE Living Labs, future iterations of this report will support the evaluation in several ways and cross-referencing with merging results from 'followed' projects:

- **Case-Specific Applications:** Insights from the IDSS implementation in diverse urban contexts will be documented, highlighting adaptations made to address local needs.
- **Stakeholder Engagement and Feedback:** Refinements to the IDSS based on input from local authorities, community groups, and technical experts will be presented.
- **Scalability and Cross-Lab Insights:** Comparative analyses of IDSS performance across different cities will inform its potential for broader application beyond the LLs.

### 7.3. Lessons Learned and Scaling Adaptation Strategies

Future reports will build on the existing and planned interactions with other Horizon funded R&I projects documented in this first iteration of the deliverable, and other sources (such as the EEA) to ensure that all relevant knowledge is captured and incorporated into CARMINE's tools, and explore:

- **Replication in New Urban Contexts:** Challenges and successes in extending CARMINE's adaptation strategies to non-Living Lab cities.
- **Comparative Effectiveness of NbS and Participatory Approaches:** Analyses of diverse urban settings will provide insights into the scalability of solutions like nature-based systems (NbS) and early warning frameworks.
- **Best Practices for Knowledge Transfer:** Lessons learned will inform guidelines for disseminating CARMINE outputs to cities outside the project scope.

### 7.4. Addressing Outstanding Actions

The Grant Agreement outlined several ambitious networking and collaboration activities that remain partially implemented as of M12 (January 2025). These include:

- **Workshops and Knowledge Exchange:** No joint workshops have yet been conducted with partner projects, although initial exploratory discussions have been undertaken. In January 2025, for example, CARMINE will take part in the CLIMAAX project webstival, and later in 2025 CARMINE's Living Labs regions will apply to join the PATHWAYS2RESILIENCE programme.
- **Engagement with Standardisation Bodies:** Partnerships with CEN, OGC, and other standardisation committees need to be formalised to align CARMINE's digital twin and IDSS outputs with international standards. However, CARMINE is engaged with the ITU Global Initiative on Resilience to Natural Hazards through AI Solutions, which offers an avenue for CARMINE to engage with the standardisations community.
- **Global Visibility and Advocacy:** While CARMINE has not yet presented findings at events like the UN's Sustainable Development Solutions Network annual International Conference on Sustainable Development (ICSD), given the abstract submission deadline in the first months of the project as well as revised format of the 2024 edition, plans are being developed to ensure participation in these and other prominent platforms.
- **Platform Integration:** Links with thematic platforms like the Climate-Adapt Platform, Smart City Marketplace, and Network Nature are still in the early stages and will require strategic focus in the coming years.

### 7.5. Roadmap for Future Actions

To address outstanding tasks and maximise CARMINE's impact, several possible activities could be planned:

#### 1. Workshops and Events (2025–2027):

- a. **2025: arrange and conduct in depth meeting with parallel R&I** projects like Pathways2Resilience and Pro-Climate to explore shared tools and methodologies, convene joint session at ECCA 2025 with parallel projects.
  - b. **2026: Collaborate with DestinE to ensure integration of CARMINE DT findings into broader frameworks.**
2. **Standardisation and Technical Liaison (2025):**
- a. Establish liaisons with standardisation bodies, perhaps mediated through the ITU Global Resilience Initiative.
  - b. Continue to explore with ITU how CARMINE's tools could support evolving European and international standards around climate resilience, and adaptation and mitigation.
3. **Enhanced Global Visibility (2025–2027):**
- a. Leverage partnerships with CARMINE consortium members SDSN and WMO to showcase CARMINE findings at high-profile international events, including ICSD in September 2025 and subsequent annual conferences.
  - b. Align CARMINE project milestones with, and contribute to, major annual events like the Europe Sustainable Development Report.
4. **Engagement with Thematic Platforms (2025–2026):**
- a. Strengthen connections with the Climate-Adapt Platform and Smart City Marketplace to share datasets and tools.
  - b. Collaborate with NetworkNature(PLUS) and Living-in.EU to promote CARMINE outputs through their events and resources.

## 8. DISCUSSION

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### 8.1. Challenges in Aligning Multiple Stakeholders

The success of CARMINE is dependent in part on its ability to foster synergies among a diverse range of stakeholders, including past and current EU R&I projects, global initiatives, local governments, and community actors. However, aligning these varied stakeholders presents several challenges, including governance fragmentation, competing priorities, and disparities in technical capacity.

This subsection acts as a complement to an existing CARMINE deliverable (D1.1, ‘Target Groups (Stakeholders) Engagement Strategy’<sup>38</sup>) and examines these challenges to outline how CARMINE WP7 and T7.3, supported by the unique leverage of SDSN and WMO, can address them to maximise impact.

**Fragmented Governance Frameworks:** Many of the stakeholders engaged in CARMINE operate under distinct and discrete governance systems, including regional, national, and municipal structures. This fragmentation complicates efforts to align methodologies, share data, and implement solutions coherently. For example, differences in climate adaptation priorities between local governments in the Living Labs, such as Bologna’s focus on heat resilience versus Odense’s emphasis on flood management, can impede the development of standardised tools that are applicable across different metropolitan regions not *a/ways* subject to the same climate hazards.

**Competing Priorities Among Stakeholders:** Stakeholders often prioritise their own objectives, which can conflict with the collective goals of CARMINE. Academic partners may focus on advancing research outcomes; Local governments may prioritise immediate, ‘easy-win’ cost-effective solutions over more expensive long-term resilience investments; EU-level projects may aim for broad brush scalability, potentially sidelining local contexts.

**Disparities in Technical and Financial Capacity:** Some stakeholders, particularly municipalities in less-resourced regions, lack the technical infrastructure or financial resources needed to effectively contribute to or implement CARMINE outputs. Smaller cities in Romania or Greece may struggle to integrate advanced decision support services or systems like the IDSS due to limited staffing or technological expertise. However, by working together with the PATHWAYS2RESILIENCE project (which can support such metro regions with grant funding), CARMINE may be able to support these locations.

**Lack of Unified Communication Channels:** Engaging diverse stakeholder groups requires clear, consistent communication channels to share progress, collect feedback, and ensure alignment. Without these, duplication of efforts can arise, undermining collaboration.

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<sup>38</sup> CARMINE DEC Strategy deliverable: [https://carmine-project.eu/wordpress/wp-content/uploads/2024/11/CARMINE\\_-D1.1-Target-groups-stakeholders-engagement-strategy-v01\\_31072024\\_ATH-RC.pdf](https://carmine-project.eu/wordpress/wp-content/uploads/2024/11/CARMINE_-D1.1-Target-groups-stakeholders-engagement-strategy-v01_31072024_ATH-RC.pdf)

## 8.2. Actionable Solutions

Several strategies can be used under the umbrella of CARMINE WP7 (and T7.3 specifically) to address the challenges in aligning stakeholders:

**Facilitating Coherent Governance Integration:** SDSN, WMO and other T7.3 partners can act as a bridge between regional, national, and municipal stakeholders. For example, WMO can leverage its relationships with its national Permanent Representatives to advocate for national-level alignment with CARMINE objectives, ensuring consistency in methodologies and tools, and through dialogue at its Regional Climate Forums and Scientific Forums, where representatives can discuss harmonised approaches tailored to CARMINE's goals. SDSN can ensure that CARMINE's IDSS and DTs are well aligned with the broader sustainable development community's goals and targets. It can also leverage its unique access to high-level political fora and solicit the support of renowned experts to amplify CARMINE's objectives and fuel debates and discussions with insights and results from CARMINE.

**Addressing Capacity Disparities:** WMO's expertise in capacity building can help mitigate technical and financial disparities by organising trainings for local government officials and national hydromet services staff to enhance their ability to integrate IDSS tools into decision-making processes. Providing technical assistance to under-resourced Living Labs, leveraging WMO's Regional Office for Europe to connect local stakeholders with regional experts and resources will also support a wide take-up of the CARMINE IDSS, as would targeted climate finance through global initiatives, such as the Green Climate Fund, to support the deployment of CARMINE solutions in lower-capacity regions.

**Streamlining Communication and Engagement:** Led by SDSN, all WP7 (and other) CARMINE partners can help establish and maintain clear communication channels across CARMINE stakeholders by drawing on their own internal DEC strategies and tools, for example by WMO using its existing communication networks, including the WMO Community Platform, to disseminate CARMINE findings widely among NMHSs and policymakers. SDSN draws on its decade-long experience in engaging with a diverse range of stakeholders and crafting tailored messages and communications designed to serve as a common language, resonating with all stakeholders and fostering understanding and collaboration.

**Anticipated Outcomes:** By leveraging WMO's strengths and implementing these solutions, CARMINE can deliver greater stakeholder alignment, ensuring that its IDSS and other outputs are relevant, actionable, and scalable across diverse urban contexts. It can also strengthen stakeholder capacity to implement cutting-edge tools and methodologies, bridging the gap between innovation and application, as well as enhance communication and knowledge-sharing, fostering a collaborative environment that supports long-term urban resilience.

Aligning multiple stakeholders (not least given the number of beneficiaries in CARMINE) is a complex but critical task. WMO's role as an international convener and technical advisor provides a strategic advantage in addressing these challenges. By advocating for governance coherence, promoting capacity building, and ensuring clear communication, WMO can enable CARMINE to achieve meaningful, measurable impacts on urban resilience across Europe.

### 8.3. Opportunities for Scaling CARMINE Outputs

CARMINE offers significant potential for scaling its methodologies and tools to urban contexts across Europe and beyond. The IDSS and Living Lab approaches are central to this scalability, providing transferable frameworks that can be adapted to diverse socio-economic and climatic conditions. This section outlines the opportunities for scaling CARMINE's outputs, leveraging WMO's global network and strategic partnerships to enhance impact.

One core mechanism through which CARMINE can ensure metropolitan regions outside its remit can benefit from the IDSS and DT tools is by engaging with the EU Scalable Cities Programme<sup>39</sup> and the Scalable Cities Marketplace. Scalable Cities is an initiative of the European Commission to create an innovative, sustainable and city-led community of smart and climate-neutral cities in Europe. Several of the CARMINE Living Labs/Case Study Areas are already designated as scalable cities: Bologna, Prague, and Leipzig. Smaller cities adjacent to both Barcelona and Athens are also designated. By participating in discussions or focus groups<sup>40</sup>, CARMINE can ensure as wide a dissemination as possible of its tools.

#### 8.3.1. Enhancing Regional and National Implementation

CARMINE's outputs, such as the IDSS and participatory planning frameworks, will be adaptable to varying governance structures, environmental challenges, and local capacities. Opportunities for regional and national scaling include integration into national climate strategies in CSA countries; by aligning the IDSS with National Adaptation Plans (NAPs) and urban climate action strategies, CARMINE can support long-term resilience planning at the national level. For example, WMO's engagement with its Permanent Representatives (PRs) can help advocate for IDSS adoption in CARMINE countries. Lessons learned from Living Labs can be applied to cities with similar vulnerabilities and support widespread replication.

#### 8.3.2. Expanding Geographic Reach

The CARMINE's IDSS is well-suited for deployment in urban contexts beyond the current Living Labs and CSAs. CARMINE can expand its reach and implementation of its IDSS to cities in low-capacity regions of Europe, supported by WMO's technical assistance, advocacy, and Regional Office for Europe networks, as well as the Climate-Adapt platform. WMO's network of Permanent Representatives could play a critical role in mobilising financial and technical resources, advocating for prioritisation of urban resilience initiatives.

Applications to climate finance mechanisms such as the Adaptation Fund, the Green Climate Fund (GCF), or the European Union's LIFE Programme may secure funding to support IDSS deployment and capacity building in smaller or under-resourced cities. The parallel PATHWAYS2RESILIENCE project (also currently active and funded under the EC Horizon programme), with its grant funding mechanism, can also act as a similar mechanism (albeit on a smaller scale).

<sup>39</sup> See <https://smart-cities-marketplace.ec.europa.eu/scalable-cities>

<sup>40</sup> <https://smart-cities-marketplace.ec.europa.eu/networked-community/focus-and-discussion-groups>

WMO can collaborate with regional organisations, such as the European Investment Bank (EIB) or the European Regional Development Fund (ERDF), to develop financing packages specifically targeting urban adaptation and resilience projects. Additionally, cross-border collaborations between high-vulnerability regions could attract funding from the EU's Horizon programme, further integrating urban resilience into regional development strategies.

With its global reach, SDSN can support the communication, dissemination, and exploitation of CARMINE's results, solutions, and insights beyond Europe. This provides an opportunity to highlight the project's relevance and contributions to adaptation strategies and plans in other regions facing similar challenges and impacts of climate change. By showcasing the value of CARMINE's approach, tools, and solutions, SDSN can help inspire the initiation of similar projects worldwide. This will leverage lessons learned and best practices from CARMINE, fostering collective intelligence to build resilience and prosperity on a global scale.

### *8.3.3. Promoting Standardisation and Policy Integration*

Scaling CARMINE's outputs requires embedding its methodologies into regional and international policies and standards. By working with EU institutions and WMO's technical networks, CARMINE can support and contribute to standardised metrics for urban climate resilience, facilitating easier adoption by new cities. For example, metrics developed for IDSS outputs, such as urban heat exposure or flood risk indices, could become benchmarks for EU adaptation frameworks like Climate-ADAPT. Such alignment means that the CARMINE IDSS and other tools could be integrated into EU directives, such as the European Green Deal and 'Fit for 55' urban resilience targets, ensuring policy alignment. In parallel, WMO's advocacy within the Regional Office for Europe's Scientific Forum can provide pathways for embedding CARMINE methodologies into regional policies through national meteorological service channels.

### *8.3.4. Boosting CARMINE outputs*

There are several clear pathways to boost the uptake and usage of the CARMINE IDSS. For example, seeking interoperability and compatibility with existing systems in CSAs and other metropolitan regions should lower adoption barriers. Additionally, the collaborations with Destination Earth (DestinE) to be executed in WP4 (Task 4.5 and deliverable D4.6) will enhance the scalability of CARMINE's tools, integrating them into larger-scale simulation platforms.

Through these actions, CARMINE can position its IDSS as a cornerstone tool for urban resilience planning across Europe, contribute to the delivery of the 'Fit for 55' EU programme, and underpin scalable, actionable solutions for urban adaptation in a world where 1.5° is expected to be missed.

Scaling CARMINE's outputs requires a strategic approach that builds on the project's existing synergies and leverages WMO's unparalleled network and expertise. By aligning with national and regional policies, promoting standardisation, and investing in capacity building, CARMINE can deliver transformational impact, extending beyond its current Living Labs to shape the future of urban climate resilience globally.

## 8.4. EC-Led Resilience Dialogues and Stakeholders

The Climate Resilience Dialogue<sup>41</sup>, which culminated in a comprehensive final report<sup>42</sup>, was a key initiative by the European Commission to advance urban resilience and climate adaptation across Europe. The process convened a diverse array of stakeholders, including the Directorate-General for Climate Action (DG CLIMA), the United Nations Office for Disaster Risk Reduction (UNDRR), local and regional authorities, researchers, and private sector actors. While the formal dialogue has concluded, its outputs provide valuable lessons that can inform CARMINE's work over the next three years.

The dialogue highlighted the importance of aligning local, regional, and national adaptation strategies through robust governance frameworks. This is particularly relevant for CARMINE's Living Labs, which aims to co-develop solutions that integrate the needs of diverse stakeholders.

UNDRR, already a key WMO partner through the Early Warnings for All (EW4All) initiative, played a significant role in advocating for cohesive governance structures. CARMINE can leverage this synergy to strengthen policy linkages in its case study areas.

The dialogue emphasised the vital role of private sector actors, including insurers, urban developers, and infrastructure providers, in scaling adaptation solutions. CARMINE's IDSS can be positioned as a valuable tool for these stakeholders, particularly in providing data-driven insights for risk assessment and planning. Companies such as Munich Re, cited in the dialogue report for their innovative climate risk solutions, could be valuable partners in CARMINE's efforts to incorporate risk transfer mechanisms into urban resilience planning.

The report underscored the effectiveness of NbS in addressing urban climate challenges, such as flooding and heat waves. Collaborative opportunities exist with organisations like the European Environment Agency (EEA) – through the Climate Adapt Platform – whose work on NbS closely intersects with CARMINE's objectives, as well as via the NbS focused projects including UNESCO as a partner (outlined in [section 4](#) of this report).

### 8.4.1. Applications to CARMINE

External stakeholders can support CARMINE in several ways. They can help refine the Living Labs by incorporating governance and stakeholder engagement lessons from the dialogue to enhance their participatory methodologies and policy alignment, or by actively involving external private sector actors such as insurers and developers (for example, via CARMINE partner MITIGA) in co-developing solutions. The CARMINE IDSS could be enhanced by embedding dialogue-derived metrics into the IDSS to ensure that its outputs are consistent with EU and global best practices in adaptation monitoring.

<sup>41</sup> See [https://climate.ec.europa.eu/eu-action/adaptation-climate-change/climate-resilience-dialogue\\_en](https://climate.ec.europa.eu/eu-action/adaptation-climate-change/climate-resilience-dialogue_en)

<sup>42</sup> Available at [https://climate.ec.europa.eu/document/download/4df5c2fe-80f9-4ddc-8199-37eee83e04e4\\_en?filename=policy\\_adaptation\\_climate\\_resilience\\_dialogue\\_report\\_en.pdf](https://climate.ec.europa.eu/document/download/4df5c2fe-80f9-4ddc-8199-37eee83e04e4_en?filename=policy_adaptation_climate_resilience_dialogue_report_en.pdf)

Further, strengthened policy integration could be achieved by using insights from the dialogue to ensure that CARMINE's outputs align fully with EU adaptation policies, including the EU Strategy on Adaptation to Climate Change, the Green Deal, and the 'Fit for 55' programme.

WMO's UN partner agency relationship with UNDRR and other dialogue participants could be leveraged to advocate for greater investment in NbS and equitable adaptation planning.

Although the Climate Resilience Dialogue process has concluded, its outputs remain highly relevant for advancing CARMINE's objectives. By integrating these insights into its Living Labs, IDSS development, and stakeholder engagement strategies, CARMINE can ensure its contributions to urban climate adaptation are impactful, equitable, and aligned with EU and global frameworks. This approach not only enhances the project's credibility but also reinforces its role as a catalyst for systemic resilience in metropolitan regions.

Over the remaining years of CARMINE, the project will also engage with the EU Civil Protection Network, attending the annual Civil Protection Forum (held in Brussels in June).

## 9. CONCLUSIONS AND RECOMMENDATIONS

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### 9.1. Collaborative Impact

By the end of its first year of work, the CARMINE project has made some initial steps in fostering synergies and collaborative activities with related EU R&I projects, ESA and global initiatives, with many more activities planned across the remaining project period. Through an interdisciplinary approach and the co-development of innovative solutions, the project addresses the critical need for climate resilience in metropolitan regions of Europe. Leveraging its eight case study areas, CARMINE aims to serve as a nexus for integrating local knowledge with cutting-edge tools, including the Digital Twin simulations and the Impact-Based Decision Support System (IDSS).

The project's alignment with initiatives like Destination Earth and the Horizon funded R&I project MedEWSa underscores its potential to operationalise IDSSs and DTs to underpin urban resilience planning frameworks across Europe. Engagement with the Climate-ADAPT platform and collaboration with the World Meteorological Organization (WMO) have also expanded the project's reach.

### 9.2. Recommendations: Networking and Synergy

To maximise the project's impact, following several strategies should be productive:

**Deepen Integration with Key EU Platforms:** CARMINE should seek to maximise its operational links with the Climate-ADAPT and the Mission on Adaptation to Climate Change Implementation Platform<sup>43</sup>. This will ensure that the project's tools and methodologies are aligned with broader EU adaptation strategies, enhancing uptake and replicability.

**Consider Resource Mobilisation Efforts for post-funding tool lifecycle:** Funding mechanisms such as the European Union's LIFE Programme, the Adaptation Fund, and the Green Climate Fund (GCF) to scale project outputs. These resources could support the follow-on implementation of CARMINE's Digital Twins and IDSS in additional metropolitan regions, ensuring financial sustainability and tool maintenance beyond the project's lifecycle.

**Enhance Knowledge Exchange via the networks of CARMINE WP7:** Led by SDSN (which operates under the auspices of the UN Secretary General) and WMO as a UN specialised agency, CARMINE should leverage these unique advantages available through these global organisations to disseminate CARMINE's findings through (for example) SDSN's activities and national and regional networks, and WMO's Regional Climate Centres, User Forums, and Scientific Forums in Europe and beyond. This will facilitate knowledge sharing among national hydrological and -meteorological services and ensure CARMINE's IDSS and DTs could be utilised globally, to support more vulnerable regions, cities, and communities. The institutional

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<sup>43</sup> Website – <https://climate-adapt.eea.europa.eu/en/mission>

networks of all CARMINE partners (those mandated to act in WP7 and beyond) should be employed to ensure that the reach and availability of CARMINE's IDSS and DTs are widely used and understood.

**Foster Cross-Sectoral Synergies:** Seek to build and maintain stronger connections with parallel and relevant Horizon Europe projects, including those funded by calls from future work programmes. By participating in joint workshops and communities of practice, CARMINE can enhance its methodologies and explore shared solutions for urban resilience.

Contribute to NetworkNature (its current, second phase incarnation is called NetworkNaturePLUS<sup>44</sup>) to maximise the impact and spread of CARMINE's NbS components and ensure that the NbS community is aware of how NbS in a European urban mitigation and adaptation context has been advanced by CARMINE. For example, CARMINE could join a project group or task force<sup>45</sup>.

### 9.3. Alignment: CARMINE Description of Action (DoA)

CARMINE's activity plan over its four-year span reflects its commitment to bridging local and regional adaptation strategies, as agreed with the European Union in its Description of Action (DoA). By prioritising co-creation, participatory design, and nature-based solutions (NbS), CARMINE and its products – the IDSS and DTs for the Living Labs – aim to ensure that by 2028 it has proved itself as a key contributor to science-based, scalable, and impactful urban climate resilience solutions aligned with European and global objectives.

CARMINE actively supports the EU Mission on Adaptation to Climate Change (MACC) and the Climate-ADAPT Platform, by preparing eight metropolitan regions (MREs) to adopt climate-resilient practices and contribute to broader EU adaptation goals. As outlined in the DoA, the project's tools, including its IDSS and Digital Twin simulations, enable stakeholders to model climate risks and prioritise effective adaptation strategies. The project also promotes economic co-benefits, fostering green jobs and attracting investment in sustainable urban infrastructure.

#### 9.3.1. Alignment: EU Policies

CARMINE is strategically aligned with several key EU policy frameworks:

- EU Strategy on Adaptation to Climate Change (SACC): By integrating high-resolution datasets and urban adaptation tools, CARMINE ensures its outputs are policy-relevant and actionable for metropolitan regions.
- European Green Deal and Climate Law: The project's emphasis on NbS and participatory governance advances net-zero emissions by 2050 target and urban resilience.

<sup>44</sup> Website available at <https://networknature.eu>

<sup>45</sup> See [https://networknature.eu/sites/default/files/networknature/documents/NbS\\_Task\\_Forces\\_Welcome\\_Package\\_Updated.pdf](https://networknature.eu/sites/default/files/networknature/documents/NbS_Task_Forces_Welcome_Package_Updated.pdf)

- Zero Pollution Action Plan: CARMINE's methodologies for cleaner urban air, water, and soil align closely with the EU's zero-pollution objectives, creating synergies with broader environmental sustainability goals.
- Numerous EU directives and regulations focused on flood management and NbS, such as the EU Water Framework Directive, the EU Floods Directive, the EU Regulation on Nature Restoration (Nature Restoration Law, 2024), and the proposed EU Water Resilience Initiative.