



CLIMA PROOF

Synthesis Report

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 Austrian
Development
Cooperation

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Introduction

The Western Balkan region is heavily exposed to risks from climate change. Despite having minimally contributed to global greenhouse gas emissions, the region will face disproportionate impacts that threaten human health, livelihoods, security, and the economy – in a region that has historically been wrought with instability in these areas.

Although climate change will yield challenges across many sectors, the negative impacts posed to infrastructure are particularly significant in the Western Balkans. Many infrastructural endeavors in the region were planned without climate considerations, putting them at substantial risk of damages that could threaten people, the economy, and the environment with devastating impacts.

Infrastructure is of utmost importance for climate action and the United Nations Sustainable Development Goals, playing a dual role in both mitigation and adaptation. The UNOPS Infrastructure for Climate Action Report (2021) stated that the sector accounts for 79% of greenhouse gas emissions globally while also making up 88% of the adaptation costs that will be required in the wake of climate impacts. Focusing on infrastructure will help alleviate economic and human suffering, if adapted properly to the challenges at hand.

The project “Enhancing Environmental Performance and Climate Proofing of Infrastructure Investments in the Western Balkan Region from an EU integration perspective” (ClimaProof) strives to help the Western Balkans improve infrastructural resilience. The project focuses on road infrastructure in particular, while also trying to encourage the incorporation of green infrastructure and evidence-based policy development into planning to help adapt to changing climate conditions. The long-term goals of ClimaProof are to help increase awareness of climate-related challenges to infrastructure and strengthen capacities of countries in the region to climate proof investments in infrastructure and incorporate European Union best practices in future planning. Through these efforts, the Western Balkans will become better adapted to what is to come, and will be prepared to withstand the impacts from climate change.

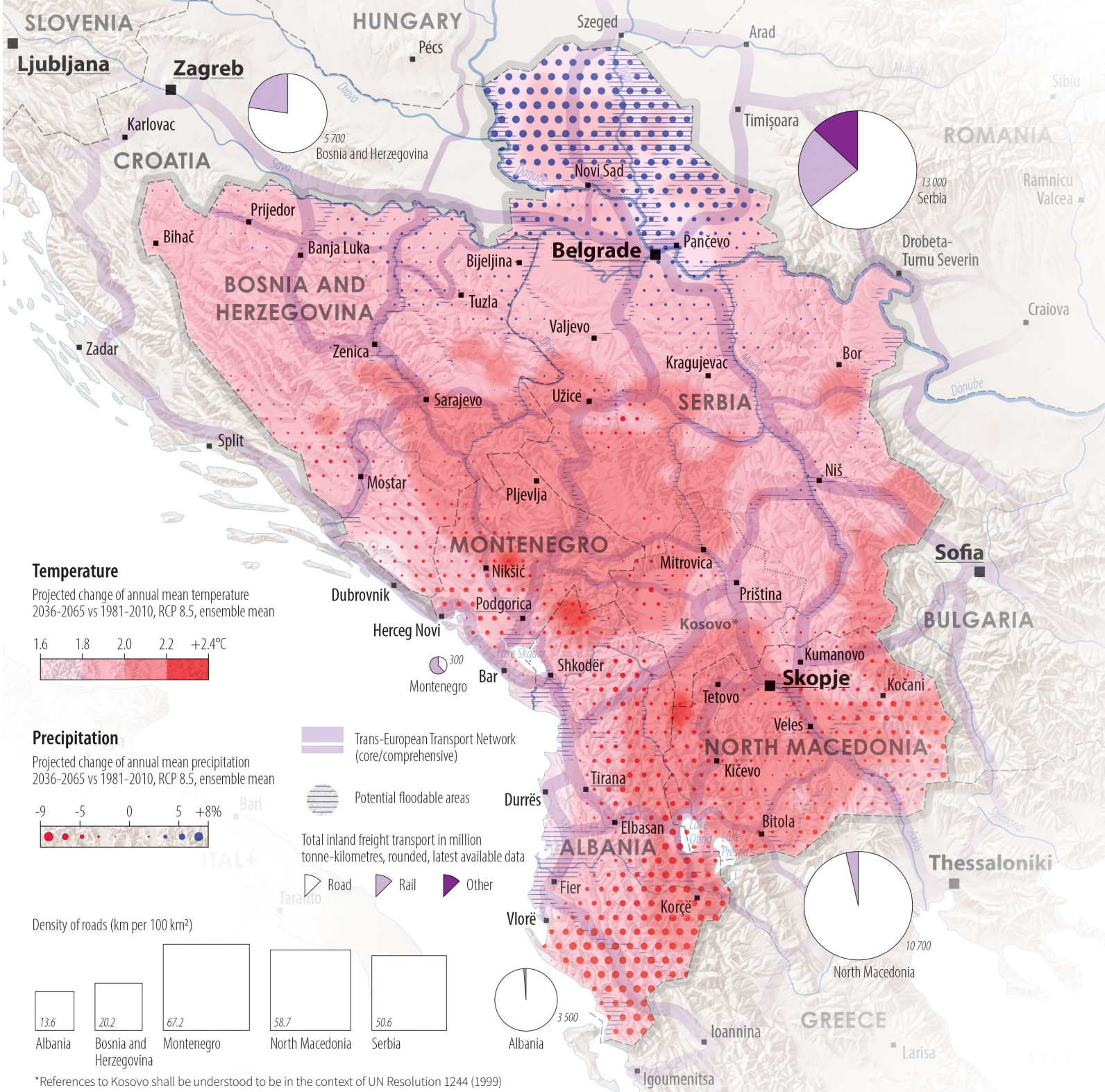
Climate projections and importance

Climate change will bring a multitude of challenges to the Western Balkan region, which permeate different sectors and create threats to the economy, environment, and human health. The region will experience higher temperatures, more intense floods and droughts, and an array of subsequent impacts like forest fires, desertification, and decreased agricultural outputs due to the changing climate. Extreme heatwaves in the region have doubled over the past 20 years, and given the likelihood of further increases, the EU Status of Environment and Climate report has also identified

the development of adaptation plans as a major area of focus for the Western Balkans. Natural hazards like floods have already had devastating impacts on countries in the Western Balkans, such as those that occurred in May 2014 which caused 86 deaths, several billion USD in damages, and compounding hazards, such as the 2,000 landslides associated with them. Climate projections have shown possible scenarios for the region, which help understand the potential risks that will be faced as climate change worsens – and begin to respond to them.



Poorly patched road in Negotin, Serbia. Regional road in Bor district of Serbia.



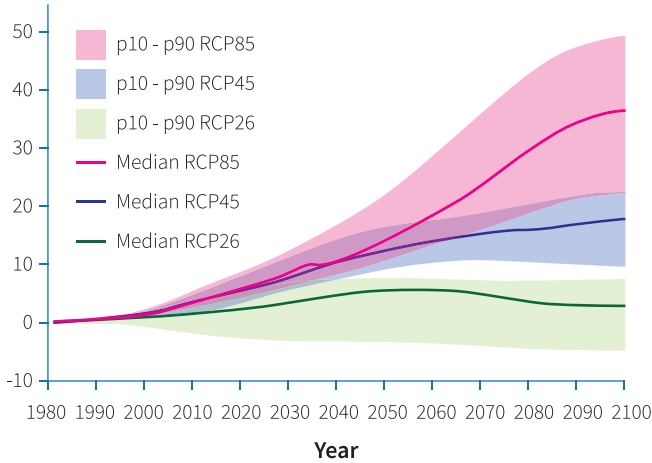
Under ClimaProof, various climate projections have been calculated based on a series of relevant indicators (shown in the table below). The current situation of the indicators in the Western Balkans was examined, in addition to a series of climate-related factors in order to develop climate scenarios that depict what the region is likely to face in coming decades.

Climate indicators developed in the project

INDICATOR NAME	DEFINITION	TIMESTEPS
Droughts	Consecutive 5 and 7-day periods of less than 1mm daily precipitation during April-September (days in periods, maximum period length)	Annual
Droughts & Heat	Days in 5 and 7-day drought periods with exceedance of 30°C daily maximum temperature	Annual
Extreme Wind	Days with exceedance of the 99.9-percentile of daily mean wind speeds of the observation period 1981-2010	Annual
Freeze-Thaw-Cycles	Days with Tmin ≤ 2.2 °C and Tmax ≥ 0°C	Monthly
Heat Days	Days with exceedance of 30°C / 40°C daily maximum temperature	Monthly
Landslides	Days with exceedance of precipitation intensity thresholds after the Moser-Hohensinn approach ($M = 41.66 * (h-0.77) * h$) for h = 24, 48 and 72 hours	Annual
Precipitation intensity	99.9 percentile of daily precipitation sums (3-yearly event)	Annual for 30-year periods
Snowfall	Days with precipitation sums of more than 1mm / 10mm and daily mean temperature <= 0°C	Monthly

Droughts and heat

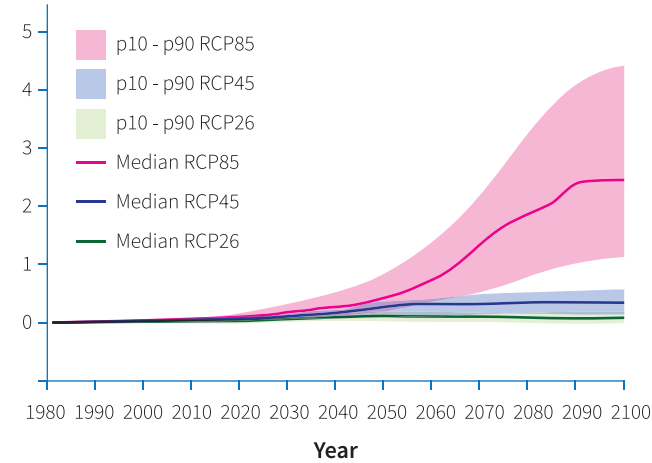
Change in days



One aspect that is highly important is the number of days of droughts and heat. Based on the varying levels of extremity for the scenarios, there is clear indication that these days will increase from the current average of 15.8 across the region. This may be as few as 5 days in the RCP 2.6 scenario, or as many as 35 days in the RCP 8.5 scenario, which would be a considerable change that could significantly affect human health and safety, the capacity for agricultural production, and overall well-being in the region.

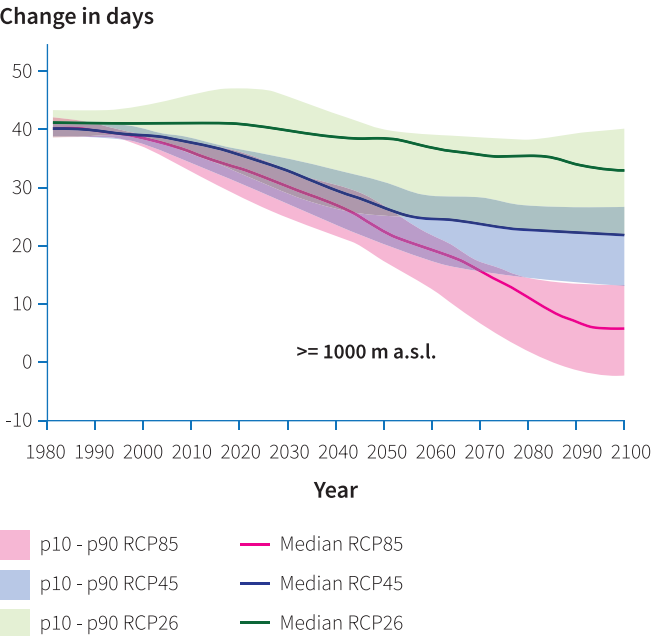
Heat days with at least 40 degrees C

Change in days



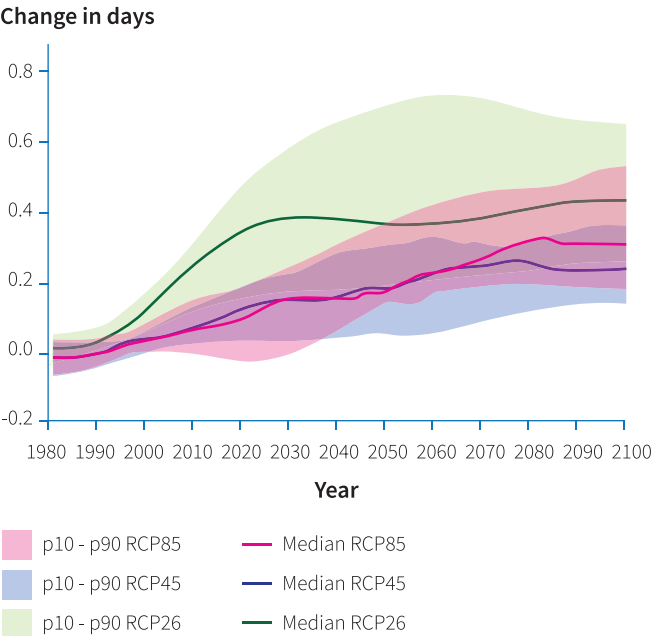
Extreme heat is also a significant threat faced by Western Balkan countries. Though some areas are more accustomed to instances with days that have temperatures exceeding 40 degrees C, this is uncommon across the region. However, this could change drastically under different scenarios, bringing the need for adaptation for infrastructure like pavement or bridges that may be impacted by these temperatures to prevent their deterioration and the subsequent risks from crumbling infrastructure.

Snow days with at least 1mm of precipitation



Snowfall is already fairly rare in the Western Balkans, though higher in some areas than others. As showcased in the third image, this number declines further under the different climate scenarios, leaving it an extremely rare event in the most extreme situations.

Landslides, averages across the entire Western Balkan region



The final graph shows landslides triggered by extreme precipitation in the region. These instances increase in all three scenarios, regardless of the extremity, indicating that landslides will become a greater risk in coming years.

As demonstrated by these projections, climate change is leaving the Western Balkans more vulnerable to different extreme events that will become more frequent and severe under different scenarios. The potential impacts of these occurrences are discussed in the following section.

Impacts on infrastructure

One major area of focus of the ClimaProof project is helping countries manage and plan for the impacts from climate change on infrastructure, particularly roads. Roads are highly vulnerable to climate change, making them a key target for adaptation initiatives. Higher temperatures will have direct impacts on roads, as they will cause pavement to soften and expand yielding ruts, potholes, and further stress on them. Roads are also subject to various natural disasters, such as floods, landslides, wash-outs, and wildfires, which will increase in frequency and intensity as climate change worsens.

The Western Balkan region already faces challenges related to their road infrastructure. The existing roads and highways lack preventive qualities to respond to various hazard-related challenges. For example, many are placed adjacent to unsecured slopes, leaving them in danger from landslides and tunnels lack primary protection measures, putting them at risk from flooding or wash-outs.

Climate indicators help make climate data acquired more relevant for decision-makers. Understanding the effects that different climate events have on infrastructure is useful for

deciding priority areas to make the most impact and which projections to pay attention to most closely. Some climate indicators should also be monitored to understand how they react in parallel to one another. For example, a high number of hot days in addition to dry spells increases the risk of forest fires. It is also important to monitor other areas, such as topography or socioeconomic data when considering potential effects. Heavy precipitation combined with higher elevated topography could yield a greater risk for landslides. And, heat waves and a higher average-aged population could mean significant risks for a large number of people, particularly the elderly.

Climate-proofing roads alone can lead to significant benefits for the Western Balkans, both economically and for overall safety. Current road maintenance costs are estimated to be roughly 30-50% caused by weather stresses, according to the European Commission. This comes out to roughly 8-13 billion euros each year, and 10% comes from extreme weather events. Targeting road infrastructure will help reduce costs and ensure that natural hazards are able to be withstood in the region – a high priority for the region based on various UN and EU assessments.



CLIMATE EVENT	EFFECTS ON INFRASTRUCTURE
Extreme Rainfall events (local or regional) 	<ul style="list-style-type: none">• Flooding of road surface• Erosion of road embankments• Weakening of the road embankments and road foundation due to standing water• Landslides and mudflows• Loss of road structure integrity• Overloading of drainage systems• Damage to energy supply and communication• Traffic hindrance and safety (aquaplaning)
Seasonal or annual rainfall (sum) 	<ul style="list-style-type: none">• Structural integrity of roads, bridges and tunnels (soil moisture levels)• Damage of the road base due to standing water• Risk of floods, landslides and slope failures (if change in precipitation pattern)
Max Temperature/Heat Days 	<ul style="list-style-type: none">• Pavement integrity (Rutting, cracking and blow-ups of asphalt; migration of liquid bitumen)• Thermal expansion in bridge expansion joints and pavements
Drought 	<ul style="list-style-type: none">• Increased risk of wildfires threatening transport infrastructure• Threats from areas deforested by wildfires (decreased soil integrity)• Increased generation of smog
Thaw/Frost-Thaw Cycle 	<ul style="list-style-type: none">• Cracking due to weakening of the road base• Increased demand for reconstruction• Increases risk of stone chipping
Extreme wind speed (storm surge, worst gales and wind gusts) 	<ul style="list-style-type: none">• Threat to stability of bridges• Damage to signs, lightings etc• Trees, windmill, noise barriers and trucks falling on the road• Reduced vehicle control

Potential Solutions

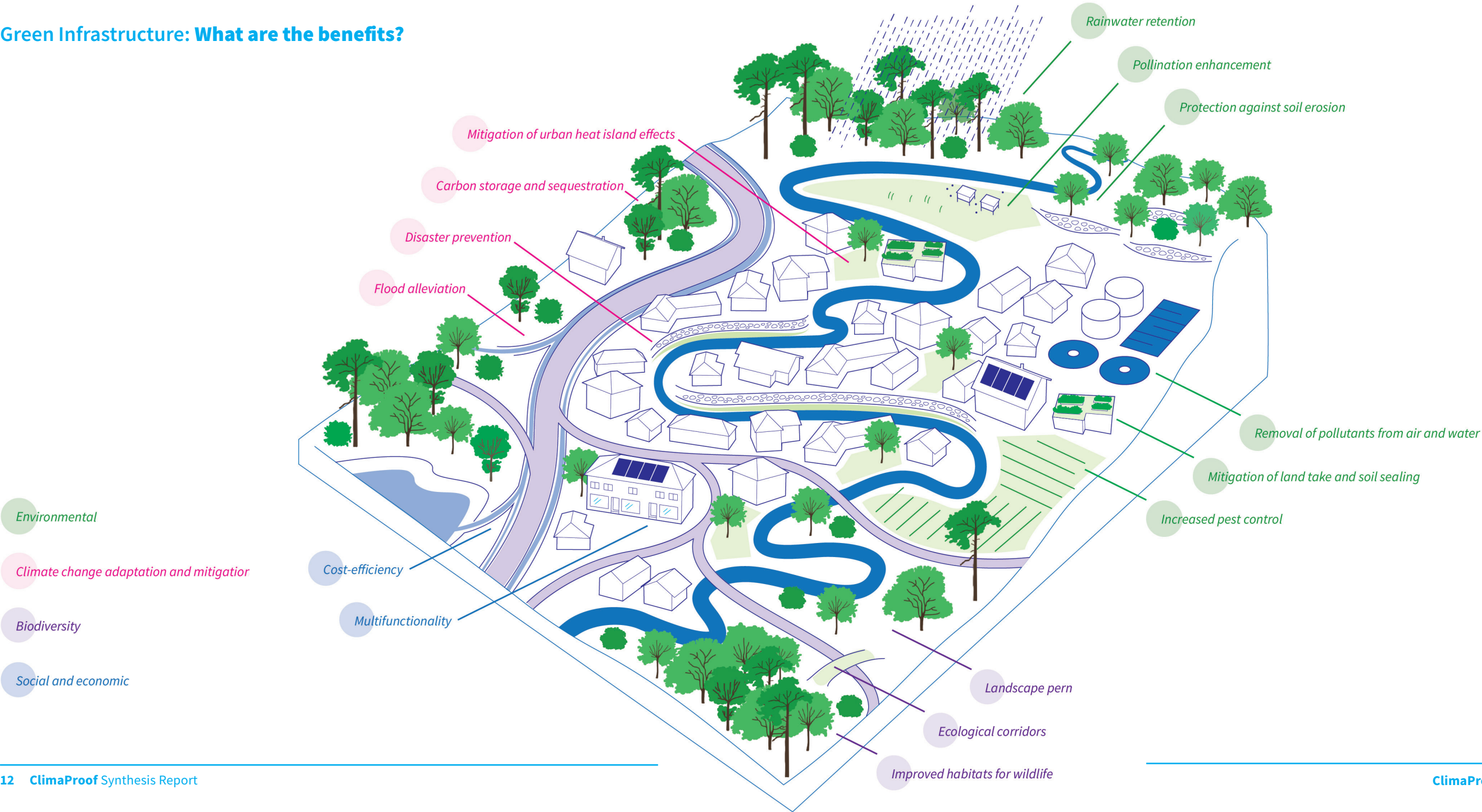
In the wake of these challenges, ClimaProof is working to increase the technical capacities of national authorities in making them aware of potential solutions for the Western Balkans. A main goal of the project is to help incorporate green infrastructure principles into existing and future infrastructure in the region.

Green infrastructure is when urban or rural areas are planned in such a way that natural or semi-natural areas are incorporated, giving them environmentally friendly features that help protect ecosystem services and biodiversity while coexisting with infrastructure developments. Green infrastructure can be combined with climate proofing measures to help adapt road infrastructure to upcoming challenges in the Western Balkans.

SUSTAINABLE DRAINAGE SYSTEMS

One example introduced during ClimaProof training sessions is the incorporation of Sustainable Drainage Systems (SuDS). Roads cover land with impermeable surfaces that impact the environment’s natural drainage mechanisms. SuDS help fulfill the need for drainage by creating a place for water to go through common features such as: a filter strip, swale, detention basin, pond, and/or constructed wetland area. By recreating drainage through an adaptable mechanism, SuDS helps address flooding in a more effective manner than traditional piped drainage systems placed underground.

Green Infrastructure: What are the benefits?



The ClimaProof Project

ClimaProof is incorporating these principles to help the Western Balkans tackle climate-related challenges to infrastructure through three major components:

- Understanding the future climate and weather patterns in the target region
- Planning for the future climate and weather patterns in the target region
- Building infrastructure adapted to the future climate and weather patterns

The project was conducted in a wide participatory manner, with a variety of stakeholders and partners involved.

Institute of Meteorology and Climatology (BOKU-Met)
Eurac Research
Public Enterprise Roads of Serbia
Chamber of Commerce and Industry of Serbia
Ministry of Capital Investments, Directorate for State Roads of Montenegro
Ministry of Transport and Maritime Affairs, Transport Administration of Montenegro
Ministry of Environment, Spatial Planning and Infrastructure of Kosovo*
Public Enterprise Motorways of the Federation of Bosnia and Herzegovina
Public Enterprise Roads of the Federation of Bosnia and Herzegovina

*References to Kosovo shall be understood to be in the context of UN Resolution 1244 (1999)

Government of North Macedonia, Office of the Deputy of the Prime Minister in charge of economic affairs, coordination of economic sectors and investments
Transport Community, Belgrade

Component 1 involves strengthening national capacities to understand climate change and related risks in the region through improvement of the information base. By creating several tools, ClimaProof wants to better enable countries to use climate projections to plan for the most pressing issues.

Component 2 focuses on strengthening national capacities to integrate climate change projections and climate proofing and green infrastructure in the development on a regional and national level. This has been implemented through various activities, such as background reports to better identify areas of focus for the different countries, based on their needs.

Component 3 is working to create an enabling environment for regional cooperation and investments in climate resilient infrastructure in the Western Balkans. ClimaProof partners have presented the results of the project and different recommendations to relevant regional partners, hosted events, and are creating a strategy to address challenges throughout the Western Balkans. This component hopes to enable regional actors to take action and incorporate climate proofing into existing and future infrastructure endeavors.

The ClimaProof Strategy and Deliverables



For more information, visit: <https://climaproof.net/>

Major achievements:

Component 1: ClimaProof has developed bias-corrected climate scenarios for the Balkan region. These scenarios integrated local expertise with Scaled Distribution Mapping to help predict the region’s future weather and climate patterns and inform future decision-making.

Deliverables:

- Bias-corrected Climate Scenarios for the Western Balkan Region
- ICC-OBS Tool
- Model Selection Tool
- Downscaling Tool

Component 2: The project developed focus reports and policy guidelines for the Balkans, providing analysis of the climate-related institutional framework and other policies and legislation in force in the countries. These reports also helped identify gaps and weaknesses in the institutional, legal and policy frameworks both at the national and local levels, accompanied by a set of recommendations.

Deliverables:

- Introduction Focus Report
- Gap Analysis Report
- Focus Reports: Albania, Bosnia and Herzegovina, Kosovo*, North Macedonia, Montenegro, and Serbia
- Policy Guidelines: Albania, Bosnia and Herzegovina, Kosovo*, North Macedonia, Montenegro, and Serbia

Component 3: The Regional Strategy for Climate Resilient Road Infrastructure demonstrates what the main barriers are for implementation and how to overcome these, both in terms of technical needs and capacities for adequate and available financing possibilities. It integrates the results and lessons learned, particularly highlighting how the understanding of climate resilience is enhanced by increasing the technical capacities of each of the national authorities working on climate change adaptation in road infrastructure.

Deliverables:

- Consultation Meeting
- Regional Conference on Climate Change Impacts and Resilience of Transport and Infrastructure
- Webinar on Climate Change Impacts and Adaptation of Transport Infrastructure
- Webinar on Green Infrastructure
- National Consultation Workshops
- Regional Conference on Financing Climate Proofing and Green Infrastructure
- Training on Financing and Economic Instruments for Climate Proofing and Green Infrastructure
- Regional Consultation Workshop
- Regional strategy for climate resilience road infrastructure

For more information about results of the project, visit <https://climaproof.net/>



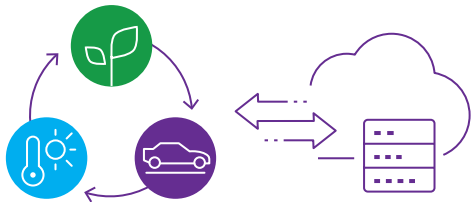
Discussion of the Regional Strategy, July 7th 2022

*References to Kosovo shall be understood to be in the context of UN Resolution 1244 (1999)

Conclusions and Way Forward

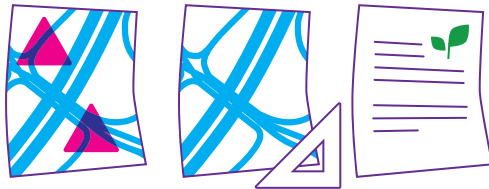
Phase 1 of the ClimaProof project provided a strong basis for introducing climate-proofing mechanisms into the Western Balkan region. These are some of the key messages to keep in mind moving forward.

At the regional level:



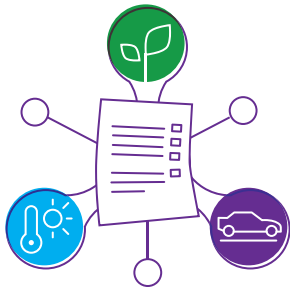
Operationalize institutional cooperation for relevant data collection and risk assessment

- Hydrometeorological institutes in cooperation with road agencies to set a hazard/risk assessment methodology, including the list of necessary data for its development
- Hydrometeorological institutes in cooperation with road agencies to develop missing probability hazard/risk maps and diagrams
- Responsible ministries of transport and environment in close cooperation with road agencies and hydrometeorological institutes to set-up national integrated information systems with all data/ hazard /risk maps and diagrams available



Build and strengthen institutional capacities for infrastructure risk assessment, resilience planning and mainstreaming of climate adaptation measures across infrastructure sectors

- Continuous training of national stakeholders on how to mainstream climate proofing measures into national infrastructure planning procedures while ensuring the use of data made available through ClimaProof Project.
- In terms of resilience assessment, refer to the GAP analysis produced within ClimaProof as well as Focus and Policy Recommendations reports to address the gaps identified and take further actions as per recommendations set (<https://climaproof.net/publications>)
- Responsible ministries of transport and environment in close cooperation with road agencies, hydrometeorological institutes and private sector working on EIA and SEA should organize in-depth climate resilience trainings for future members of climate resilience team within all relevant stakeholders (including training on EU Technical Guidance on Climate Proofing of Infrastructure).



Strengthen normative and institutional framework for resilience planning and design

- Responsible ministries of transport and environment in cooperation with institutes for statistics to develop cooperation mechanisms among institutions and SOP for data exchange and elaboration
- Responsible ministries of transport and environment in cooperation with international institutions to prepare guidelines for mainstreaming climate risks into sectoral policies and programs, EIA, SEA, as well as into project design.
- Road agencies in cooperation with hydrometeorological institutes to prepare national methodological guidelines/ technical standards on infrastructure risk assessment

Further details on this topic, as well as country-specific recommendations, are available in the Regional Strategy for Climate Resilient Infrastructure in the Western Balkans.

The Regional Strategy also provides a Roadmap for Adaptation Planning, which includes key governance measures to be

taken in the region. These measures are organized sector-by-sector, provide data improvement recommendations, and refer to specific institutions that should be involved in these activities.

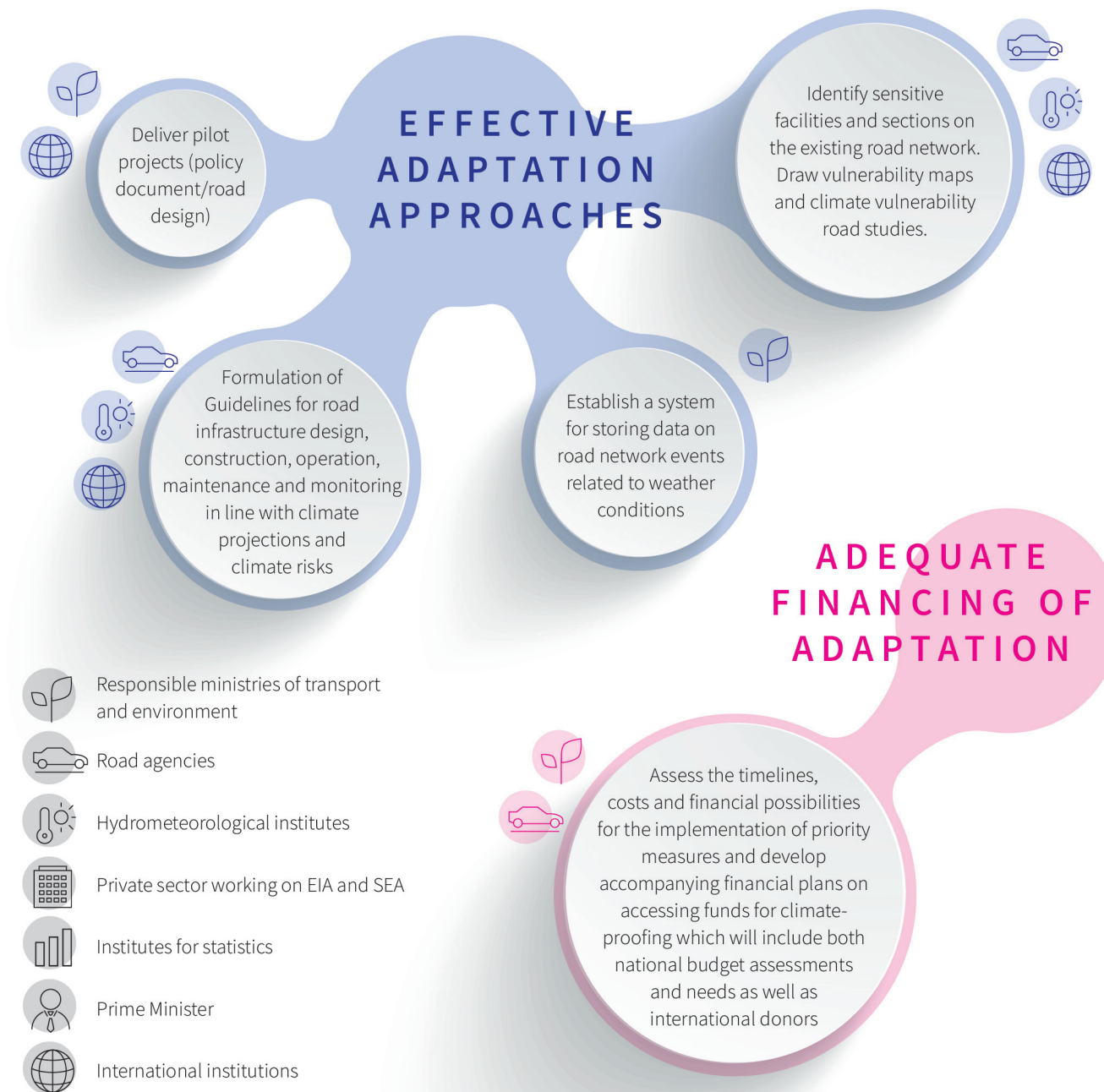
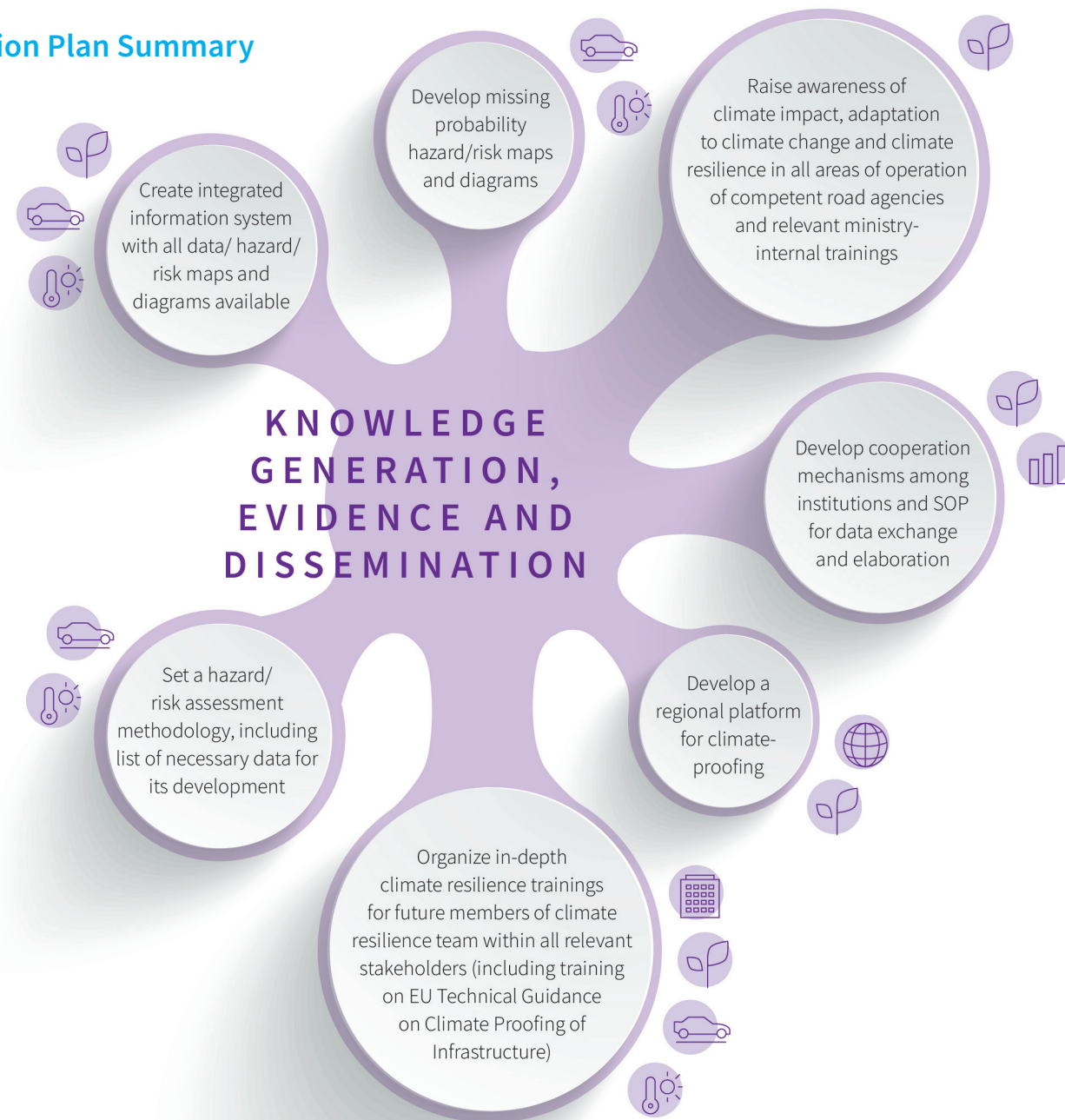
In order to address some of the gaps identified by the project, an Action Plan was developed as part of the Regional strategy for climate resilient infrastructure. This Action Plan acts as a guide for the region in preparing national strategies and plans, and provides scope for regional cooperation. It is based on three main objectives:

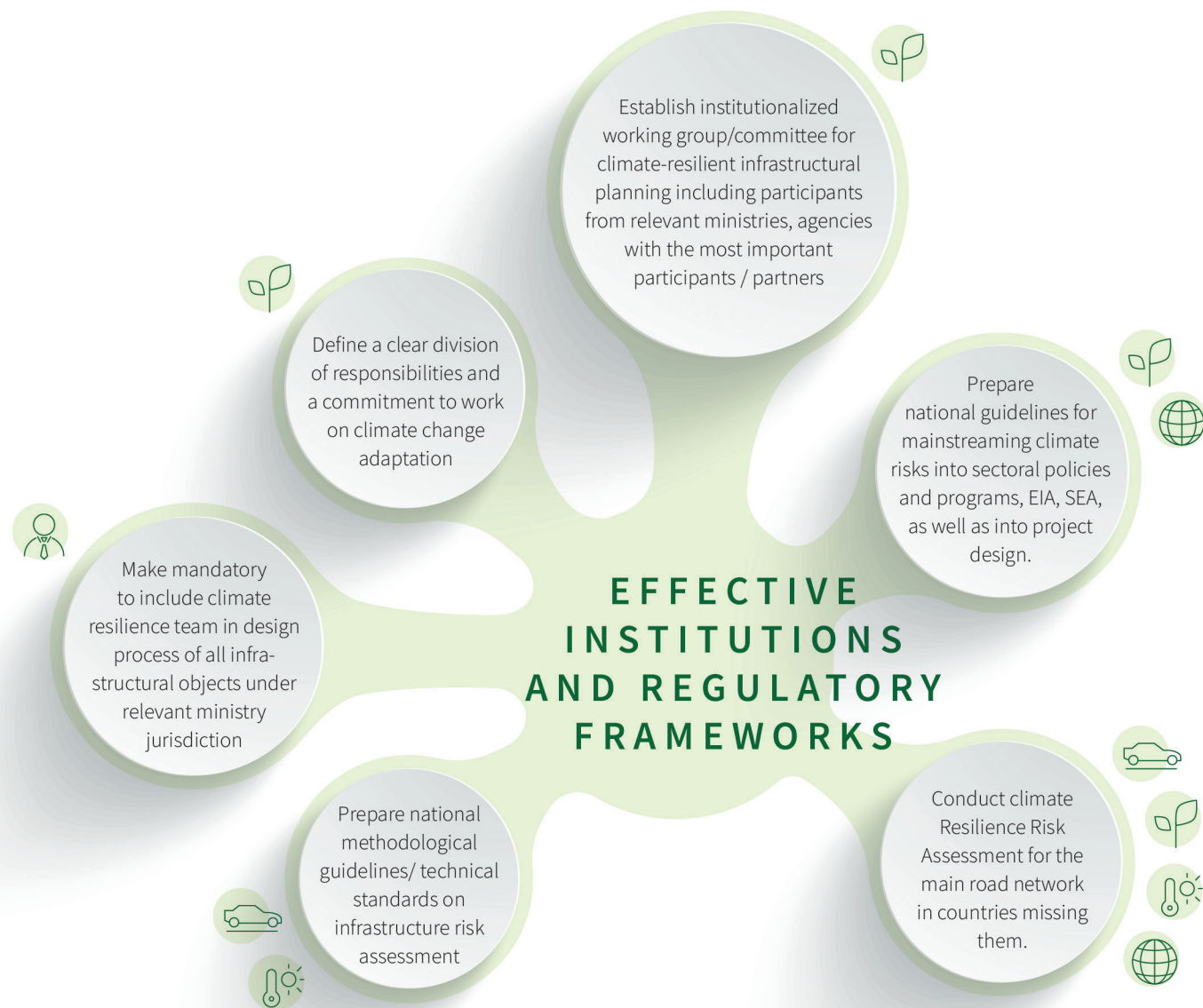
1. Operationalize institutional cooperation for relevant data collection and risk assessment
2. Build and strengthen institutional capacities for infrastructure risk assessment, resilience planning and mainstreaming of climate adaptation measures across infrastructure sectors
3. Strengthen normative and institutional framework for resilience planning and design

These objectives have been given defined measures that can be taken, which are organized in four priority action areas

- Knowledge generation, evidence and dissemination
- Effective institutions and regulatory frameworks
- Effective adaptation approaches
- Adequate financing of adaptation

Action Plan Summary





Aerial Drone View of Bosnia Herzegovina River Canyon

The ClimaProof Project aims to help respond to climate-related threats in the Western Balkans by enhancing understanding of climate projections and making recommendations for the future through a collaborative, well-structured approach. Visit the ClimaProof website to learn more about potential solutions and find other helpful resources.

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