

CLIMATE RESILIENT URBAN MOBILITY

SUMP 3.0 - From National Policies to Local Implementation

PODGORICA

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SCIENCE AND TECHNOLOGY PARK MONTENEGRO



Climate-Resilient Infrastructure for Sustainable Urban Mobility

Activating the private sector to deliver resilient mobility

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Sarajevo Urban Mobility Network Resilience Study

Let's start with your thoughts!

AUDIENCE PULSE-CHECK

**What comes to mind when you think of
climate impacts on urban mobility?**

Share your thoughts via Mentimeter.
Enter 1–3 words!



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The Sarajevo study: scope, task and objective

Sarajevo Canton • approximately 130 km of mobility network across five municipalities

01 STUDY SCOPE

Roads, public transport, walking and cycling links, and access to critical public functions.

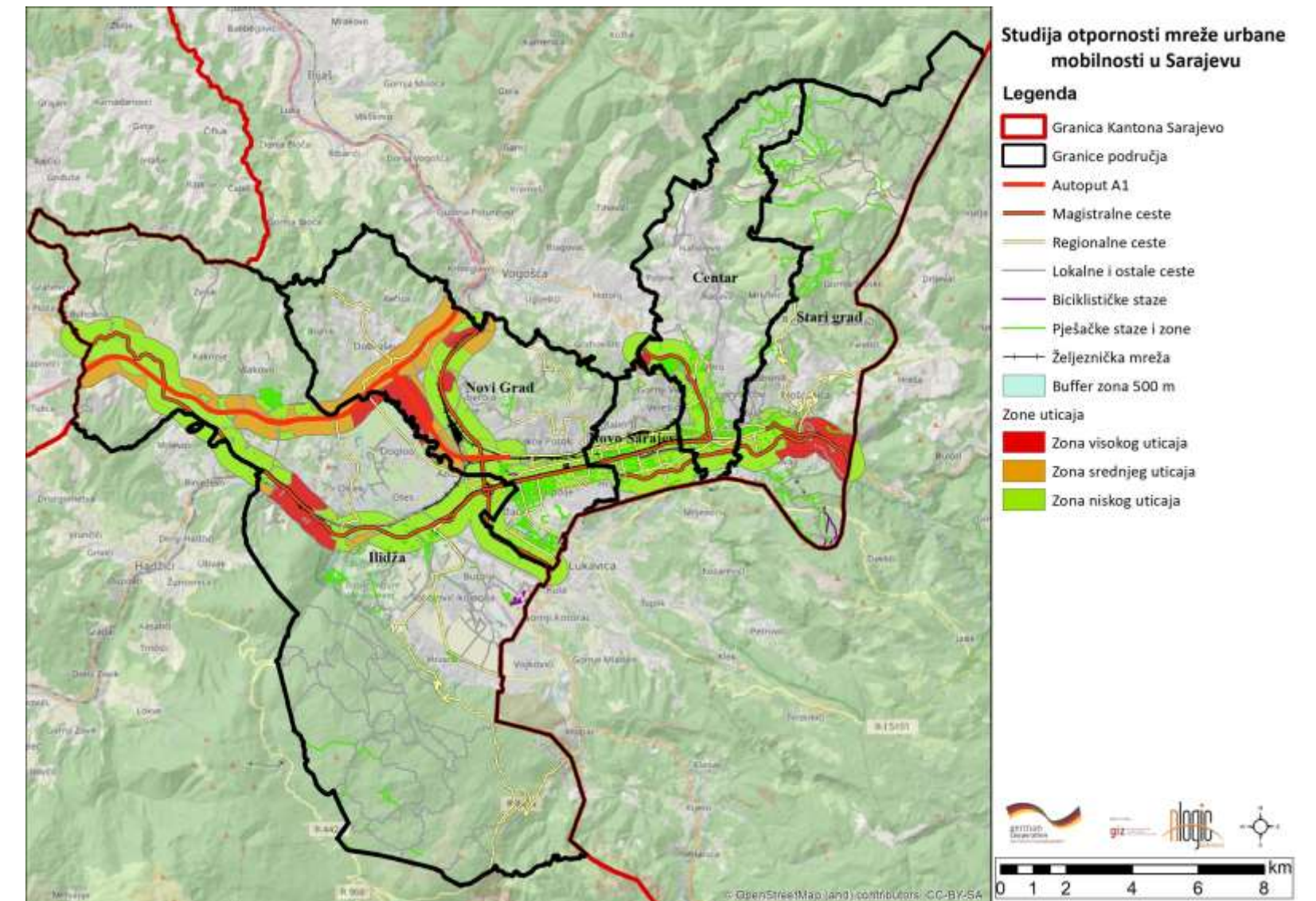
02 STUDY TASK

Identify relevant hazards, assess exposure and vulnerability, and locate critical network points and dependencies.

03 OBJECTIVE

Translate the risk assessment into targeted Climate Resilience Measures (CRM) and recommendations for prioritisation and future SUMP integration.

The study moves from understanding risk to prioritising measures that can protect mobility services and access.



MOBILITY NETWORK AND PRELIMINARY CRITICAL-RISK ZONES

The hazard profile: multiple threats to one network

The study considers climate-driven hazards and other events that can disrupt mobility assets, users and services.

01 FLOODING & INTENSE RAINFALL

Surface-water accumulation, drainage overload, and flooding of roads, underpasses, junctions and terminals.

02 EXTREME HEAT & URBAN HEAT ISLAND

Higher heat loads on walking and cycling routes, public-transport stops, paved areas and mobility operations.

03 LANDSLIDES & EROSION

Slope roads, trolleybus corridors, retaining structures and access links may be damaged or blocked.

04 DROUGHT & WILDFIRE

Dry vegetation, smoke and fire-related closures can restrict movement and access for emergency services.

05 SNOW, ICE & FREEZE-THAW

Reduced road capacity, unsafe pedestrian/cycle conditions, public-transport delays and pavement deterioration.

06 EARTHQUAKES*

A non-climatic hazard considered in the wider resilience context due to potential infrastructure damage and secondary slope instability.

* Earthquakes are not climate hazards; they are considered because a seismic event can disrupt network connectivity and compound other vulnerabilities.

Compound hazards create cascading mobility impacts

An event can trigger secondary hazards; impacts can spread when critical links have few alternatives.

01 RAINFALL → FLOODING

Intense rainfall → Drainage overload

Urban flooding → Road / underpass closure

02 RAINFALL → LANDSLIDE

Prolonged rainfall → Soil saturation

Landslide / erosion → Corridor disruption

03 HEAT + DROUGHT → FIRE

Heat and drought → Dry vegetation

Wildfire / smoke → Route restrictions

04 EXTREME HEAT + UHI

Heatwave → Urban heat island

Higher user exposure → Reduced comfort / use

System amplification: limited route alternatives and shared dependencies can turn a local hazard into a wider loss of access.

Exposure tells us where; vulnerability explains how impacts grow

The study connects hazard footprints with mobility infrastructure, people and access to critical functions.

EXPOSURE

Where are assets, users and functions located relative to the hazard?

MOBILITY ASSETS Roads, underpasses, junctions, bridges, public transport and active-mobility links.

PEOPLE & USERS Population, public-transport users, older people, children and people with reduced mobility.

CRITICAL FUNCTIONS Health, education, civil-protection and other essential services reached through the network.

VULNERABILITY

How susceptible is the system, and how readily can it keep functioning?

PHYSICAL Asset condition, drainage, slope stability, erosion and supporting technical systems.

FUNCTIONAL / SPATIAL Limited alternative routes, shared corridors, dependencies between network elements and access gaps.

SOCIAL / INSTITUTIONAL Different user needs, coordination, early warning, response and recovery capacity.

A hazard map alone is not a risk assessment: exposure and vulnerability determine how a hazard can affect mobility.

How the study defined inherent risk

A consistent, scenario-based screening method for comparing risks to selected mobility elements.

$$\text{INHERENT RISK} = \text{HAZARD SCORE} \times \text{CONSEQUENCE SCORE}$$

$$\text{Consequence} = \text{ROUND}((\text{Exposure} + \text{Vulnerability}) / 2)$$

Hazard (H), exposure (E) and vulnerability (V) are scored on a 1–5 scale; the resulting inherent-risk score ranges from 1 to 25.

1–4

VERY LOW

5–9

LOW

10–14

MODERATE

15–19

HIGH

20–25

VERY HIGH

IMPORTANT DISTINCTION

Coping capacity is assessed separately to inform residual-risk interpretation; it is not multiplied into the inherent-risk score.

The question after the risk assessment

Knowing where the risks are is only the first step.

The implementation challenge is to decide who can reduce those risks, how solutions can be delivered, and how their impact will be measured.

MANDATE

PUBLIC AUTHORITIES

Set the public-interest outcome, identify priorities, steward assets and ensure accountability.

CAPABILITY

PRIVATE SECTOR

Bring technology, data, specialised expertise, operational know-how, services and investment capacity.

EXECUTION

DELIVERY PARTNERSHIPS

Connect a defined need with a capable provider, measurable results and a route from pilot to scale.

The goal is not private-sector participation for its own sake; it is better continuity, access and safety for people.

Resilience is a mobility outcome—not only an engineering property

01 ASSET

Can the infrastructure withstand, adapt to or be repaired after disruption?

Drainage • materials • slope protection • inspection

02 NETWORK

Can people and services keep moving when one link is unavailable?

Redundancy • alternatives • traffic management • shared data

03 SERVICE

Can people still reach essential destinations safely and reliably?

Public transport continuity • accessible routes • passenger information

The unit of resilience is not just the asset—it is the mobility service people depend on.

Sarajevo: the study gives us a focused starting point

Selected inherent-risk screening results for defined study scenarios

20/25

VERY HIGH

Landslides affecting regional/local roads and trolleybus links

15/25

HIGH

Extreme heat affecting tram, trolleybus, walking and cycling infrastructure

10/25

MODERATE

Urban heat-island exposure across public and active mobility elements

NETWORK REDUNDANCY IS A SECOND CRITICAL SIGNAL

3 of 6

critical node pairs have only one independent route

4 of 4

critical nodes have at least one link with only one independent route

Why this is a business-continuity issue

The location of a hazard is only the beginning. Consequences travel through the network.



Private-sector value can sit at every step: prevent failure, keep services running, inform users, restore function faster.

The study has moved from risk diagnosis to a portfolio of actions

40

CANDIDATE CRM MEASURES

A broad starting pool—not a funded project pipeline

5

SUMP PILLARS

Planning • public transport • active mobility • private motor transport • urban logistics

18 + 18 + 4

TIME HORIZONS

18 short-term • 18 medium-term • 4 phased or continuous

Examples of measures with clear entry points for specialised providers and operators

DATA & GIS

Shared asset register, risk maps and incident records

DRAINAGE & SLOPES

Targeted inspections, drainage upgrades and geotechnical solutions

HEAT & COMFORT

Shaded routes, cooler surfaces and improved stops

SERVICE CONTINUITY

Early warnings, disruption information and alternative-service plans

Next step: connect each measure to an owner, delivery route, operating budget, and measurable result.

Where the private sector can contribute

01 DATA & DIGITAL

GIS asset registers • exposure dashboards
Incident data • early warning
Passenger information

02 RESILIENT ASSETS & OPERATIONS

Drainage and slope solutions
Materials • inspections • maintenance
Heat / continuity operating plans

03 MOBILITY PRODUCTS & SERVICES

Bike parking and micromobility
Better stops and accessible connections
Alternative services during disruption

04 PEOPLE & BUSINESS PRACTICE

Employer mobility programmes
Cycling and travel-behaviour initiatives
Urban logistics continuity

The panel brings together complementary entry points: geospatial intelligence, active mobility, micromobility infrastructure, and transport cooperation / capacity.

Three conditions make collaboration deliver—not just consult

01

BUY OUTCOMES, NOT JUST EQUIPMENT

Specify the service or resilience outcome: less downtime, reliable access, safer alternatives—not just a device or a study.

02

MAKE DATA USABLE AND SHARED

Agree a baseline, data ownership, access rules, interoperability and who updates the information after handover.

03

CONNECT PILOTS TO SCALE

Name an asset owner, define maintenance, test procurement and financing early, and establish a route into plans and budgets.

MEASURE WHAT MATTERS

Service availability • recovery time • access to key functions • user reach • exposure reduced

A useful lesson from international practice: co-develop, test, scale

REFERENCE CASE

Bengaluru, India

Mobility Innovation Living Lab

GIZ + Bosch / develoPPP

10 innovative solutions advanced

Examples: second-life batteries + solar charging, accessibility support for public-transport users, and digital journey planners.

THE TRANSFERABLE LESSON

- 1 CO-CREATE** Bring public authorities, implementers and firms around a practical problem.
- 2 TEST** Give promising ideas a structured place to be tested against real user needs.
- 3 REPLICATE** Capture evidence and define conditions for use in other locations.

Source: GIZ, “How GIZ Works in Transport – Made with Germany”, slide 6 (“Partnering with Private Sector” – Mobility Innovation Living Lab, Bengaluru)

A practical route from the study to implementation

Start with a service problem and a clear owner—not with a technology looking for a use.



A measure becomes implementable when responsibility, costs, maintenance, procurement and performance are all visible.

Let's open the panel with one practical question

AUDIENCE PULSE-CHECK

What is the biggest barrier to activating the private sector for climate-resilient mobility?

Choose one. Vote in Mentimeter.

- A** A clear project pipeline and asset owner
- B** Access to reliable, shareable data
- C** Procurement and the path from pilot to scale
- D** Financing and allocation of risk
- E** Institutional coordination and capacity