



**Novi Sad**

# **Green City Action Plan**

bridging the past

touching the future

## Supported by

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## For the benefit of the citizens of Novi Sad

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## Prepared by

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**April 2025**

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# Abbreviations

AD	Anaerobic Digestion
ANPR	Automatic Number Plate Recognition
ATU	Administrative Territorial Unit
BAT	Best Available Technique
BMS	Building Management System
CDW	Construction and Demolition Waste
CTMC	City Traffic Management Centre
CWWTP	Central Wastewater Treatment Plant
DH	District Heating
DWTP	Drinking Water Treatment Plant
EBRD	European Bank for Reconstruction and Development
GCAP	Green City Action Plan
LEZ	Low Emission Zone
Nbs	Nature-based Solution
PTES	Pit Thermal Energy Storage
PPP	Public-private partnership
PSR	Pressure-State-Response (Framework)
PT	Public Transport
PUC	Public Utility Company
PV	Photovoltaic
RDF	Refuse-Derived Fuel
RES	Renewable Energy Sources
RWMC	Regional Waste Management Centre
SO	Strategic Objective
ToR	Terms of Reference
UHI	Urban Heat Island
VRI	Vehicle-Related Integration
WEEE	Waste from electrical and electronic equipment

# Executive Summary

Novi Sad is the second largest city of Serbia with a dynamic urban development and a charming atmosphere generated by its geographical position and historical treasures. Nevertheless, besides its diverse values, the inhabitants are the most important asset of Novi Sad, and they are making our city truly enjoyable and welcoming.

Novi Sad is well known all over Europe as being a multicultural city, where Eastern, Central and Western European cultures are mixing up. Its geographical position and its role in history as a defence fortress situated at the edge of an empire gave our city a special aura and a unique vibe. The Danube River and Petrovaradin Fortress are definitely the most significant and well-known features of the city. The old town, with magnificent old buildings, small streets and large public squares, is also contributing significantly to the overall charm of the city.



*Figure 1 View of Novi Sad from Petrovaradin Fortress*

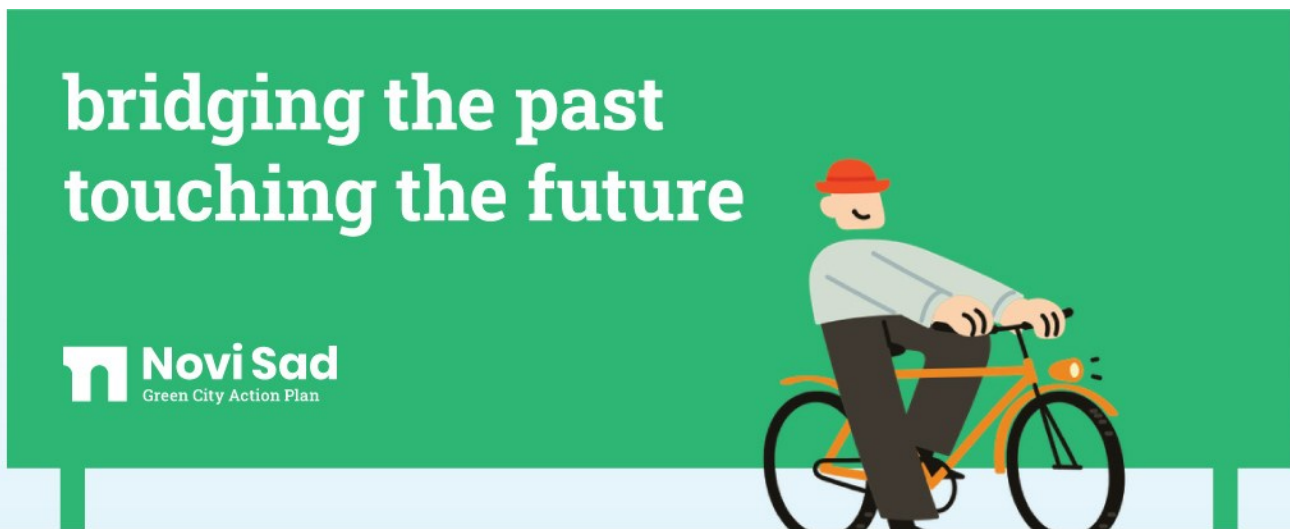
The Green Cities Programme developed by the European Bank for Reconstruction and Development (EBRD) is a good opportunity for our Municipality to enhance and strengthen the position of Novi Sad as one of the greenest cities in Serbia. Thus, the present Green City Action Plan (GCAP) is prepared as a strategic document which will guide the future development of the city in the coming 15 years. The document is the result of a fruitful cooperation between representatives of Novi Sad Municipality and the members of the GCAP working group established for this project, EBRD and the consulting team led by the RWA Group together with Arcadis Belgium. The GCAP development process followed the EBRD methodology, which starts with a comprehensive assessment of the state of the urban environment and examines the pressures on the environment coming from seven sectors: transport, energy, buildings, industry, water, waste and land use.

Based on this assessment, the Municipality defined its main environmental and sectoral development challenges and opportunities. The former is related to poor air quality, lack of a proper and efficient wastewater treatment facility and availability and accessibility to quality green spaces. Along with the above, a list of sectoral pressures for the urban

environment has been drafted. This list included the key aspects that the Municipality would tackle via this GCAP and provided the starting point for formulating the GCAP vision and strategic objectives.

Nowadays, Novi Sad offers good opportunities for personal and professional development due to a good educational system, stable business environment, strong information and communication technology sector and good strategic planning at Municipality management level.

The ambition of the Municipality is to shift towards a smart and unique urban habitat, building it up considering and treasuring the cultural heritage and constantly bringing in innovative solutions for socio-economic development, enhancement of quality of life and environmental protection. Novi Sad's vision is:



Based on this vision, three strategic objectives have been defined:



STRATEGIC OBJECTIVE 1

**Urban  
Green  
Renewal**



STRATEGIC OBJECTIVE 2

**Towards  
net-Zero  
Emissions**



STRATEGIC OBJECTIVE 3

**Smart  
Innovative  
City**

A total of 22 short-term actions are included in the GCAP. Altogether, they provide an investment plan and equate to a total funding requirement of around 614 million EUR (CAPEX) over a 5-year period. The total annual greenhouse gas (GHG) emissions reduction resulting from the implementation of the GCAP short-term actions is estimated at 152,000 t CO<sub>2</sub>eq/year.

The plan is organised according to the sectors analysed in the GCAP, providing a clear and logical structure to facilitate understanding of the relationships between sector-specific actions and the key challenges they address. However, it is important to note that the actions outlined in this document are interconnected, with several addressing multiple challenges and overlapping across various sectors.

In addition to identifying key challenges, the plan outlines short-term actions to be implemented over the next five years, as well as long-term actions spanning up to 15 years, all aimed at achieving the strategic objectives and vision of the GCAP. The following sections provide an overview of each GCAP action per sector.

Sector	Short-term actions	Brief description
<b>TR</b>  <b>Transport</b>	1. Public transport modernisation	This action aims to develop a robust, safe, comfortable and reliable public transport system in the city and the surrounding settlements. Investments foreseen are related to rolling stock, dedicated bus lanes and mobility hubs. Also, the public transport network will rely on smart solutions and innovations for prioritising public transportation and providing real-time information to passengers related to the location of public transport vehicles and timetables of arrivals and departures.
	2. Improvement of the cycling network	Investments will expand and improve the quality of non-motorised transport networks at metropolitan level. This will include among others expanding the existing bike network, constructing dedicated bike lanes, and installing smart traffic lights for micro-mobility vehicles.
	3. Network of connected sidewalks around schools & kindergartens	Investment will mainly cover the school and kindergarten zones. Instating these sidewalks is just the first step. Speed reducing measures, visibility of school zones and setting up educational/community systems also contribute to safer school environments.

Sector	Short-term actions	Brief description
	4. Improved traffic management system	This action aims to implement a traffic management system that will improve access of the population to clean mobility and will balance the increased efficiency and safety of some modes against the delay experienced by other traffic modes.
<b>E&amp;B</b>  Energy and Buildings	5. Energy management programme	The key components included in this action are: mapping public building roofs for solar collector/PV installations, developing an energy efficiency programme, promoting energy efficient behaviour through educational campaigns, and implementing automated energy management systems and a digital energy management platform for real-time monitoring and control of energy use in public buildings.
	6. Energy rehabilitation of public buildings and facilities	This action focuses on reducing energy consumption in public buildings in Novi Sad through a deep energy retrofit programme. Key components include energy audits, selection of buildings, development of terms of reference, and implementation of passive and active measures including the integration of smart technologies.
	7. Energy rehabilitation of private/residential buildings	The residential buildings retrofit programme aims to improve the energy performance of these buildings by reducing energy consumption and associated costs, promoting indoor air quality, and implementing consumption-based billing models.
	8. Integration of RES into the district heating system of Novi Sad	This action focuses on modernising the district heating system of Novi Sad by integrating solar thermal energy and heat pump technologies to reduce dependence on fossil fuels and enhance system sustainability and efficiency.
	9. Digital one-stop shop	This action focuses on establishing a digital one-stop shop to centralise information and resources for energy efficiency, eco-friendly materials, and green building standards. It will serve as a hub for homeowners, builders, and stakeholders, providing access to tools, incentives, and guidelines for adopting sustainable building practices.
<b>WA</b>  Water	10. Drinking water system modernisation	The primary goal of this action is to ensure high quality drinking water to Novi Sad and suburban areas in sufficient quantities. The investments will be directed towards achieving a stable, reliable, and high-quality water supply in Novi Sad for all categories of users through the expansion of water source extraction capacities and the accompanying infrastructure for the treatment and distribution of drinking water.
	11. Rehabilitation, modernisation and extension of the wastewater collection network	This action aims to upgrade the sewerage network and modernise the wastewater system of Novi Sad through the construction of a new and the rehabilitation of outdated wastewater sewer system collectors.
	12. Central wastewater treatment plant – detailed design and construction	The primary objective of this action is to construct the Central Wastewater Treatment Plant (CWWTP) in Novi Sad that can effectively process the city's wastewater before it is released into the Danube River, thereby reducing pollution and safeguarding the environment.
	13. Preparatory steps to expand the network with a separate system for stormwater drainage and wastewater	Construction of separate stormwater and sewage drainage systems in suburban areas of the city that are still not entirely covered by the combined network, such as the areas of Paragovo and parts of Popovica, and Sremska Kamenica.
<b>WS</b>	14. Remediation of the existing unsanitary landfill	This action aims to transform the unsanitary landfill into a safe, environmentally stable, and community-friendly site by implementing comprehensive remediation measures. This will

Sector	Short-term actions	Brief description
Waste		include waste compaction, disposal site reshaping, soil and groundwater decontamination, collection of landfill gas, restoration of natural vegetation, implementation of a final capping layer and a monitoring and aftercare system all following regulatory standards and best environmental practices.
	15. Construction of two new recycling yards and expansion of the Reciklomat system	The goal of the action is to enhance the waste management infrastructure of Novi Sad and promote sustainable recycling practices by constructing two new recycling yards for recyclables and expanding the Reciklomat system, thereby increasing accessibility, convenience, and community engagement in waste separation and recycling. This action aims to reduce landfill waste, improve resource recovery, and encourage environmental responsibility among residents.
	16. Implementation of a citywide two fractions waste collection system	The further improvement of the waste collection system in Novi Sad through a citywide two-bin system is a proactive approach to enhancing waste management practices in the city. This system aims to reduce landfill dependency, increase recycling rates, and promote the responsible management of organic and non-organic waste streams, fostering a cleaner urban environment and supporting long-term ecological and economic benefits for the community.
	17. Waste treatment facility for refuse-derived fuel production	This action focuses on reducing landfill waste, recovering energy from non-recyclable materials, and promoting environmental sustainability. By integrating advanced waste sorting and processing technologies within a Regional Waste Management Centre, the proposed facility for RDF production offers further treatment options for non-recyclable waste.
	18. Construction and demolition waste processing facility	The Construction and Demolition (C&D) waste processing facility in Novi Sad is essential for addressing the increasing challenges of C&D waste management. This project represents a significant step towards a circular economy and a cleaner, more sustainable future for Novi Sad.
LU Land use	19. Green urban landmarks	This action aims to enhance the urban environment of Novi Sad and its tourist attractions (together with Action 20) by creating iconic green spaces and infrastructure that promote sustainability, improve quality of life, and foster economic opportunities.
	20. Establish a citywide blue-green network	The blue-green network aims to enhance environmental protection, economic development, and climate resilience by creating interconnected green and blue spaces that manage stormwater sustainably and provide social, recreational, and touristic benefits.
	21. Smart city	Novi Sad has already taken some steps towards collecting data and creating valuable information using digital technology. The natural next step is to gradually include smart components and ICT system applications in all public services, as well as in monitoring environmental parameters at city level and preventing and controlling pollution.
	22. Development and implementation of a sustainable tourism strategy	The aim of this action is to develop a comprehensive strategy and roadmap to promote sustainable tourism in Novi Sad and its vicinity. This involves identifying and enhancing high-value touristic spots near the city, creating thematic tours, and optimising infrastructure to ensure easy and eco-friendly access to these sites. The goal is to boost tourism while

Sector	Short-term actions	Brief description
		minimising environmental impact and promoting sustainable practices.



**Novi Sad**

Green City Action Plan

PART I

# Introduction to the GCAP process

bridging the past

touching the future

## Context

EBRD has developed the **EBRD Green Cities programme** in an effort to build a better and more sustainable future for cities and their residents. The programme comes as a response to the acknowledgement that although cities are dynamic and vital parts of society and the main engines of social, economic and technological development, rapid urban growth has vastly increased the demand for resources, which, in turn, affects the environment as well as the quality of life of urban residents.

One of the programme's central components is the **Green City Action Plan (GCAP)**, the process whereby a city's environmental challenges are systematically assessed, prioritised and addressed through various policy instruments and sustainable infrastructure investments.

The Municipality of Novi Sad joined the EBRD programme in 2019 and started to develop its GCAP in October 2020 together with the consultant team consisting of experts from the RWA Group and Arcadis consultancies, involving in the process a wide range of local stakeholders.

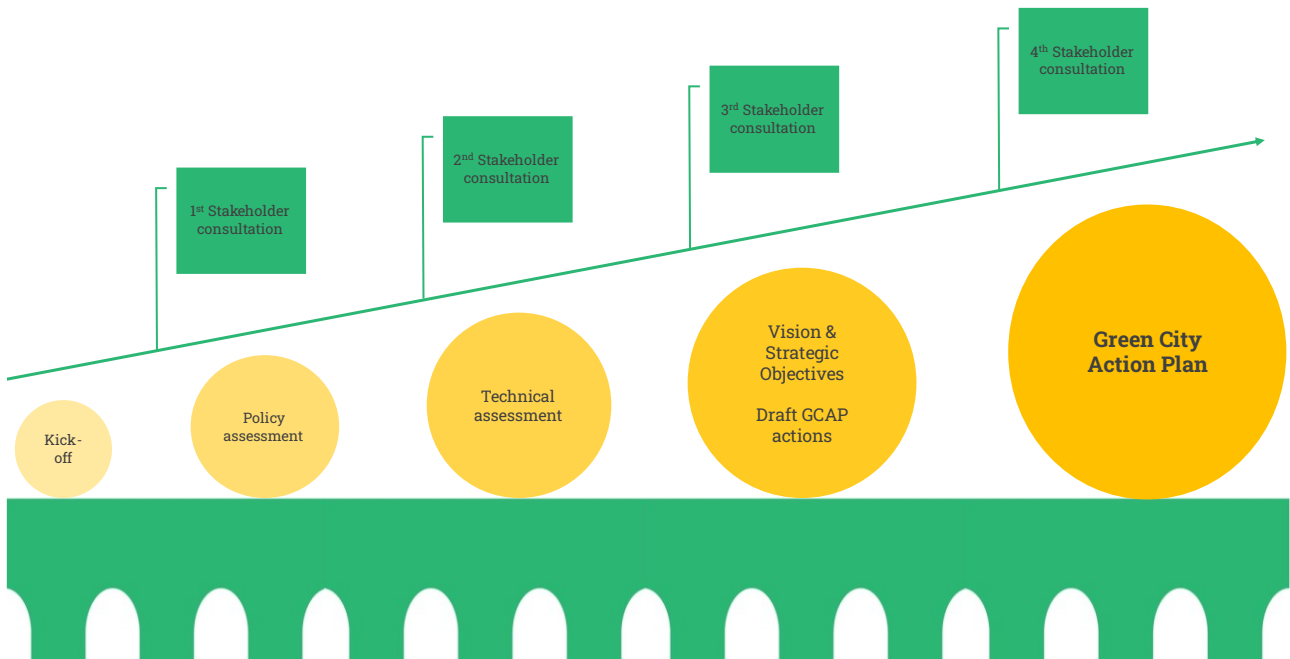
Our aim in developing a GCAP for Novi Sad is to address the existing environmental and urban development challenges systematically, while considering social concerns, including gender. Thus, the GCAP will provide input to optimise the Municipality's financial and personnel capacity while addressing the urban issues with great environmental benefits and social and gender co-benefits.

The process of developing the GCAP had the **following phases and key milestones**:

The first phase consisted of **developing the city baseline**. It was a complex process, which aimed to assess the environmental and policy performance of the city, map its resilience based on risks and vulnerabilities, examine its smart maturity, and perform an analysis of gender aspects.

Following this assessment, **challenges were identified and consulted with key stakeholders**. The consultation process allowed for the prioritisation of the challenges.

Once the prioritised challenges were formulated, a **long list of GCAP actions** was elaborated and submitted to public consultation, which had as a result the range of **short- and medium-term actions** to include in the present action plan.



*Figure 2 Summary of the GCAP development process*

The following chapters briefly present the main findings of the baseline analysis. It is to be noted that all the above-mentioned aspects are broadly discussed and presented in a series of stand-alone documents available at Novi Sad Municipality. These documents are the following:

- External Framework Report (EFR)
- Green City Baseline, including Indicators' Database
- Technical Assessment Report (TAR)

# City Overview

## Geography and socio-economic context

The city of Novi Sad is the largest city and the administrative centre of the Autonomous Province of Vojvodina, the northernmost administrative and political region within Serbia. According to the Spatial Plan of the City of Novi Sad,<sup>1</sup> the administrative area of Novi Sad consists of three types of settlements: the urban zone of Novi Sad, the smaller urban settlements of Petrovaradin, Futog and Sremski Kamenica (Figure 2, marked with blue and green), and the rural settlements of Veternik, Kać, Begeč, Budisava, Bukovac, Čenej, Kisač, Kovilj, Rumenka, Ledinci, Stari Ledinci, and Stepanovićevo (Figure 2, marked with purple).

The present GCAP focuses on the urban zone of Novi Sad, which includes the city of Novi Sad and the 3 smaller urban settlements.

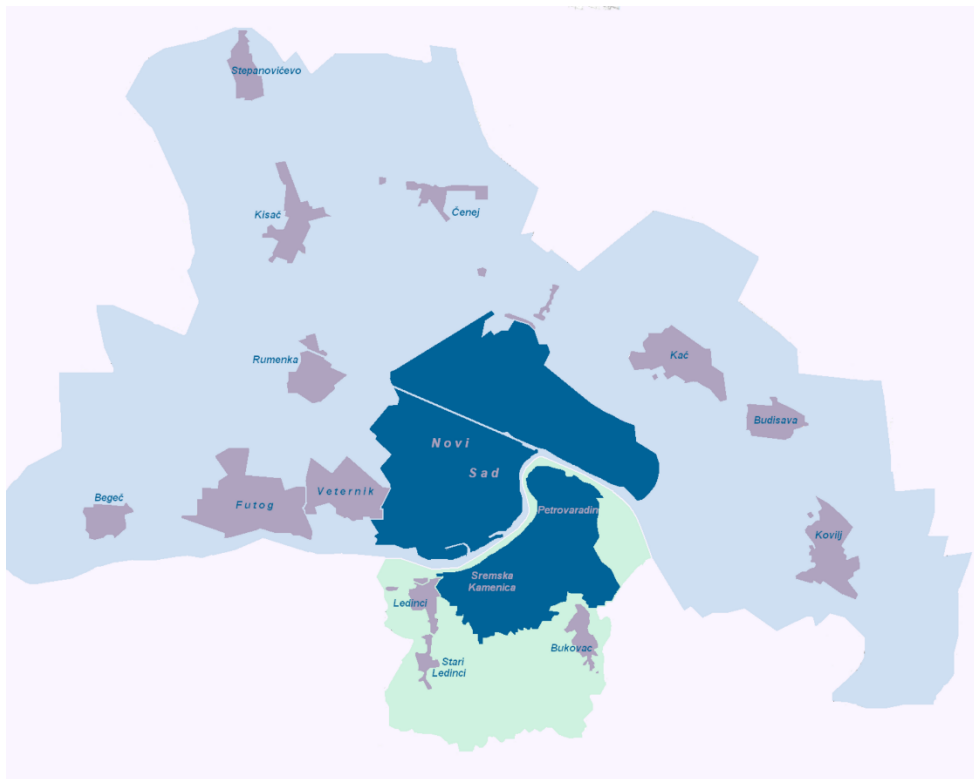


Figure 3 City Municipality of Novi Sad (source: [https://www.wikiwand.com/en/articles/City\\_municipality\\_of\\_Novi\\_Sad](https://www.wikiwand.com/en/articles/City_municipality_of_Novi_Sad))

The area of Novi Sad is 699.2 km<sup>2</sup>, with an average population density of 528 inhabitants per km<sup>2</sup>. It consists of 16 settlements, both urban and suburban, that fall under the broader metropolitan area of Novi Sad. According to the 2022 population census (SORS), about 306,000 inhabitants live in Novi Sad urban areas, and around 260,000 inhabitants in the city proper, thus Novi Sad being the second largest city in Serbia.

<sup>1</sup> Official Gazette of the City of Novi Sad no. 11/12

Novi Sad is located in the southern part of the Pannonian Plain, on the border of the Bačka and Srem geographical regions. It lies on the banks of the Danube River and incorporates part of the northern slopes of the Mountain of Fruška Gora.

The total population of Novi Sad is slowly but constantly growing at a rate of around 0.70%/year,<sup>2</sup> in contrast to the national negative trend of -0.55%/year.<sup>3</sup> In this respect, Novi Sad is one of the urban centres in which the improving quality of life is attracting new people to move into the city. The vast majority of the population living in Novi Sad are Serbian natives (78.4 %), followed by Hungarians (2.65 %), Slovaks (1.5%), Croats (1%), Roma (1.1%), and Yugoslavs (1%), while all the rest of the ethnicities each attest for under 1% of the ethnic setup of the city.<sup>4</sup>

There is a small difference between the distribution of the population regarding gender, in favour of the female population which makes up 52.6% compared to 47.4% of the male population. As can be observed in the figure below, the main difference is accounted for in the elderly population (aged 60+), where women are represented in a higher number than men. In terms of the age distribution within the city, the average age is 41 and the majority of the population (63%) is between 18 and 64 years old, while 19% are minors and 18% are over the age of 64.<sup>5</sup>

**Population by five-year age groups and sex, 2023 (%)**

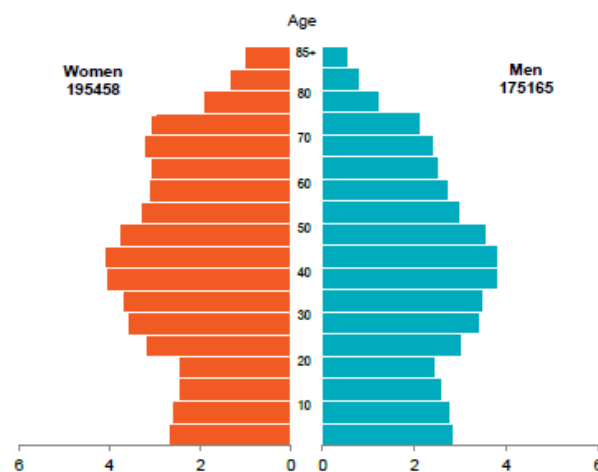


Figure 4 Age distribution by gender (source: population estimates, SORS)

The majority of the Novi Sad population declare themselves as Christian Orthodox (76.6%), while almost 7% share other Christian faiths, and about 1.5% of the city population identifies as Muslim.<sup>6</sup>

The education level of the population reflects the presence of universities in the city, the University of Novi Sad hosting around 50,000 students, with 20% of residents benefiting from

<sup>2</sup> <http://www.citypopulation.de/en/serbia/novisad/>

<sup>3</sup> Worldometer - <https://www.worldometers.info/world-population/population-by-country/>, accessed on 20.11.2024

<sup>4</sup> Novi Sad official website - <https://novisad.rs/eng/population-novi-sad>

<sup>5</sup> Statistical Office of the Republic of Serbia - <https://www.stat.gov.rs/en-us/oblasti/stanovnistvo/procene-stanovnistva/>

<sup>6</sup> Source: <https://data.stat.gov.rs/Home/Result/3104020301?languageCode=sr-Cyrl>. Accessed on 24.10.2024

higher education as opposed to 5.5% for the general Serbian population. When taking gender into consideration, one can observe that access to education is evenly distributed, with a small advantage for women in terms of higher education (Figure 4).

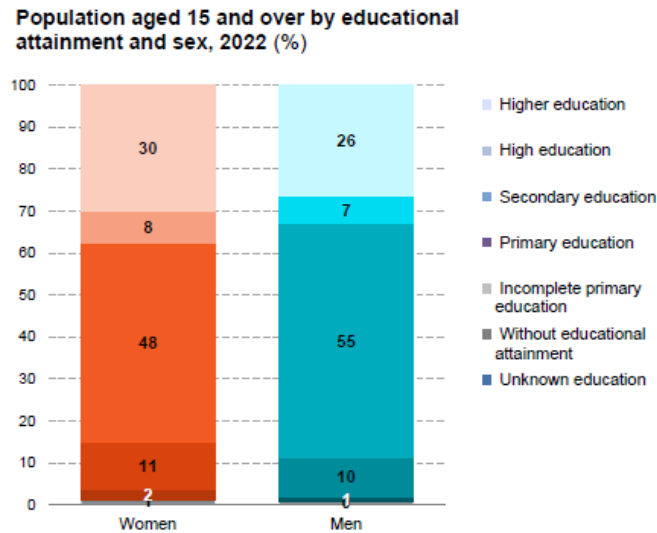


Figure 5 Access to education disaggregated based on gender (source: Census of Population, SORS)

## Social and gender aspects

According to the Poverty Map of Serbia published by the Statistical Office of Serbia and the World Bank, in 2016 the GINI index (coefficient that measures inequality across the entire income or consumption distribution) in case of Novi Sad was at the level of 0.3293 on the scale between 0 and 1 (0 indicates a fully equal distribution of income/consumption, while 1 denotes entirely unequal distribution of income/consumption).

In terms of the age structure of the unemployed, the biggest percentage of the people out of work (55%) is between 30 and 54 years old, this trend being similar in the case of both men and women, as can be observed in the figures below.

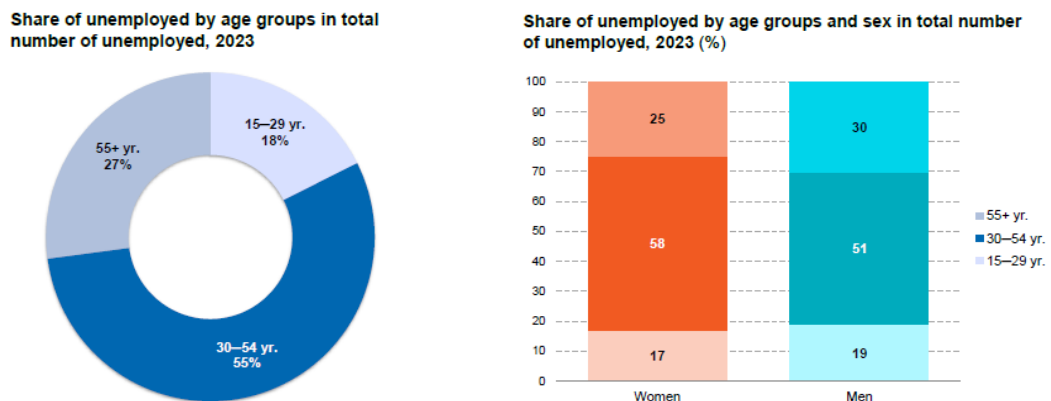


Figure 6 Unemployment relative to age structure (source: National Employment Service, Serbia)

While there is no available data about unemployment for ethnic and vulnerable groups, at national level the rate of unemployment is higher among the Roma community. The European Commission Progress Report for Serbia of 29 May 2019 states that the 'Roma unemployment rate is 36% (45% for women), compared to 16% for the non-Roma population'.<sup>7</sup> While unemployment in Novi Sad is below the national average, it is however expected that ethnic and vulnerable groups are more affected than the majority population. Our Municipality launched different policy initiatives and projects aimed at tackling this issue, described in the following section.

## Policy landscape relevant for the GCAP

The local and regional policies that are highly relevant to this plan and that provide the legal basis for the implementation of the GCAP actions are briefly mentioned below. It should be noted that during the GCAP development phase, a more detailed legal basis for our scope has been conducted, which not only provides a comprehensive mapping of relevant policies but also includes an update on the status of implementation.

### Novi Sad Development Plan 2023–2030

The Novi Sad Development Plan outlines a comprehensive strategy for transforming the city into a more sustainable, innovative, and liveable urban centre, addressing multiple sectors. The plan is based on a detailed analysis of the city's current situation. It presents a vision for the city's future development focused on the following:

- Smart City – enhancing resilience through the concept of a communally organised "Smart City."
- Human Potential – building capacity for development by strengthening human resources.
- Sustainable Economy – development of a knowledge-based economy.
- Good Governance – inclusive and accessible administration available to all citizens.

The Novi Sad Development Plan for 2023-2030 outlines several key development actions aimed at fostering a knowledge-based economy for the city. The plan emphasises that a sustainable economy is one based on innovation and knowledge, promoting job creation and attracting investments. Some specific examples of these actions include:

- Stimulating eco-friendly and sustainable construction: this includes encouraging the integration of green building principles, such as green roofs and walls, the use of renewable energy sources, and promoting energy efficiency in buildings.
- Encouraging the improvement of energy efficiency in Novi Sad. The plan highlights the importance of energy efficiency in public buildings, public lighting, and public transportation. It proposes energy audits and the issuance of energy performance certificates for public facilities. It also suggests subsidising energy-efficiency renovations for homes and buildings, including replacing windows, improving insulation, and upgrading heating systems.

<sup>7</sup> Serbia 2019 Report. Accessed on 08.12.2020, at: <https://ec.europa.eu/neighbourhood-enlargement/sites/near/files/20190529-serbia-report.pdf>

- Encouraging the use of renewable energy sources in Novi Sad. The plan aims to promote the integration of renewable energy sources in the city's energy mix. This includes incentives for the installation of solar panels, solar collectors, and heat pumps in residential, commercial, and public buildings. It also supports the integration of renewable energy sources into the district heating system.
- Promoting circular economy principles. This involves encouraging waste reduction, recycling, and reuse of resources.

All these measures have been considered when developing this GCAP.

### **Smart Plan**

In order to address the needs of the city, the Smart Plan has been developed as part of the broader Novi Sad Smart City Project. It constitutes a crucial component of the Development Plan's urban development pillar, which represents one of the four main pillars of the Municipality's strategy. The plan addresses chronic issues in the transport sector, including the increasing number of passenger vehicles, the decline in the use of the public transport, the lack of parking spaces, the expansion of pedestrian zones, and attitudes towards cycling. The detailed action plans and proposed measures included in the document aim to modernise and enhance the transport infrastructure of Novi Sad, thereby making the city more efficient, environmentally friendly, and conducive to a higher standard of living.

### **The Sustainable Development Strategy of the City of Novi Sad, 2016–2020**

This Strategy focused on promoting sustainable development and improving the quality of life for its residents. Novi Sad aspires to become an innovative, economically attractive, smart, modern, and democratic city. Priority 1 - Urban Development has a particular relevance for the development of the GCAP, in terms of both its topics and its planned activities and projects, with significant opportunities in every GCAP sector.

### **Regional Waste Management Plan for the City of Novi Sad and the municipalities of Backa Palanka, Backi Petrovac Beocin, Zabalj, Temerin and Vrbas for the period 2019–2028**

This document represents the primary regulatory framework for the modernisation of waste management practices within the specified region. The document sets ambitious objectives and is correlated with the national sectoral policies. The main objectives are: the development of a system of separate waste collection and management of special waste streams; the establishment of a Regional Waste Management Centre; the strengthening of the capacity of competent PUCs; the expansion of waste collection coverage up to 100%; and the improvement of institutional and organisational capacity.

### **General Urban Plan 2023–2030**

The General Urban Plan of Novi Sad until 2030 outlines a strategic vision to transform the city into a modern, sustainable, and economically vibrant urban centre. The plan focuses on enhancing urban infrastructure, fostering economic development, and improving the quality of life for its residents. Key priorities include the modernisation of city governance, increased transparency, and the provision of comprehensive public services.

### **Air Quality Plan in Agglomeration Novi Sad for the Period 2017–2021 and 2022–2026**

The plan was developed to achieve the target values of air quality set by the National Regulation. The data presented in the plan illustrate the trend in air quality and aim to inform both decision-makers and the public about exposure to pollution. The plan is adopted based on an assessment of the state of air quality and includes all the main pollutants and the main sources of air pollution.

The final section of the plan outlines the measures that will be taken to prevent and reduce air pollution, as well as those that will be implemented to improve air quality both before and after the plan's adoption.

### **Program of Environmental Protection of the Autonomous Province of Vojvodina for the period 2016–2025**

This document, adopted in 2016, is a document foreseeing rather general environmental policies. However, the eight general objectives and the set of short and medium-term goals included in the document can be seen as guiding principles for environmental policies at municipal level.

### **Development Programme of AP Vojvodina 2014–2020**

This document aims to align with national and EU policies to enhance competitiveness, improve quality of life, and promote sustainable development in the region. The programme focuses on economic growth, infrastructure improvement, social inclusion, and environmental sustainability, and serves as a guide for investment and policy-making decisions, aiming to leverage Vojvodina's strategic location, natural resources, and human capital.

## **GHG emissions in Novi Sad**

Regarding climate change mitigation and GHG emissions, the baseline emission levels were assessed using national values, since no specific data exists for the city of Novi Sad. According to the identified values, the level of emissions is of 6.4 tonnes CO<sub>2</sub> equivalent/year/capita, but it is important to note that the collected data is not very recent (2016 being the latest). Based on the available data the trend seemed to be descending which could indicate the values falling under 5 tonnes CO<sub>2</sub> eq./year/capita in most recent years.

Several actions were taken to mitigate GHG emissions at city level. The transport sector received substantial development support from the Municipality. New alternative fuelled busses were introduced in recent years and incentives were provided for the renewal of the local taxi fleet. Investments in the transport sector are carried out annually, which would indicate a potential downward trend for CO<sub>2</sub> emissions from traffic in Novi Sad. Compared to the national level, currently Novi Sad does not have an industry with high emission potential, so it is possible that the level of CO<sub>2</sub> emissions per capita would be consistently descending in the city, but considering this value to be between 5 and 6 t CO<sub>2</sub>/year/capita is a more conservative and confident approach.

## **Climate hazards and resilience**

Novi Sad faces significant challenges from extreme weather events, notably urban flooding due to stormwater and urban heat islands (UHI). These phenomena pose risks to infrastructure, public health, and the city's overall resilience.

Urban flooding in Novi Sad is primarily attributed to inadequate stormwater management systems that struggle to cope with intense rainfall events. The city's infrastructure, characterised by extensive impervious surfaces, exacerbates runoff, leading to localised flooding. During heavy rains, certain hotspots in the city experience temporary street flooding due to the combined stormwater and sewage system's insufficient capacity to handle large volumes of water quickly. This issue may stem from the system's inadequate design and lack of a periodic cleaning program for street drains, which can become clogged with sludge and other materials, further reducing capacity. Maintenance of this combined water drainage system is performed when urgent needs arise, rather than following a systematic schedule.

A study evaluating the implementation of bioretention systems demonstrated their potential to enhance urban flood resilience. Simulations conducted at four locations in Novi Sad indicated that bioretention systems could significantly reduce runoff, thereby mitigating flood risks.<sup>8</sup>

The presence of the Danube has posed challenges in the past. An embankment system was constructed to mitigate the high flood risk. Additionally, the Municipality carried out major hydrological and topography works in order to reduce flooding risk, and since 1953, the city has monitored groundwater levels, pressure, and temperature, with the Urban Planning Institute of Novi Sad publishing annual reports.

The UHI effect in Novi Sad results in elevated temperatures within urban areas compared to their rural surroundings, primarily due to human activities and the prevalence of heat-absorbing materials. Research conducted by the Novi Sad Urban Climate Lab<sup>9</sup> highlights the residents' vulnerability to heat-related health issues, including increased mortality and hospitalisation rates during heatwaves<sup>10</sup>. Studies emphasise the need for urban design strategies that incorporate green infrastructure to mitigate UHI effects and enhance outdoor thermal comfort.

Densely populated neighbourhoods with limited green spaces experience more pronounced UHI effects, exacerbating health risks. Additionally, low-lying areas near the Danube River are at higher risk of flooding, impacting residents and infrastructure in these zones.

Initiatives by the Urban Planning Institute of Novi Sad together with actions proposed in the present GCAP to enhance both the quantity and quality of green spaces and implement more blue-green infrastructure would help alleviate the UHI effect and increase the city's overall

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<sup>8</sup> A. Greksa et al, Contribution of low impact development practices-bioretention systems towards urban flood resilience: case study of Novi Sad, Serbia, *Environ. Eng. Res.* 2022; 27(4): 210125, DOI: <https://doi.org/10.4491/eer.2021.125>

<sup>9</sup> <https://www.nsucl.com/home>; [https://drive.google.com/file/d/17ucoJbQDIM\\_OKDR9cNIIYYKFBc5bGZl\\_/view](https://drive.google.com/file/d/17ucoJbQDIM_OKDR9cNIIYYKFBc5bGZl_/view); <http://www.dgt.uns.ac.rs/improving-the-environment-in-vojvodina/>

<sup>10</sup> [https://www.researchgate.net/publication/338528663\\_Heat-related\\_Mortality\\_as\\_an\\_Indicator\\_of\\_Population\\_Vulnerability\\_in\\_a\\_Mid-sized\\_Central\\_European\\_City\\_Novi\\_Sad\\_Serbia\\_summer\\_2015](https://www.researchgate.net/publication/338528663_Heat-related_Mortality_as_an_Indicator_of_Population_Vulnerability_in_a_Mid-sized_Central_European_City_Novi_Sad_Serbia_summer_2015)

resilience to climate threats. This GCAP includes several land use and water sector-related actions which promote such solutions.

## Smart maturity

The GCAP development process included an assessment of the smart maturity of the city of Novi Sad, based on data available and following the discussions between representatives of the Municipality, other key stakeholders and the consultant team.

The main conclusion of the smart maturity assessment is that Novi Sad is in its enabling stage of smart integration and digital transformation. The Municipality acknowledged the importance of smart components and is already collecting and interpreting data, mainly on transport and e-government to be able to use them for beneficial outcomes in the near future. Smart solutions are adopted in the land use sector as well, the Municipality operating a GIS cadastre, which is not updated though. Other gaps identified in this sector are the lack of data for existing infrastructure systems; no 3D model of the city that could be useful in the planning process, along with the topographical morphology of the city in digital format, etc.

Apart from these two sectors, the other GCAP sectors don't show any significant implementation of smart solutions, with the main gaps identified per each sector as follows:

- **Buildings** – lack of individual metering and control of heating at household level; limited availability of smart control applications for lighting systems in buildings (at least in public buildings); lack of BMS in public buildings; limited support for water consumption reduction (tap aerators, etc.) and water reuse.
- **Energy** – limited introduction of RES in district heating company energy mix; shortage of smart grids powered by Demand Response (DR) models that allow real-time analysis of customer demand trends; microgrids / locally produced energy systems
- **Industry** – insufficient smart logistics to support business incubators, accelerators, and creative hubs; online registration and reporting system for industrial facilities connected to the environmental management authorities to report on emissions, waste generation and management, wastewater volumes by type and operation;
- **Water** – incomplete digitalisation of the water supply and sanitation systems; limited availability of smart metering and remote data readings along the network and for every customer; non-continuous water quality and quantity monitoring sensors for both drinking water and wastewater treatment plant.
- **Solid waste** – lack of smart data collection on collected, recycled, and disposed waste; deficient online reporting system for industrial and commercial waste generation to report on type, quantities, contracted operators and waste management methods employed.

Each GCAP action will also include, where relevant, measures that are going to enhance the smart maturity of the city. When defining the GCAP actions, the following aspects will be considered:

- Smart City development as one of the objectives in the Sustainable City Development;
- Several (pilot) projects, co-founded by the EU, to test the possible benefits of smart applications (e.g. CLIPS, WeLive, SocIoTal, MobiWallet);
- The recently developed NOvi Sad TRAnspOrtation Model (NOSTRAM), as a backbone for actions on smart and sustainable mobility;
- The Municipality has its own Open Data Portal within seven datasets uploaded by four entities: City Administration for Environmental Protection, PUC "Informatika", PUC "Parking Servis", and through SMART IMPACT project.

# Green city environmental baseline and challenges

Developing the green city baseline involved documenting the environmental conditions in Novi Sad and the status of its sectors, and identifying the challenges faced by the city. This process adheres to the EBRD methodology, developed in collaboration with the OECD, using the pressure-state-response (PSR) framework. The PSR framework categorises specific indicators to illustrate the causal linkages between environmental pressures, the resulting state of the environment and the responses from local government, residents and the private sector. Challenges were prioritised through stakeholder consultations and translated into green city priorities.

Mapping the city's environmental performance included collecting and benchmarking state indicators (such as air quality, water bodies, soil, water use, land use, biodiversity, and ecosystems) and pressure indicators (such as transport, energy and buildings, industry, water and waste management, and land use) against international standards.

The baseline environmental assessment revealed the following:

- The air quality in Novi Sad is generally good, the Environmental Protection Agency reporting mostly clean air between 2015-2019. However, spikes in PM<sub>10</sub> levels, potentially from traffic are a cause for concern.
- Novi Sad benefits from a plentiful groundwater supply due to its location on the banks of the Danube River. This high-quality groundwater is easily accessible at a depth of only 50m, making it a reliable source of drinking water for the city.
- The drainage system is inadequate to handle heavy rainfall and snowmelt, leading to flooding in specific areas.
- Novi Sad lacks a wastewater treatment plant, resulting in the discharge of untreated wastewater directly into the Danube. This poses a significant environmental risk despite the Danube's dilution capacity.
- Novi Sad boasts a high amount of green space per capita, with 12 sqm per person. The city also benefits from its proximity to the Fruska Gora National Park and the Koviljsko Petrovaradinski Rit nature reserve. Despite a high green space per capita, only 12% of Novi Sad's total area is officially designated as public green space. This is flagged as RED and attributed to past urban development practices that did not mandate sufficient green spaces, particularly in newer neighbourhoods.
- Noise pollution, mainly from traffic, is a major concern. Annual average noise levels consistently exceed national standards across all designated zones in the city, indicating a persistent problem requiring targeted action.



*Figure 7 Pressure factors and the main environmental challenges in Novi Sad*

Benchmarking the collected data provided a clear understanding of the environmental challenges faced by the city. The above figure presents an overview of the pressure factors which amplify the following identified environmental challenges of the city:

- Air quality: lack of a systematic air quality monitoring network and methodology, spikes in PM<sub>10</sub> and other pollutants;
- Drinking water quality: a limited number of samples compliant with quality standards;
- Water bodies: lack of wastewater treatment, with polluted waters discharged directly into the Danube;
- Green spaces: low value of official green space compared to city area;
- Climate change resilience: urban drainage network overflows in case of heavy rains and snow melt;
- Noise: high level of noise pollution, mainly due to traffic.

The present GCAP aims to work towards improving the environmental performance of the city and reducing the pressure factors that influence the city's environmental conditions. The sectoral challenges are presented in Part II of the GCAP, in introduction to the detailed sectoral actions.

# Stakeholder engagement process

The stakeholder engagement activities aimed at involving a wide range of stakeholders in the GCAP development process: municipal departments, municipal companies, local businesses, civil society, and local citizens. The main objective of the consultation activities was to ensure that the GCAP actions were in line with the Municipality's strategic development objectives, the existing legal framework and the citizens' expectations. Challenges related to the COVID-19 pandemic (since the process started in 2020, during the global health emergency caused by the COVID-19) have also been considered in terms of restrictions on in-person meetings and travel. In this regard, a variety of tools were used throughout the entire process such as physical and online meetings, online surveys and voting platforms.

The process included four major stakeholder engagement activities as follows:

## **GCAP Kick-off Meeting and 1<sup>st</sup> stakeholder consultation**

The official Launch Event of the GCAP project was not held due to the pandemic. This was decided on the basis of the agreement of all parties involved in the process. For this purpose, on 9 October 2020 an online introductory meeting was organised between the Consultant team, the EBRD representatives and representatives from the Novi Sad Municipality. The meeting was attended by 11 participants, and the main points of discussion were focused on the GCAP objectives, the GCAP implementation team, and the green development objectives formulated at municipality level.

The 1<sup>st</sup> Stakeholder Consultation Workshop held on 28 April 2021 focused on discussions and consultations on the perceived environmental challenges of the city of Novi Sad with all interested stakeholders in the GCAP development process, allowing the participants to make their contributions to this strategic document.

## **Prioritisation of city challenges workshop, visioning exercises and long list of actions draft – 2<sup>nd</sup> stakeholder consultation**

The 2<sup>nd</sup> Stakeholder Consultation consisted of seven sectoral online meetings carried out with the Working Group, during which the environmental challenges were formulated based on the collected GCAP indicators, sectoral discussions, experts' judgement, and technical analysis. During an online meeting, held in October 2021, the environmental challenges were prioritised together with the Working Group.

In addition to prioritising green city challenges, the sectoral meetings and the online meeting provided a framework for developing a vision and strategic objectives for the GCAP. Furthermore, they facilitated the formulation of a comprehensive long list of actions to assess the city's needs.

## **Prioritisation of the long list of actions and validation of environmental challenges – 3<sup>rd</sup> stakeholder consultation**

The process of prioritisation of actions has been conducted in 2 phases, mainly due to the pandemic context. The first phase of the process took place between August and October

2021, when the Consultant developed a long list of actions grouped by sectors, which were presented in a survey format and followed by an online consultation process.

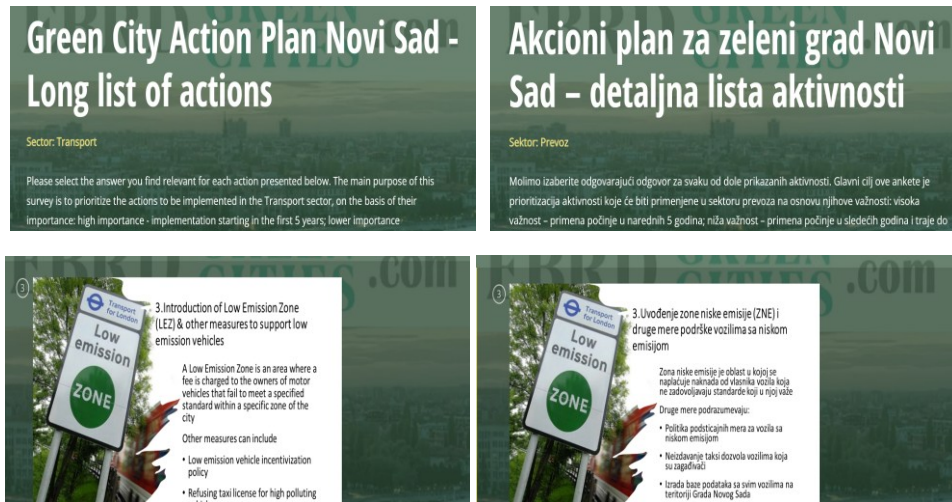


Figure 8 Extract from the online survey, Phase 1, 2021

The second phase of the process took place in May 2024, after the GCAP process had been reinstated. Due to the hiatus in the GCAP process, both the long list of actions and the environmental challenges had to be revised to reflect the actual state of the city. To this end, the consultant team, together with the Working Group, organised a workshop on 28 May 2024, during which an online voting platform was provided, where the participants could express their position on the availability of the proposed long list of actions, prioritised actions and identified challenges.

Following the validation workshop, the consultant team developed an online survey that integrated both the long list of actions and the prioritised actions by sector. This survey was sent to the Municipality to be published for the public at large for a three-week period. On average, each sector received more than 100 responses, with the transport sector receiving the most responses (211) and the waste sector receiving the fewest (122).



Figure 9 Working Group Workshop, Phase 2, 28<sup>th</sup> May 2024

### Development and consultation of prioritised GCAP Actions – 4<sup>th</sup> stakeholder consultation – October- November 2024

The draft GCAP actions have been consulted with members of the GCAP Novi Sad working group and other interested stakeholders during October and November. The consultant team, together with the representatives of Novi Sad Municipality organised 5 sectoral meetings, covering the Transport, Land Use, Water, Energy and Buildings and Waste sectors. During these meetings, stakeholders provided valuable insights and context to each action and gave guidance on the way the actions should unfold in the GCAP and on the type of measures to be included in each action.



Figure 10 Consultation Workshop, Phase 2, October 2024

Based on the outcomes of the sectoral meetings, the GCAP actions were fully developed and sent to all members of the GCAP working group for another round of feedback. Also, the EBRD sectoral specialists provided their suggestions and feedback for each action.



**Novi Sad**

Green City Action Plan

Part II

# Green City Action Plan

bridging the past ————— touching the future

# Vision and Strategic Objectives

## Vision

Taking into account the geographical position and the historical significance of the city, our vision of Novi Sad is a city acting as an interface between different regions, cultures and opportunities. Throughout history, the city had to reinvent itself several times, from a fortress city to a modern and high-tech city.

Nowadays, Novi Sad offers good opportunities for personal and professional development due to a good educational system, stable business environment, strong information and communication technology sector and good strategic planning at the city management level.

The Municipality's ambition is to shift towards a smart and unique urban habitat, while considering and treasuring the cultural heritage and constantly bringing in innovative solutions for socio-economic development, enhancement of quality of life and environmental protection. Novi Sad's vision is coined as follows:

**bridging the past  
touching the future**

 **Novi Sad**  
Green City Action Plan



## Strategic Objectives

Based on the identification and prioritisation of environmental and infrastructure challenges, three strategic objectives have been defined. These refer to the way how Novi Sad wants to develop in the future, shaping the green ideals and aspirations of the city.



STRATEGIC OBJECTIVE 1

**Urban  
Green  
Renewal**



STRATEGIC OBJECTIVE 2

**Towards  
net-Zero  
Emissions**



STRATEGIC OBJECTIVE 3

**Smart  
Innovative  
City**

bridging the past ————— touching the future



STRATEGIC OBJECTIVE 1

# Urban Green Renewal

Novi Sad is a vivid city, constantly changing and adapting to its citizens' needs. After the collapse of former Yugoslavia, the city industry has also slowly changed, many large industrial sites closed down, while the number of small and medium-sized enterprises increased. Currently, there is still a considerable number of urban industrial areas that are no longer in use and the objective is to revitalise and re-purpose them to become functional and bring added value to the local community.

The city also has an extended network of green areas both along the Danube and in the inner part of the city. Many of these are not yet officially designated as green areas. The aim is to connect all these green areas into an integrated multifunctional blue-green network. This will contribute to improved air quality, reduced traffic, increased mobility due to an extended cycling network, enhanced quality of life and an improved urban landscape.

The aim is to transform the city by constantly renewing it and making use of all available land following green and sustainable principles, good practice examples of urban regeneration/revitalisation projects and social inclusion.



**STRATEGIC OBJECTIVE 2**

# Towards net-Zero Emissions

Environmental pollution and GHG emissions are a top concern for Novi Sad, a rapidly growing city packed full of carbon-emitting processes and structures, from fossil fuel-generated energy to old, energy-intensive buildings, poorly managed waste systems, lack of a wastewater treatment plant and highly polluting vehicles.

Accelerating green energy transition, smart design and greener public services are the keys to a decarbonised city, which follows the net-zero carbon route.

Novi Sad is already planning to include renewable energy sources in the district heating energy mix, build a regional waste management centre and reduce emissions from public transport. These actions will be enhanced and widened to include renewable energy sources, energy efficiency in buildings, mainstream renewable energy use and empower consumers to actively contribute to and benefit from a green energy system. The Municipality will take action to promote and increase the uptake of cleaner public services across all sectors, decarbonising public transport, promoting alternative means of transportation, and designing and building a modern and efficient wastewater treatment plant.

The ambition of Novi Sad, beyond the low-hanging fruit of shifts in the energy mix and mobility options, is to engage its citizens towards changing consumer behaviours and achieving carbon neutrality.



### STRATEGIC OBJECTIVE 3

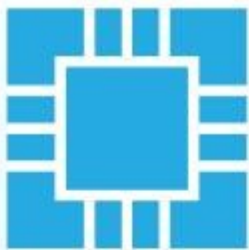
# Smart and Innovative City

The city benefits from one of the most important educational and research institutions in Serbia and South-East Europe, the University of Novi Sad. The university contributes significantly to the enhancement of standards of living in the city, since highly educated graduates remain in the city and decide to open new businesses, especially in the Information and Communication Technology (ICT) sector. This also contributes to a higher degree of solutions for digital connectivity, automation and robotisation in Novi Sad. The city already acknowledged that the ICT systems – as an enabling, integrative, and constitutive technology of the twenty-first century – will be instrumental in addressing many of the challenges presented by urbanisation.

Novi Sad has already made some steps towards collecting data and creating valuable information using technology. The natural next step is to include smart components and ICT system applications in all public services as well as in the monitoring of environmental parameters at the city level, pollution prevention and control.

Innovative solutions will be designed and integrated with all the municipal services. For example, the waste management sector will switch from basic functioning which includes collection and disposal of waste, to a system based on resource efficiency and circular economy principles, combined with modern solutions for the treatment of specific waste streams.

Moving towards a smart leadership and governance and towards the integration of innovative solutions in municipal services is one of the main objectives of this plan.





## GCAP Actions

The GCAP includes 22 actions clustered per sector. For ease of understanding and coherence, the presentation of actions for each sector starts with an overview of the sector, where a brief description of key characteristics of the sector and the main challenges are indicated, followed by corresponding actions for that sector.

Certain actions presented in the present GCAP are also referenced in other policy documents (either national, regional or local) and are in their development stage or close to implementation. They are also included in this GCAP, since this is the main strategic document which will guide the green development of Novi Sad. For all these actions, the GCAP presents the estimated budget based on the available data from pre-feasibility or feasibility studies. Please note that the estimated CAPEX of these actions can be further refined and adjusted during the technical detailed design, contracting and/or implementation stage.

Additionally, note that some actions are cross-referenced in several sectors. The table below provides an overview of all GCAP actions and highlights their correspondence with the strategic objectives.

## Overview of actions and their correlation with the strategic objectives

Sector	Short-term actions	S01	S02	S03
<b>TR</b> Transport	1. Public transport modernisation		✓	✓
	2. Improvement of the cycling network	✓	✓	
	3. Network of connected sidewalks around schools & kindergartens	✓		✓
	4. Improved traffic management system		✓	✓
<b>E&amp;B</b> Energy and Buildings	5. Energy management programme		✓	✓
	6. Energy rehabilitation of public buildings and facilities		✓	✓
	7. Energy rehabilitation of private/residential buildings		✓	✓
	8. Integration of RES into the district heating system of Novi Sad		✓	✓
	9. Digital one-stop shop		✓	✓
<b>WA</b> Water	10. Drinking water system modernisation		✓	✓
	11. Rehabilitation, modernisation and extension of the wastewater collection network		✓	✓
	12. Central wastewater treatment plant – detailed design and construction		✓	✓
	13. Preparatory steps to expand network with separate system for stormwater drainage and wastewater	✓	✓	✓
<b>WS</b> Waste	14. Remediation of the existing unsanitary landfill		✓	
	15. Construction of two new recycling yards and expansion of the Reciklomat system	✓	✓	
	16. Implementation of a citywide two fractions waste collection system		✓	✓
	17. Waste treatment facility for refuse-derived fuel production		✓	
	18. Construction and demolition waste processing facility	✓	✓	
<b>LU</b> Land use	19. Green urban landmarks	✓		
	20. Establish a citywide blue-green network	✓		
	21. Smart city			✓
	22. Development and implementation of a sustainable tourism strategy	✓		✓



**Novi Sad**

Green City Action Plan

# Transport



## Sector overview

### Baseline

Novi Sad holds a strategic position at the crossroads of major international routes, establishing it as a crucial transport hub. Located on the Danube River, a key E VII European Traffic Corridor segment and one of Europe's principal waterways, the city also lies along a significant railway line connecting Istanbul, Athens, and Budapest. Novi Sad is well connected to Belgrade by train, with more than 10 departures per day and an average one-way journey duration of less than one hour. Additionally, it sits on the E-75 highway, part of the European Traffic Corridor X. Novi Sad's current transportation infrastructure and upcoming projects will further enhance its connectivity and solidify its role as a macro-regional hub.

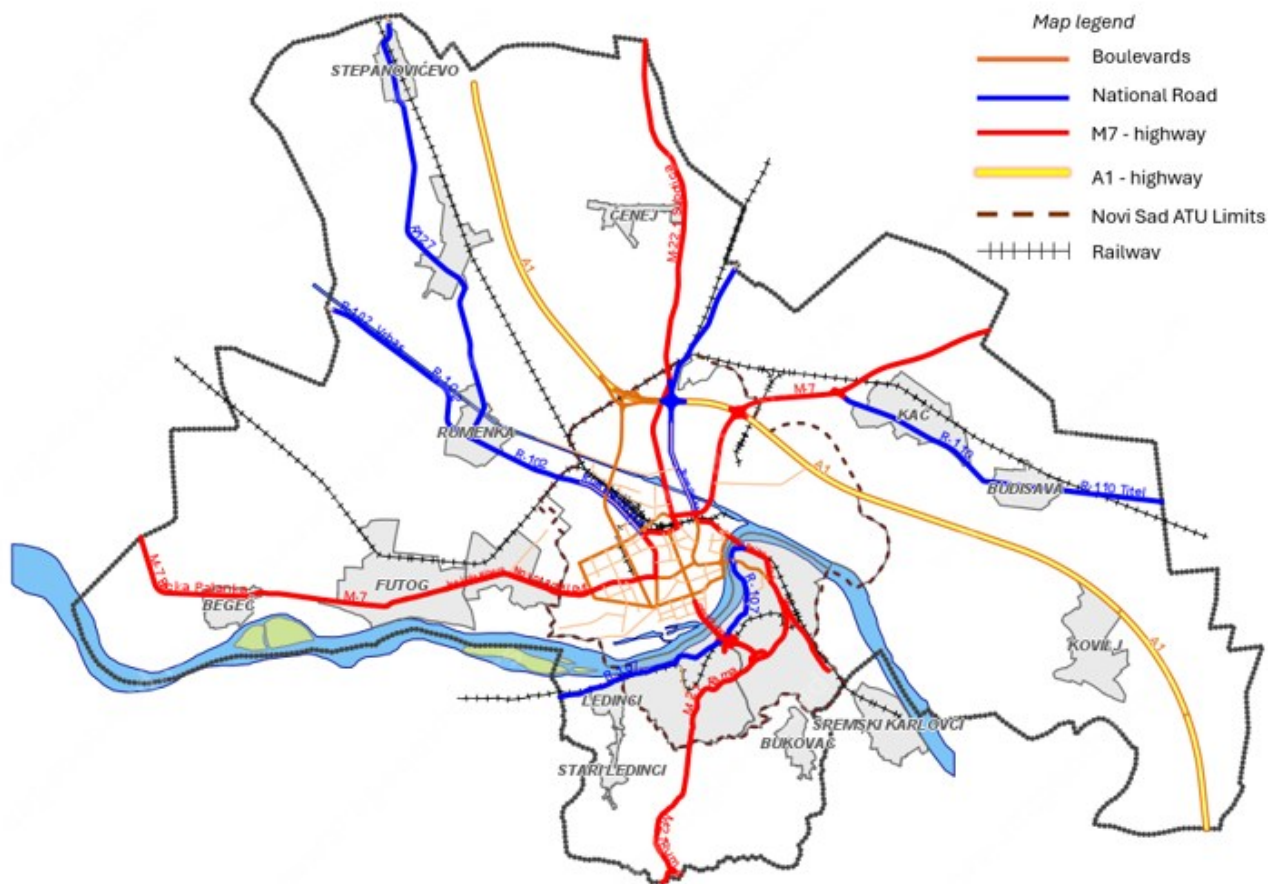


Figure 11 Transport infrastructure map of the City of Novi Sad  
(<http://www.mapanovisad.rs/mapserver2015/nsmaps/#>)

New investments and developments in the transport sector are envisioned, aiming for significant improvements through the promotion of environmentally friendly modes of transport, such as walking, cycling, and public transport. These modes of transport address

the existing challenges caused by the high degree of motorisation, the lack of sufficient parking spaces, and the lack of incentives.

In recent years, the city's road network infrastructure has become more efficient, with the construction of five boulevards, new roads, and the modernisation of the existing ones. A major upcoming contribution is the completion of the new bridge extending Boulevard Europa and the bridge within the Fruškogorsk Corridor.

The parking system in Novi Sad includes parking areas along the streets and dedicated parking zones in the city centre, along the main roads and in residential areas. This service is managed by the Parking Service Novi Sad PUC, which developed a monitoring system for illegal parking. The monitoring system is based on license plate recognition technology, enabling the Municipality to automatically detect and identify illegally parked vehicles. The city parking areas are clustered into four main zones – Extra Zone, Red, White and Blue Zones –, each with different tariffs and time limits. The highest hourly parking fee is in the Extra Zone at 100 dinars per hour (approximately 0.8 EUR/hour), while the lowest rate is in the White Zone at 35 dinars per hour (about 0.3 EUR/hour). In the Red Zone, a maximum parking duration of two hours per day is enforced.

Novi Sad offers residents discounted parking permits in certain regulated parking zones. Residents living in neighbourhoods outside the city centre can park their cars for free. Parking areas in many neighbourhoods are not yet regulated.

The public transport system in Novi Sad is operated by Javno Gradsko Saobraćajno Preduzeće Novi Sad (JGSP), a Municipality-owned public utility company. The fleet comprises 266 buses, out of which 113 are CNG buses and 10 electric buses, including articulated, solo, and mini-buses, serving not only the city but also 5 suburban zones and 4 neighbouring municipalities. EBRD has been constantly engaged in the modernisation of the public transport sector in Novi Sad. Due to the projects financed by EBRD, new electric buses have been procured. The new buses are used on two of the city's busiest routes and replace old, polluting diesel buses, thus helping to reduce air pollution in the city centre. The replacement of the old bus fleet is expected to help reduce greenhouse gas emissions by at least 25% from current levels. The public transport system consists of 21 urban lines and 35 suburban lines, including a key transport point terminal at the train station and a smaller one in the town centre.



Figure 12 Danube Cycle Path, Novi Sad

The motorisation rate rose from 290 cars per 1,000 inhabitants in 2009 to 370 in 2017, accounting for 33% of the city's modal split. Public transport usage declined from 22% to 15% during the same period. As of 2017, the city's modal split also includes cycling at 9%, walking at 40%, and other modes of travel at 3%.<sup>11</sup>

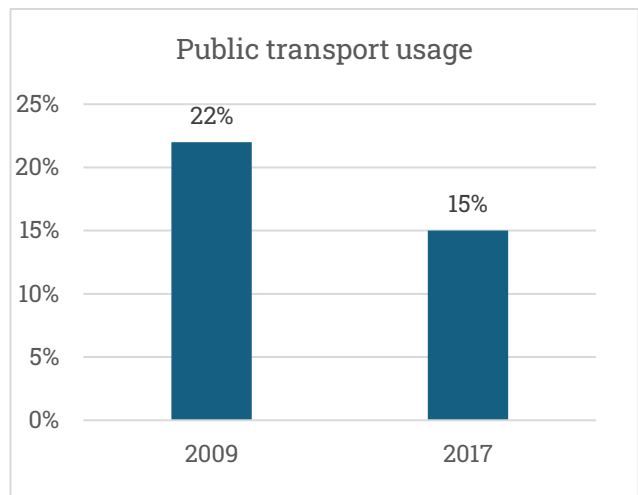
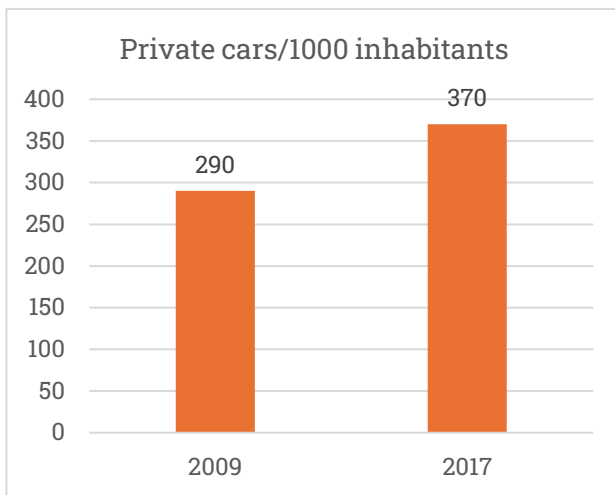


Figure 13 Changes in choices for transportation means 2009 - 2017

Novi Sad is known as a bicycle-friendly city, with an extensive network of over 145 kilometres of bicycle tracks and lanes over 1,100 cycle routes, including the EuroVelo 6 Route, a cycle route linking the Atlantic Ocean and the Black Sea, which passes through Novi Sad, and the 23-kilometre path along the Danube that connects the Novi Sad with Begeč. Also, Novi Sad is a member of the network of cities and regions for cycling; the city has more than 10 cycling associations and is the first city in Serbia to introduce a bicycle rental system.<sup>12</sup>

### Policy Framework

- Development Plan for the City of Novi Sad (2023)
- Smart City Action Plan for Novi Sad (2023)

<sup>11</sup> Novi Sad Mobility: Historical Background and Shifting Planning Paradigms

<sup>12</sup> <https://visitdistrikt.rs/2020/11/12/biciklom-kroz-novi-sad/>

*Prioritised challenges, short-term and long-term GCAP actions*

**Challenges**

The average age of vehicles is quite high

Traffic congestion and low road safety due to heavy traffic

Ascending/ high degree of motorisation corroborated with lack of incentives/ stimulus measures and decreasing usage of public transport

Low level of interconnectivity of different means of transportation

Insufficient branching of bicycle paths in urban and suburban settlements

Limited safe parking facilities both for cars and bicycles

**Short-term actions**

- 1. Public transport modernisation**
- 2. Improvement of the cycling network**
- 3. Network of connected sidewalks around schools & kindergartens**
- 4. Improved traffic management system**

**Long-term actions**

Redesign PT hubs as mobility hubs, including micromobility

Cycling highways

Implementation of a multimodal circulation plan

Promotion of electric vehicles for private transport

Start of implementation

Year 5

Year 15

# Action 1 Public transport modernisation



## GOAL OF THE ACTION

This action aims to develop a robust, safe, comfortable and reliable public transport system in the city and the surrounding settlements. Investments foreseen are related to rolling stock, dedicated bus lanes and mobility hubs. Also, the public transport network will rely on smart solutions and innovations for prioritising public transportation and providing real-time information to passengers related to the location of public transport vehicles and timetables of arrivals and departures.

## CHALLENGE ADDRESSED

- The average age of public transport vehicles is quite high
- Traffic congestion
- Decreasing usage of public transportation facilities
- Low level of interconnectivity of different means of transportation

## STRATEGIC OBJECTIVES

S01

S02



S03



## BENEFITS

- Increased number of PT passengers, lowering private car ownership (decreased air pollution)
- Decreased congestion of bus traffic, leading to an increase in PT use, punctuality and reliability
- Renewal of the bus fleet, leading to increasing the comfort and safety of PT users and better working conditions for employees of PT Company
- Increased average travel speed for buses on the major thoroughfares

## TARGETS

- 70% of buses are electric or reach the EURO4 or higher. Adding 25 new buses to the fleet each year
- 10% citywide increase in the punctuality of PT vehicles and 5% decrease in the average PT travel time due to the installation of 5 Vehicle-Related Integration (VRI) systems and adding 5 km of priority lanes per year
- 10% increase in the amount of regular PT users due to the improved service

## TIMEFRAME

2025–2029

## GHG SAVINGS

151 t CO<sub>2</sub>eq/year

## CAPEX (EUR)

63,610,000

## Context

At present, Novi Sad is facing challenges regarding its public transport system's efficiency and potential usage. The PT network consists of 25 city lines and 26 suburban bus lines. In addition, there are 14 intercity lines that connect Novi Sad with the rest of Serbia. Day tickets cost around €2,4 and single fares about €0,56. Recently (2023), with the support of EBRD, Solaris has delivered 10 electric buses and charging stations to JGSP Novi Sad as a first step in the renewal of their rolling stock. At present, Novi Sad has about 266 busses, of which 143 use Diesel that the Municipality wants to gradually replace with less polluting buses. Serbia's current pollution norms for public transport and other vehicles are nearly fully aligned with EU standards. The country enforces emissions standards based on EURO pollution norms, with new light-duty vehicles required to meet EURO5 standards, while used vehicles, including buses, must comply with at least EURO3 standards.



*Figure 14 Old public transport vehicle - Novi Sad 2024*

Some other challenges are related to the development of bus lanes, which would increase the reliability and punctuality of the most used PT lines, construction of mobility hubs at the busiest PT intersections, and the PT tariffs' alignment with users' needs. By increasing the punctuality and reliability of PT, certain operational benefits will occur, which can lead to an increased bus service, thus to increased passenger numbers. Furthermore, the setting-up of bus stops interconnected with other mobility networks also contributes to the use of public transport.

## Description

This action focuses on modernising public transport in Novi Sad and enhancing mobility through several key initiatives. Plans are underway to renew the bus fleet with low-emission vehicles, preferably electric vehicles, supported by investments in charging infrastructure and ongoing capacity-building for personnel, from procurement and planning

to maintenance. This is an ongoing activity that will be continued up to the moment when all the old diesel public transport vehicles are fully replaced by modern, non-polluting vehicles.

Actions will be also implemented for establishing priority bus lanes on primary public transit corridors, starting with network flow analysis and feasibility studies, followed by ongoing performance assessments.

Mobility hubs will be also developed in order to facilitate smooth modal transfers, beginning with site identification and feasibility studies to address needs like parking, bike sharing, and car sharing, and moving through permitting, construction, and continuous use evaluation.

## Implementation steps

### 1. **Renewal of the bus fleet:**

- Develop procurement plans for acquiring low-emission PT vehicles and supporting facilities.
- Carry out the acquisition of buses.
- Construct and install the charging stations.
- Invest in capacity-building programs for bus lifecycle management, including training for procurement, planning, operation, maintenance staff, and drivers.

### 2. **Establishment of mobility hubs:**

- Identify suitable locations for mobility hubs and modal interchange points.
- Develop and finalise detailed plans for implementation, covering parking spaces, bike-sharing/car-sharing systems.
- Supervise construction activities and evaluate usage effectiveness post-implementation.

### 3. **Development of priority bus lanes and additional public transport infrastructure:**

- Develop feasibility studies and initial planning, including flow analysis to identify bottlenecks and capacity issues in the public transport network.
- Establish dedicated bus lanes.
- Renovate and upgrade bus stops.

### 4. **Enhancement of the operational performance and integration of smart and digital elements:**

- Evaluate the current tariff system and propose necessary adjustments to enhance accessibility and operational performance.
- Implement real-time dynamic passenger information systems to improve passenger experience.
- Integrate PT management with e-mobility and smart charging systems.
- Connect the digital platforms with broader citywide systems, such as **Action 21 on Smart city**.

## Stakeholders

JGSP Novi Sad, Municipality

## Estimated costs

Item	CAPEX (EUR)	OPEX (EUR/year)
Replacing rolling stock of fleet: electric buses, 600,000 EUR/bus, 10 new buses per year and buses with lower pollution norm (EURO4 or higher) 300,000 EUR/bus, 15 new buses per year, 3 charging stations @ 70,000 EUR/unit	52,710,000	1,000,000
Mobility Hub infrastructure – at least one hub in the upcoming 5 years	200,000	20,000
Feasibility study for priority bus lanes	300,000	
Priority bus lanes, 350,000 EUR/KM, 5 Km per year over 5 years	8,750,000	200,000
Modernisation of bus stops, at least 10 stops/year @ 7,000 EUR/bus stop	350,000	3,500
Intelligent VRIs with adaption to bus traffic, 50,000 EUR per installation, 25 installations over 5 years	1,250,000	100,000
Operational performance assessment – analysis of PT tariffs	50,000	
<b>TOTAL</b>	<b>63,610,000</b>	<b>1,323,500</b>

## Potential sources of financing

Municipal budget, state budget, IFIs

## Social and gender aspects

This action will also consider gender equity and inclusivity aspects such as:

- Stimulate career path for PT drivers of (e-)vehicles.
- New buses will also comply with international standards on inclusiveness and accessible design.

This action is expected to have a **moderate positive impact** on social and economic inclusion, and gender equality aspects.

## Smart and digital aspects

The provision of dynamic digital passenger information (such as real-time schedule, occupancy rate, and travel time) via panels and applications can facilitate the use of public transport. Furthermore, this data can be used also to monitor public transport systems.

Integrate the public transport management system with passenger information system, (e)micro-mobility and smart charging system for optimal public transport functioning. The passenger information system will be connected and can rely on the existing digital platform under development by the Municipality (see **Action 21**) and with the city traffic management system (see **Action 4**).

Mobility Hubs will also include digital components and smart facilities such as charging stations for e-bikes and smart information boards.

VRI systems (Vehicle-Related Integration) are technologies that allow public transport vehicles, like buses, to communicate with traffic signals and other infrastructure to optimise traffic flow. For instance, VRI can enable traffic lights to give priority to buses, allowing them to pass through intersections with reduced waiting times. This technology helps improve the efficiency and reliability of public transport by reducing delays and improving schedule adherence on busy routes.

## Correlation with other GCAP actions

Action	Explanation
Action 2. Improvement of the cycling network	An improved cycling network will complement public transport by providing first-mile and last-mile connectivity options.
Action 3. Network of connected sidewalks around schools	Safe and well-connected pedestrian infrastructure will support access to public transport, ensuring an inclusive and multimodal urban mobility system.
Action 4. Improved traffic management system	Enhancing the efficiency and punctuality of public transport by prioritising public transport lanes and optimising urban mobility.
Action 16. Implementation of a citywide two fractions waste collection system	Coordination between waste collection logistics and public transport routes can help reduce congestion and improve traffic flow.
Action 21. Smart city	Digital tools to optimise public transport operations and enhance the user experience.

# Action 2 Improvement of the cycling network



## GOAL OF THE ACTION

Investments will expand and improve the quality of non-motorised transport networks at metropolitan level. This will include: expanding the existing bike network, constructing dedicated bike lanes, and installing smart traffic lights for micro-mobility vehicles.

## CHALLENGE ADDRESSED

- Traffic congestion
- Low road safety due to heavy traffic
- Insufficient branching of bicycle paths in urban and suburban settlements
- Limited safe parking facilities both for cars and bicycles

## STRATEGIC OBJECTIVES

S01		S02		S03
	<small>STRATEGIC OBJECTIVE 1</small> <b>Urban Green Renewal</b>		<small>STRATEGIC OBJECTIVE 2</small> <b>Towards net-Zero Emissions</b>	

## BENEFITS

- Reduced traffic congestion, emissions and noise linked to the decrease in journeys by car
- Increased quality and number of journeys by bicycle / other non-motorised means of transport
- Fast and easy connectivity between points of interest in the city
- Increased safety for all traffic participants
- Improved health and improved community cohesion

## TARGETS

- Construction of bike lanes, including rapid transit bike paths, 5 km/year
- Installation of smart traffic lights, 5 intersections/year
- The number of journeys by bicycle / other non-motorised means of transport increased by 10% per year

## TIMEFRAME

2025–2029

## GHG SAVINGS

322 t CO<sub>2</sub>eq/year

## CAPEX (EUR)

12,100,000

## Context

Biking has a long tradition in Novi Sad. While bike usage has decreased in the last 30 years due to convenience and accessibility aspects, in the last few years, the population of Novi Sad has started to pick up cycling again as a form of transport more extensively. The share of cyclists has increased from 3,5% in 2010 to 9% in 2017.



Figure 15 Glimpse into the history of cycling in Novi Sad

The current transport system is characterised by the preference of residents to travel by private car, which puts high pressure on the road infrastructure, generates traffic congestion at peak times, and leads to a low-quality cycling experience in public spaces. Non-motorised trips are not considered alternatives in the true sense but offer solutions for small-scale accessibility, for the last hundreds of meters, to services, schools and workplaces. Among these, cycle paths have the potential to offer alternatives on a large scale, connecting essential areas of the city or making a link between the city centre, the suburbs and the economic activities (retail/industry) to the north of the centre.

The realisation of the new Bypass Route (Highway) might offer opportunities regarding cycling infrastructure. Furthermore, the Municipality has already built the Danube Cycling Road connecting Backi Breg, Novi Sad, Beograd and Bregovo (total length of 665 km), which can serve as a prime example to more cycling paths to build.

## Description

This action aims to create a safe, well-connected, and functional cycling network in the metropolitan area in order to transform Novi Sad and its suburbs into a bicycle-friendly city. Also, the action will contribute to better connected biking routes. The action is complementary to **Action 19 on Green city landmarks**, which includes a new

pedestrian/cycling bridge over the Danube connecting the urbanised area of the city with the Petrovaradin fortress and the green areas around it. Also, this action aims at improving city accessibility for tourists, offering cycling as an alternative when visiting the city.

The development of a comprehensive package of measures for the creation of a cycling network will include:

- Identification of optimal solutions to increase accessibility for cyclists at intersections linked to the cycling networks
- Provision of bicycle parking facilities near public buildings, public spaces, and private buildings
- Integration of cycling paths and cycling parking facilities with public transport (Mobility Hubs)
- Planning stages of the first bicycle highway (other than the Danube Cycling Road)
- Awareness-raising activities

Although primarily about mobility, expanding and upgrading bike paths regenerates streets and public realms, especially in densely built zones. Safe crossings and attractive cycle routes all serve as catalysts for urban renewal along their corridors.

## Implementation steps

### 1. Development of a Strategic Plan for Cycling Infrastructure:

- Conduct an assessment of the current cycling network to identify missing links and critical intersections.
- Propose a comprehensive plan for cycling network expansion, including rapid transit bike paths and dedicated bike lanes.
- Align with broader urban planning initiatives such as the Danube Cycling Road and **Action 19 – Green city landmarks**.
- Develop a feasibility study for cycling highways.

### 2. Development of cycling infrastructure:

- Construct cycling paths to connect major urban and suburban areas, prioritising functional routes between districts.
- Integrate cycling infrastructure with mobility hubs, including railway stations and bike parking facilities (**connection with the Mobility Hub component of Action 1**).

### 3. Integrate smart elements:

- Install smart traffic lights in critical intersections.
- Design an app to provide real-time information about the cycling network, routes and connectivity, incorporating user-friendly features for residents and tourists, integrating this step with **Action 22 on the Development and implementation of a sustainable tourism strategy**.

### 4. Awareness-raising and promotion:

- Organise campaigns to encourage cycling as a preferred mode of transport.

## Stakeholders

Novi Sad Municipality, NGOs, Private sector

## Estimated costs

Item	CAPEX (EUR)	OPEX (EUR/year)
Strategic Plan for Cycling	200,000	
Feasibility study first cycling highway	150,000	
Construction of bike path, including high-speed bike lanes, 5 km/year and bike parking facilities at mobility hubs in the coming 5 years	10,000,000	100,000
Development of a mobile app for cycling	200,000	2,500
Installation of smart traffic lights, 5 intersections/year in the coming 5 years	1,500,000	
Awareness raising campaigns – one campaign/year	50,000	15,000
<b>TOTAL</b>	<b>12,100,000</b>	<b>117,500</b>

## Potential sources of financing

Novi Sad Municipality – Local Budget, IFIs and/or EU funds available in the transport sector or other funding programs

## Social and gender aspects

Cycling can be a very pleasant activity, with health benefits and can bring people together, thus contributing to higher social cohesion within a community. Also, the NGOs currently active in Novi Sad very much support cycling and contribute to the development of an inclusive mobility system where a non-motorised system is integrated with the motorised one.

Safe and pleasant routes for non-motorised travel create the premises to modal shift towards sustainable modes of transport by creating a public space that motivates people to cycle.

This action is expected to have a **significant positive impact** on social and economic inclusion, and gender equality aspects.

## Smart and digital aspects

The action will result in improvements to the existing bike-sharing system also by including digital/smart elements. The Municipality will leverage data from an existing cycling app to understand better cycling patterns in the city, by adding more smart elements and information which help the user to access easily the bike-sharing facilities.

The introduction of smart traffic lights for cycling lanes will contribute to the safe and convenient commuting of bikers.

The mobile application system for cycling will enhance the bike users' experience.

## Correlation with other actions

Action	Explanation
Action 1. Public transport modernisation	Expanding and improving the cycling network will complement public transport by providing first-mile and last-mile connectivity, encouraging multimodal travel.
Action 3. Network of connected sidewalks around schools & kindergartens	Safe cycling infrastructure will enhance accessibility for students and pedestrians, supporting active mobility around educational institutions.
Action 4. Improved traffic management system	Smart traffic management, including traffic signal prioritisation and cycle-friendly junctions.
Action 19. Green urban landmarks	The cycling and pedestrian bridge component of Action 19 is complementary to the proposed cycling network.
Action 21. Smart city	Digital cycling route mapping, smart traffic signals, and bike-sharing platforms will improve cycling convenience and accessibility.
Action 22. Development and implementation of a sustainable tourism strategy	Expanding the cycling network will promote eco-friendly tourism by providing safe and attractive routes for visitors exploring the city.

# Action 3

## Network of connected sidewalks around schools & kindergartens



### GOAL OF THE ACTION

The pedestrian infrastructure will be developed in order to increase the overall quality of the pedestrian experience in the public space, as well as to increase traffic safety. Investment into pedestrian infrastructure will mainly cover the school and kindergarten zones. Instating these sidewalks is just the first step. Speed reducing measures, visibility of school zones and setting up educational/community systems also contribute to safer school environments.

### CHALLENGE ADDRESSED

- Traffic congestion
- Low road safety due to heavy traffic
- Low level of interconnectivity of different means of transportation

### STRATEGIC OBJECTIVES

S01



STRATEGIC OBJECTIVE 1  
Urban  
Green  
Renewal

S02

S03



STRATEGIC OBJECTIVE 3  
Smart  
Innovative  
City

### BENEFITS

- Decreased number of journeys by car
- Improved air quality, limited noise levels and increased quality of the pedestrian experience in public spaces
- Increased accessibility to and between functions within the city
- Increased traffic safety by limiting the number of accidents

### TARGETS

- Reduce with 25% the number of accidents in the selected school areas of the city
- Construct or redesign pedestrian routes, 5 km/year
- Implement 30 km/h regimes in selected school areas<sup>13</sup>

### TIMEFRAME

2025–2027

### GHG SAVINGS

N/A

### CAPEX (EUR)

8,170,000

<sup>13</sup> The implementation of the 30km/h regime will gradually be done in certain school areas and then expanded to other areas.

## Context

Besides the development of the cycling network, Novi Sad will also improve the pedestrian infrastructure. At present, not all school or kindergarten areas are provided with appropriate pedestrian walkways. In addition, some of the pedestrian routes are not well connected, thus discouraging their usage, since obstacles are present and citizens cannot easily and safely reach certain school areas on foot.

The study carried out as part of this action will focus on the pedestrian routes in school zones and will identify the most important ones which will be developed and/or enhanced in order to include smart and green elements, such as smart city furniture, where people can re-charge their electronic appliances, green areas, which will ensure shading of walking routes, etc.

Furthermore, measures to ensure speed management and school zone visibility can also be taken to further improve the road safety around these school zones.

## Description

A safe walking environment will be created around the schools, connecting major parts of the city and allowing citizens and visitors to enjoy the pedestrian walkways of the city. As such, this action focuses on the development of pedestrian facilities in school zones to facilitate micro-mobility and access to local schools, as well as community centres, shops and markets, green spaces, children's playgrounds, etc. The developed pedestrian infrastructure will also include green elements, such as green zones, bushes, etc., that will contribute to reducing air pollution around school areas.

At the same time, an inventory of all pedestrian crossings in school zones needs to be done to prioritise the infrastructure investments and to set up visible school zones.

The concrete measures to be implemented are:

- Establishing a clear view of which school zones to prioritise for the implementation of sidewalks. This can be done by analysing speed, traffic flows and accident databases;
- Setting clear and safe school paths allowing children to access schools safely;
- Implementing sidewalks and crossings where needed on these safe school paths, allowing children safe passage;
- Setting up speed reductions and visible zones for the school zones;
- Adding road safety education and community activities into the mix of actions. With interactive classes and neighbourhood activities, one can teach schoolchildren real-life traffic experiences. Also, the educational programme will include training for school crossing guards to support children when coming/leaving to/from school.

The action targets pedestrian safety and accessibility near educational institutions. These upgrades to sidewalks, crossings and public spaces not only address mobility and safety

concerns but also bring about small-scale rejuvenation of the surroundings, encouraging more walkable, community-friendly streets.

## Implementation steps

- 1. Conduct a comprehensive Traffic Safety Study:**
  - Identify critical school zones requiring improved pedestrian infrastructure.
  - Analyse speed, traffic flows and accident databases to prioritise zones.
- 2. Development of a Safe-to-School plan:**
  - Outline detailed measures for improving pedestrian routes in selected school zones and propose enhancements such as green areas and shaded walkways.
- 3. Implementation of pedestrian infrastructure:**
  - Construct or redesign sidewalks and safe pedestrian crossings in prioritised zones.
  - Integrate green elements like trees and bushes for air quality improvement and shading.
- 4. Enhancement of school zone visibility and setting up of educational and community engagement programmes:**
  - Establish visible school zones with speed reduction measures, dynamic traffic signs and improved signage.
  - Organise road safety education for children through interactive classes and activities.
- 5. Monitoring and evaluation:**
  - Monitor the effectiveness of implemented measures using traffic counting sensors and community feedback.

## Stakeholders

Planning and Urbanism Department of the Municipality, NGOs, citizens, teachers, parents

## Estimated costs

Item	CAPEX (EUR)	OPEX (EUR/year)
Traffic Safety Study	100,000	
Safe-to-School Study – at least 2 school areas in the coming 3 years	50,000	
Construction of pedestrian routes, 5 km, including smart elements and green zones along or integrated into the routes	8,000,000	80,000
Materials for school visibility and educational program for selected school areas (at least 2 schools)	20,000	10,000
<b>TOTAL</b>	<b>8,170,000</b>	<b>90,000</b>

## Potential sources of financing

Local budget; IFIs

## Social and gender aspects

Children are vulnerable road users with limited accessibility to transportation modes. Therefore, it is important that a safe network of sidewalks is created for their daily commuting. Also, the pedestrian sidewalks will be designed in line with international best practices for mobility-challenged persons.

The consultation process aimed at selecting the priority zones for pilot projects will be inclusive and gender sensitive.

This action is expected to have a **significant positive impact** on social and economic inclusion, and gender equality aspects.

## Smart and digital aspects

In order to increase the visibility of school areas, digital tools can be implemented. The installation of dynamic traffic signs is a convenient method to raise awareness regarding these areas. Also, digital information panels can inform citizens about parking occupancy in the proximity of school areas. Monitoring the redesign of school areas can be done by traffic counting sensors. In this way, up-to-date data can be gathered and analysed.

## Correlation with other actions

Action	Explanation
Action 1. Public transport modernisation	Well-connected pedestrian routes will improve access to public transport stops, encouraging safer and more sustainable commuting options for students and caregivers.
Action 2. Improvement of the cycling network	Integrating pedestrian and cycling infrastructure will create a safer environment for active mobility, reducing traffic conflicts near schools and kindergartens.
Action 4. Improved traffic management system	Implementing smart traffic control measures, such as speed restrictions and pedestrian-priority zones, will enhance road safety and walkability in school areas.
Action 19. Green urban landmarks	Incorporation of green spaces into pedestrian routes to improve air quality, provide shading, and create a more pleasant environment for walking.

## Action 4 Improved traffic management system



### GOAL OF THE ACTION

This action aims to implement a traffic management system that will improve access of the population to clean mobility and will balance the increased efficiency and safety of some modes against the delay experienced by other traffic modes. Also, the Municipality is aiming to establish a City Traffic Management Center which will monitor, coordinate and guide the city traffic.

### CHALLENGE ADDRESSED

- Traffic congestion
- Low road safety due to heavy traffic
- Low level of interconnectivity of different means of transportation
- Limited safe parking facilities both for cars and bicycles

### STRATEGIC OBJECTIVES

S01

S02



STRATEGIC OBJECTIVE 2  
Towards  
net-Zero  
Emissions

S03



STRATEGIC OBJECTIVE 3  
Smart  
Innovative  
City

### BENEFITS

- Improved traffic flows
- Reduced travel time
- Reduced air and noise pollution
- Reduced occurrence of traffic congestions
- Income from traffic fines
- Decreased operating costs for public transport
- Reduced GHG emissions

### TARGETS

- Decrease the number of accidents by 30% in 5 years' time, especially with pedestrians and cyclists
- Decrease the amount of unwanted (freight) traffic citywide by 25%
- Reduced number of on-street parking spaces in the public domain in the city centre by 50%, in 5 years after GCAP approval

### TIMEFRAME

2026–2027

### GHG SAVINGS

N/A

### CAPEX (EUR)

1,150,000

## Context

Traffic is the main source of air pollution in Novi Sad. Although there is no clear data on the daily freight truck volume that passes the city, it has been observed that heavy freight activity is significant due to Novi Sad's position along major trade routes. Through the Danube, the city connects shipping and regional highway routes, serving as a key transport hub for Serbia. Much of the freight movement relates to exports, facilitated by logistics companies and ports like Constanta in Romania, where goods transit to broader European and international markets. Local traffic and logistics companies have increased operations recently, especially with larger vehicles and river transport via Novi Sad's port facilities.

Traffic management can be seen as a combination of measures meant to preserve traffic capacity and improve the security, safety and reliability of the overall road transport system. An efficient and effective traffic management system will improve traffic flows and lead to reduced air and noise emissions and improved air quality. The traffic management system will also improve the access of the population to faster and cleaner ways of transportation via the city. The system will focus on prioritising alternative means of transportation against private car usage. The implementation of a traffic management system takes place at different levels of scale: the city as a whole, neighbourhood level, intersection level and road segment level. At these different levels, different traffic modes interact, and traffic networks overlap and intersect. For example, the following measures can be implemented in a traffic management system:

- traffic light optimisation;
- route restrictions (for trucks), one-way traffic, etc.;
- right-of-way restrictions (e.g. priority regulations or signals) including intersection redesign;
- speed limits;
- parking guidance.

## Description

The aim of the action is therefore to implement a traffic management system that balances the increased efficiency and safety of some modes against the delay experienced by other traffic modes. Smart and digital techniques can help (real-time) monitor the traffic and can provide data for the development of the management plan in an early stage.

This action focuses on the development of a traffic management action plan at the various levels of scale as described above. It also aims at the implementation of a pilot with license plate recognition. Also, the action foresees to set up the City Traffic Management Centre (CTMC), which will be the operational unit responsible for traffic management. This will be under the direct coordination of the Department for Traffic and Roads within the Municipality.

The pilot project will be set up to improve liveability in a certain neighbourhood. Automatic Number Plate Recognition (ANPR) will be used to ensure that these rules are followed. The

cameras are placed at different locations to act against unauthorised traffic – in this case, freight traffic (>3.5 tons) could serve as a test case.

## Implementation steps

- 1. Development of a road network hierarchy, modal priority study and a traffic management action plan:**
  - Identify priority routes for different transport modes and conduct baseline studies to assess traffic flow, congestion hotspots and interaction points between modes.
  - Develop the traffic management action plan, including designs for targeted measures such as traffic light optimisation, route restrictions, one-way streets, junction redesign and parking guidance, integrating smart technologies to enhance system efficiency.
- 2. Establishment of the City Traffic Management Centre (CTMC):**
  - Set up a facility with the required equipment and software for monitoring and managing traffic data.
  - Train CTMC operators to manage operations and respond to real-time traffic conditions.
- 3. Implement a pilot project with an Automatic Number Plate Recognition (ANPR) system:**
  - Install ANPR cameras in selected areas to monitor and regulate unauthorised traffic.
  - Evaluate pilot outcomes for potential expansion citywide.
- 4. Development of a public parking optimisation study:**
  - Develop a comprehensive citywide parking policy to optimise public parking areas.
  - Implement a pilot project based on study recommendations.
- 5. Monitoring and continuous improvement:**
  - Use real-time traffic data and system analytics to monitor performance.
  - Adjust measures as needed to improve traffic flow, reduce delays and enhance safety.

## Stakeholders

Architecture and Urban Planning Department, Department of Traffic and Roads, national authorities, Novi Sad General Police Inspectorate, research organisations, IT consultants

## Estimated costs

Item	CAPEX (EUR)	OPEX (EUR/year)
Study of the modal hierarchy in the road network	100,000	
Traffic management action plan	100,000	
Setting up the city traffic management centre – equipment and software for the operation of the data provided by the pilot project	500,000	100,000

Item	CAPEX (EUR)	OPEX (EUR/year)
Trainings for CTMC operators	100,000	
Pilot project with ANPR	300,000	30,000
Develop a study on the optimisation of public parking areas and the development of a citywide parking policy	150,000	
<b>TOTAL</b>	<b>1,250,000</b>	<b>130,000</b>

## Potential sources of financing

Municipal budget, IFIs

## Social and gender aspects

Opportunities for women and community-based organisations to be engaged in the decision-making process related to the traffic management plan.

Introduction of specific measures ensuring accessibility for people with disabilities and making the roads safer for their travel.

Introduction of safety measures targeting the reduction of car incidents at the city level and especially around schools, kindergartens, markets, elderly centres, etc.

This action is expected to have a **moderate positive impact** on social and economic inclusion, and gender equality aspects.

## Smart and digital aspects

The use of technology, such as ANPR cameras is an essential part of traffic management. In the future, it is also possible to look at ITS applications that build on this pilot and extend the traffic management plan. The installed ANPR cameras can be used for other applications as well, for example, the monitoring of a low-emission zone.

For the development of the Traffic Management Plan, the Municipality will develop an Agent-Based model of traffic patterns in the city which will enable the Municipality to define better development objectives and to be able to forecast the traffic flows and further needs.

The City Traffic Management Centre (CTMC) will include smart equipment and software which will enable the Municipality to process data and monitor the traffic in the city.

## Correlation with other actions

Action	Explanation
Action 1. Public transport modernisation	Enhancing public transport efficiency, reducing delays and congestion through smart signalling and prioritised bus lanes.

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Action 2. Improvement of the cycling network	Integration of cycle-friendly infrastructure, ensuring safe crossings, dedicated lanes, and improved cyclist visibility at junctions.
Action 4. Improved traffic management system	Traffic calming measures to increase safety around schools and kindergartens.
Action 16. Implementation of a citywide two fractions waste collection system	Optimising waste collection routes and schedules will reduce unnecessary traffic congestion.
Action 21. Smart city	Smart technologies, such as real-time traffic monitoring and adaptive signal control will contribute to more efficient mobility.

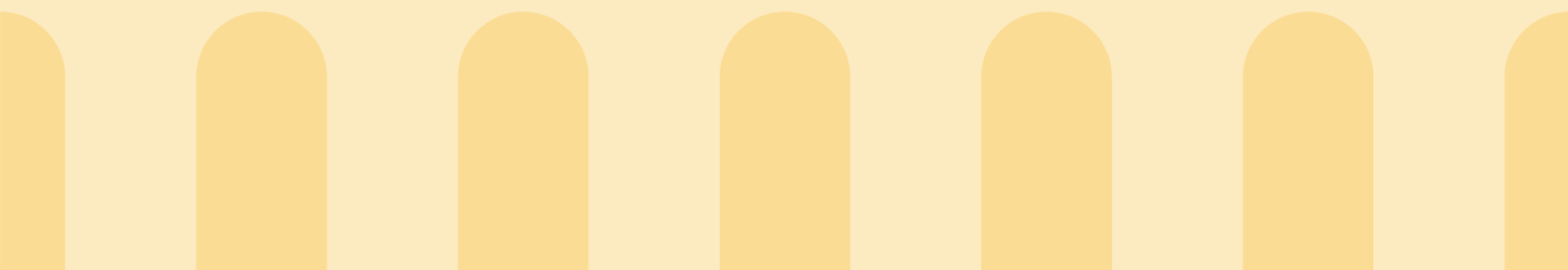
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**Novi Sad**

Green City Action Plan

# Energy & Buildings



## Sector overview

### *Baseline*

In Novi Sad, nearly the entire population (over 99.9%) is connected to the electricity network, with connections rigorously monitored by the distribution system operator. Consumption is measured precisely, and any unauthorised connection or unpaid account result in a suspension of electricity services. This achievement reflects a well-regulated and efficiently managed electricity distribution system.

The primary supplier and distributor in the region, Elektrodistribucija Srbije (Electricity Distribution of Serbia) operates locally through Elektrodistribucija Novi Sad, while other private energy firms also contribute to the energy system using the services of the distribution operator. Within Novi Sad, electricity is delivered via an extensive low-, medium-, and high-voltage distribution network spanning a total of 5.7 km. This includes 3.6 km low-voltage power line and 2.08 km medium- and high-voltage power line.

The city's public lighting system, encompassing both Novi Sad and its suburban areas, consists of high-pressure sodium lamps (60%), LED fixtures (22%), and high-pressure mercury lamps (11%), collectively consuming 21,000 MWh. An energy efficiency initiative aims to significantly upgrade this system, focusing primarily on replacing outdated mercury vapour lamps with more efficient LED options.

Heating in Novi Sad is supplied exclusively by PUC Novosadska Toplana. The district heating network operated by the company has an installed capacity of 936 MW, covering 76% of the city and heating over 5.3 million m<sup>2</sup>. The system provides heating for 113,301 connected users (105,384 of whom are residential) through a 239.5 km distribution network, with 3,063 primary heat substations, and 20,000 calorimeters. The heating plant utilises the TERMIS software platform for real-time management, incorporating weather data to forecast demand and optimise energy production, ultimately enhancing decision-making and network planning.

Renewable energy sources (RES) currently play a limited role in the energy mix of Novi Sad. A 2014 study highlighted the potential of biomass, hydropower, solar, and geothermal resources. Plans regarding the building of a solar-thermal plant aim to increase RES share in the district heating system. According to feasibility studies, this plant could meet 20% of the city's heating demand by generating 29 GWh with solar collectors, 39 GWh with electric boilers, and 98 GWh using heat pumps, with stored energy from the CHP plant, totalling about 236 GWh. The system would store solar energy collected during summer and surpluses of cheap electricity for efficient winter heating distribution through heat pumps.

Regarding the building sector, most of the data used for the baseline assessment is provided by the Energy Agency Novi Sad and the PUC Novosadska Toplana. Energy Agency Novi Sad collects data on electricity and heat consumption in public buildings as part of its responsibilities determined by the Municipality. The residential building stock of Novi Sad

consists of 57,824 structures, the majority being erected between 1991 and 2010. Public buildings, totalling 308 structures, were predominantly built between 1980 and 2000, and indicate a high thermal energy consumption.

In addition to ongoing improvements in energy efficiency within the district heating system and public lighting, the energy rehabilitation of public buildings is a key priority for the Municipality for future investments in the following years. From 2025 to 2027, the Municipality plans to renovate 22 kindergartens, 4 primary schools, 3 social welfare facilities, 2 administrative buildings, and 1 high school, all of which have determined energy savings targets to be achieved by energy efficiency measures. Such improvement activities focus on the rehabilitation of the buildings' thermal envelope and systems for maintaining thermal comfort and enhancing the buildings' overall energy efficiency. The implementation plan targets 5 buildings to be rehabilitated for 2025, 14 for 2026, and the final 12 in 2027.

Additionally, around 100 residential structures covering nearly 340,000 m<sup>2</sup>, are about to receive investments for energy efficiency. According to data presented in the Energy Efficiency Program for the city of Novi Sad, these buildings consume around 46 GWh of thermal energy annually for heating. Once the energy efficiency measures are completed, savings of 16 GWh/year are expected (a scenario where 35% savings are achieved).

#### *Policy Framework*

- The Energy Efficiency Programme of the City of Novi Sad 2022-2024
- Law on Energy Efficiency and Rational Use of Energy (Official Gazette of RS 40/2021)
- Long-Term Strategy for Encouraging Investments in the Renovation of the National Building stock of the Republic of Serbia until 2050 (Official Gazette of RS 27/2022)

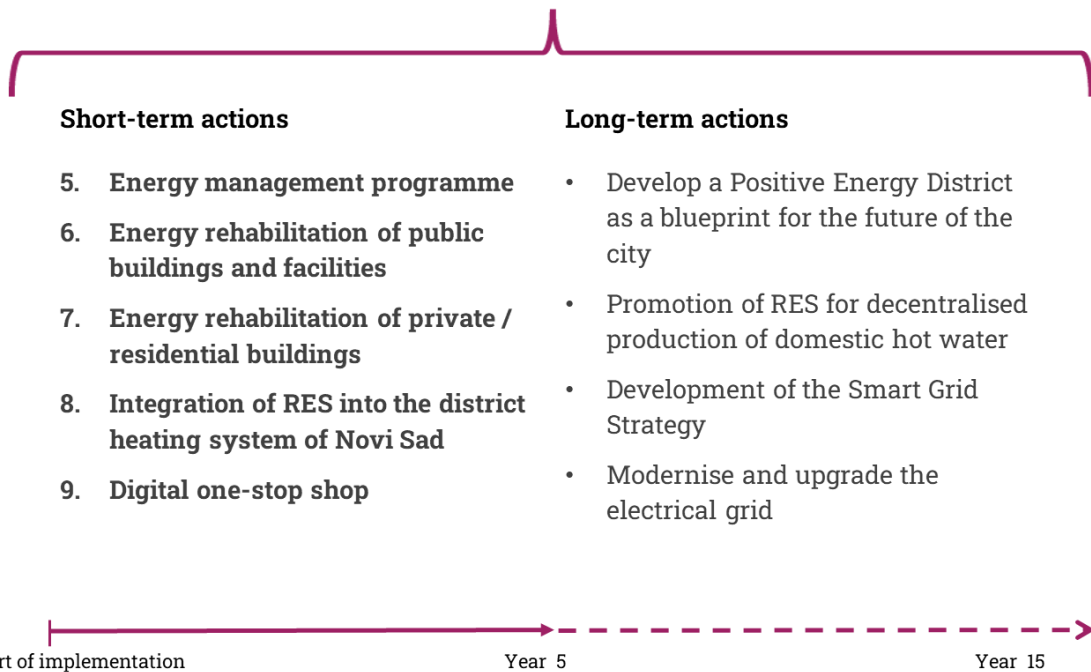
*Prioritised challenges, short-term and long-term GCAP actions*

**ENERGY challenges**

- Insufficient capacity of Energy Agency Novi Sad and completing of the introduction of an energy management system in the city administration;
- Dependence of the city district heating system on the supply of imported natural gas;
- Low share of RES in the local energy mix;
- Lack of renewable energy sources in the district heating energy mix; ;
- No consumption-based heat billing for households; This challenge is connected with thermal rehabilitation need of residential buildings with very high specific heat consumption and need to install necessary measurement equipment in individual flats;
- Renewable energy systems are not incentivised through fiscal instruments and awareness campaigns;
- The resilience of electricity and gas networks in case of disaster needs testing to identify further upgrade needs.

**BUILDINGS challenges**

- Buildings are energy intensive, resulting in a negative impact on the environment. Building rehabilitation & modernisation are not widespread;
- There is insufficient investment in energy efficiency in buildings, as well as a gap in terms of public and private financial schemes aimed at improving the poor quality and performance of existing buildings;
- Due to the significant volume and complexity of work and responsibilities in the building sector, local administration and institutions need to strengthen their operational capacity;
- Metering and billing of individual household heat consumption is not widespread.
- Renewable energy systems in residential and non-residential buildings are not incentivised through fiscal instruments and awareness campaigns. There is no integrated vision promoting and supporting public and private investments in RES technologies;
- There are no Building Standards / Codes for Green Buildings or nearly Zero Energy Buildings (nZEB), nor certified buildings according to International Green Buildings Certification Systems (BREEAM, LEED etc.). In addition, there is a lack of fiscal instruments and awareness campaigns aimed at green building promotion;
- At the moment there is no official document to report buildings and city infrastructures at risk in case of a major earthquake or other natural disasters;



# Action 5 Energy management programme



## GOAL OF THE ACTION

This action focuses on the comprehensive improvement of energy management in Novi Sad through the development of an energy management programme. Key components include mapping public building roofs for solar collectors/PV installations, developing an energy efficiency programme, promoting energy efficient behaviour through educational campaigns, and implementing automated energy management systems and a digital energy management platform for real-time monitoring and control of energy use in public buildings.

## CHALLENGE ADDRESSED

- Lack of data on potential renewable energy production in public buildings
- Low adoption of energy efficiency measures and renewable energy technologies in public buildings
- Limited public awareness of energy-saving behaviours
- Insufficient data collection and management of energy consumption, preventing efficiency improvements

## STRATEGIC OBJECTIVES

S01

S02



S03



## BENEFITS

- Increased knowledge and skills of municipal technical staff on energy consumption and renewable energy potential
- Optimised energy use through smart energy management systems
- Increased public awareness of energy efficient practices, leading to long-term energy savings
- Reduced dependency on non-renewable energy sources
- Reduction in energy consumption, GHG emissions, and energy costs in public buildings

## TARGETS

- Implement automated energy management systems in five of the largest public buildings and adopt a digital energy management platform by 2026.
- Increase awareness of energy efficiency in 80% of schools and public buildings through educational campaigns by 2026.
- Install solar collectors/PV systems in 5 public buildings, achieving approximately 300 kWp per building by 2027.
- Achieve a 20% reduction in energy consumption in public buildings that have undergone interventions.

## TIMEFRAME

2025–2027

## GHG SAVINGS

4,640 t CO<sub>2</sub>eq/year

## CAPEX (EUR)

2,000,000

## Context

At present, the Municipality of Novi Sad is confronted with challenges regarding the energy efficiency of the public infrastructure and the transition to renewable energy sources. The current energy management system lacks automation and comprehensive oversight, leading to inefficiencies and higher energy costs. For this reason, the Municipality's priority is to optimise energy use in public buildings through investments in renewable energy and automated energy management systems, while also promoting awareness campaigns to encourage energy-saving behaviours among municipal staff and building users.

## Description

The aim of this activity is to set up a comprehensive energy management programme for the Municipality of Novi Sad, focused on improving energy efficiency in public buildings and promoting sustainable energy practices. The program aims at reducing energy consumption and operational costs by incorporating automated energy management systems and increasing the use of renewable energy sources.

To this extent, the action proposes the mapping of roofs on public buildings to identify those suitable for solar collectors and photovoltaic installations, enabling the Municipality to produce energy based on solar energy. This will enhance renewable energy adoption and reduce dependency on conventional energy sources.

This action also foresees the development and adoption of an energy efficiency program, which will outline the necessary measures for the optimisation of energy use in municipal buildings. The program will identify and detail specific measures required to optimise energy consumption, focusing on improving operational efficiency. The program will incentivise the use of automated measurement and control systems. By integrating such technology, the program aims to enhance the performance of municipal buildings, reduce energy costs and pave the way for the adoption of sustainable practices. Action 5 is complementary to **Action 6** which is focused on investments for the rehabilitation of public buildings. All the newly rehabilitated public buildings will also adopt the energy management system.

Finally, this action focuses on developing a digital platform for energy management, allowing for real-time monitoring, control, and optimisation of energy use across the city's public buildings. The collected data will be integrated and embedded in the City digital platform covered by **Action 21**.

This will be complemented by educational and awareness raising campaigns aimed at promoting energy-efficient behaviours, particularly in schools and public offices, ensuring long-term energy savings through behavioural change. Moreover, the program will include specialised trainings for facility managers and municipal technical staff to maximise the benefits of the newly established systems, alongside a framework for periodic evaluations to track progress and identify further opportunities for improvement.

## Implementation steps

1. **Conduct roof mapping for renewable energy installations:**
  - Identify rooftops and spaces suitable for photovoltaic (PV) panels or solar collectors (in correlation with **Action 6. Energy rehabilitation of public buildings and facilities**).
  - Prepare a detailed plan for integrating renewable energy installations into public infrastructure.
2. **Development of energy management programme and feasibility studies:**
  - Develop a comprehensive Energy Management Programme with clear goals, strategies and KPIs.
  - Develop feasibility studies for automated energy management systems and solar collectors/PV systems.
3. **Implementation of the energy management programme:**
  - Install energy monitoring devices and smart systems in public buildings to enable real-time tracking of energy consumption.
  - Develop and deploy a digital energy management platform for central oversight.
  - Mounting solar collectors/PV systems (in correlation with **Action 6. Energy rehabilitation of public buildings and facilities**).
4. **Develop and deliver energy efficiency promotion campaigns:**
  - Launch educational initiatives to promote energy-efficient behaviours among public sector employees and building users.
  - Provide training sessions for municipal technical staff and facility managers on optimising energy use.
5. **Monitoring and reporting:**
  - Establish a system for regular reporting on energy consumption and efficiency improvements.
  - Use collected data to update and refine the Energy Management Programme.

## Stakeholders

Novi Sad Municipality; Energy Agency, Public buildings department; Energy Service Companies (ESCOs); private sector contractors; schools and educational institutions

## Estimated costs

Item	CAPEX (EUR)	OPEX (EUR/year)
Roof mapping for solar collectors/PV installations	100,000	
Energy management programme and feasibility studies for energy management systems and the digital platform	150,000	
Pilot and test digital energy management platform in 5 public buildings	200,000	10,000

Item	CAPEX (EUR)	OPEX (EUR/year)
Solar collectors/PV installations in 5 public buildings (approx. 300 kWp/building)	1,400,000	35,000
Deployment of educational and awareness campaigns	150,000	
<b>TOTAL</b>	<b>2,000,000</b>	<b>45,000</b>

## Potential sources of financing

Municipality of Novi Sad; development banks; Energy Service Companies (ESCOs); donors

## Social and gender aspects

The energy management programme in Novi Sad aims to promote equitable access to energy and address energy poverty, particularly for vulnerable and low-income households under the awareness campaigns. Additionally, the program will incorporate gender-sensitive approaches, ensuring that women and marginalised groups are actively involved in decision-making processes and benefit from educational campaigns on energy-saving practices.

This holistic approach aims to foster social equity and improve the overall quality of life for all citizens.

This action is expected to have a **marginal positive impact** on social and economic inclusion, and gender equality aspects.

## Smart and digital aspects

The action will develop a digital platform for energy management, integrating automated control systems for real-time monitoring and optimisation of energy use in public buildings. This smart energy system will collect and analyse data to drive more efficient energy use and inform future policies. The platform will also be accessible to municipal staff for tracking progress on energy savings and supporting long-term sustainability goals.

## Location of the implementation

The action will be implemented across public buildings throughout Novi Sad, with an initial focus on the largest buildings with the highest levels of energy consumption. The specific locations for solar/PV installations will be identified through the mapping process of suitable roofs in schools, municipal buildings, and healthcare facilities across the city.

## Correlation with other actions

Action	Explanation
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Action 6. Energy rehabilitation of public buildings and facilities	Provision of the necessary data and guidelines for improving energy efficiency in public buildings through monitoring and optimisation.
Action 7. Energy rehabilitation of private/residential buildings	Energy management insights will guide private sector engagement and boost residential energy efficiency.
Action 21. Smart city	Digital energy monitoring tools, automating energy use, and promoting smart grids for better energy distribution and savings.

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# Action 6

## Energy rehabilitation of public buildings and facilities



### GOAL OF THE ACTION

This action focuses on reducing energy consumption in public buildings in Novi Sad through a deep energy retrofit programme. Key components include energy audits, selection of buildings, and retrofitting of the buildings through the implementation of passive and active measures including the integration of smart technologies. A training programme is also needed to be developed and delivered for building occupants, facility managers and maintenance staff.

### CHALLENGE ADDRESSED

- High energy consumption and operational costs in public buildings
- Aging infrastructure and lack of energy-efficient measures
- Increased vulnerability to fluctuating energy prices

### STRATEGIC OBJECTIVES

S01

S02



S03



### BENEFITS

- GHG emission reduction of at least 40% from improved building energy efficiency
- Lower energy and maintenance costs for municipal budgets
- Enhanced comfort and air quality for building occupants
- Improved building data control with smart systems

### TARGETS

- Achieve a minimum energy saving of 35% in retrofitted buildings
- Retrofit a total of an estimated 50,000 sqm of public buildings

### TIMEFRAME

2025–2029

### GHG SAVINGS

2,035 t CO<sub>2</sub>eq/year

### CAPEX (EUR)

25,100,000

## Context

The Municipality of Novi Sad faces considerable challenges in terms of energy efficiency across its public building infrastructure. Many of these facilities are marked by outdated designs and systems, leading to high energy consumption, escalated operational costs, and significant greenhouse gas emissions. The Municipality is committed to significantly enhancing the energy efficiency of these buildings through a targeted retrofit programme. This programme outlines ambitious yet achievable goals for reducing energy consumption and GHG emissions savings, focusing on integrating retrofit technologies such as insulation solutions, energy-efficient windows, smart metering and energy management systems. These initiatives are supported by a framework of local and national policies that promote sustainable development and energy efficiency, aiming to align the urban infrastructure of Novi Sad with broader environmental and sustainability objectives. The program also involves a robust stakeholder engagement strategy, bringing together municipal authorities, energy service companies (ESCOs), and the local community to ensure a collaborative approach to achieving these retrofitting goals. By doing so, the Municipality aims to significantly reduce energy consumption, improve building performance, and contribute to its broader sustainability goals, aligning with national energy efficiency directives and supporting Serbia's climate action commitments.

## Description

The aim of this action is to implement a comprehensive energy rehabilitation programme specifically targeting public buildings across Novi Sad. Public facilities such as schools, hospitals, administrative offices, and cultural institutions, marked by high energy consumption due to ageing infrastructure, will undergo significant enhancements to improve energy efficiency. In the coming years, the Municipality plans to renovate 22 kindergartens, 4 primary schools, 3 social welfare facilities, 2 administrative buildings, and 1 high school. All these buildings are already mentioned in the Energy Efficiency Programme for the City of Novi Sad.

The programme will start with energy audits to assess the current performance of these buildings, identifying those with the highest energy consumption and prioritising them for retrofitting. Additionally, the integration of nature-based solutions (NbS) can provide significant environmental and social benefits. These measures enhance climate resilience, mitigate flood risks and reduce urban heat island effects while improving energy efficiency. These can be both building-level NbS or external area measures. Building-level NbS entail green roofs, living walls, rainwater harvesting systems and natural ventilation design. Possible external area measures are permeable pavements, cool pavements (these reflect more solar energy, lowering surface temperatures), urban greening, retention basins, bioswales and community gardens.

The retrofit measures will include:

- Improving building envelopes by enhancing insulation in walls, roofs, and floors to reduce heat loss and significantly lower energy demand.
- Replacing inefficient windows and doors with high-performance models to minimise heat leakage and thermal bridging, enhancing indoor comfort and reducing energy waste.
- Incorporating natural ventilation systems to improve air circulation and reduce reliance on mechanical ventilation systems. This involves strategically designing and retrofitting buildings to enhance air circulation through passive methods, such as the use of operable windows, vents, and architectural features that facilitate airflow.
- Integrating, where feasible, NbS, such as green roofs and walls to provide natural insulation, reduce heat transfer, and enhance the sustainability of the buildings, rainwater harvesting systems and external area measures, such as permeable pavements, cool pavements and urban greening.
- Upgrading HVAC systems to more energy-efficient alternatives, including heat pumps for buildings not connected with district heating infrastructure.
- Exploring the opportunity to incorporate renewable energy sources such as solar collectors for hot water and solar panels for self-consumption.

The use of smart technologies, including Building Management Systems (BMS) and smart meters, will be promoted to enable real-time energy management. This will assist facility managers in optimising energy usage and ensuring that energy savings are sustained over time.

Upgrading the insulation, lighting and heating systems of public buildings is a powerful tool for urban regeneration. The broader impact is an uplift in local streetscapes and a demonstration effect that often encourages private sectors or other stakeholders to follow suit.

A dedicated training programme for facility managers and maintenance staff will complement the behavioural change programme from **Action 5**, ensuring that the upgraded buildings are used effectively and that operations remain energy efficient.

## Implementation steps

- 1. Develop a comprehensive building assessment program:**
  - Conduct detailed energy audits to assess the current energy performance of public buildings.
  - Identify and prioritise buildings for retrofitting based on energy consumption and potential savings.
- 2. Develop terms of reference (ToR) for renovating projects:**
  - Set minimum energy efficiency requirements and eligible measures.
  - Identify financing opportunities and launch tenders for retrofitting projects.
- 3. Implementation of retrofitting measures:**
  - Launch tenders and select contractors based on cost-efficiency and quality criteria.

- Execute retrofitting measures, including insulation, energy-efficient windows and doors, and HVAC system upgrades.
  - Integrate smart technologies, such as Building Management Systems (BMS) and smart meters for real-time energy tracking.
4. **Training and capacity-building:**
- Develop and deliver training programs for facility managers, municipal technical staff and building users to optimise the operation of rehabilitated buildings.
5. **Monitoring and evaluation:**
- Use digital tools and smart meters to monitor energy savings and GHG emission reductions (in connection with the energy management system).
  - Conduct evaluations to assess the impact of retrofitting measures and identify areas for improvement.

## Stakeholders

Public buildings technical staff and authorities; Energy Service Companies (ESCOs); private contractors; Novi Sad Municipality; development banks

## Estimated costs

Item	CAPEX (EUR)	OPEX (EUR/year)
Energy audits and assessment program	120,000	
Development of ToR for renovation projects	60,000	
Retrofitting of approx. 50,000 sqm of public buildings @500 EUR/sqm, including integration of smart elements	25,000,000	150,000
Deployment and implementation of training programme	20,000	20,000
<b>TOTAL</b>	<b>25,200,000</b>	<b>170,000</b>

## Potential sources of financing

Municipal budget, National Government Funds; EU funds; development banks; Energy Service Companies (ESCOs)

## Social and gender aspects

The retrofitting of public buildings will benefit all, especially vulnerable groups, by reducing energy consumption and operational costs, improving public services, and providing better indoor comfort. Equal opportunities in training and job placement will be ensured during the retrofitting process.

This action is expected to have a **marginal positive impact** on social and economic inclusion, and gender equality aspects.

## Smart and digital aspects

The action will promote the adoption of **Building Management Systems (BMS)** and **smart meters** in rehabilitated buildings, allowing for real-time energy management. Data from these systems will be integrated into a **central Energy Management Platform** (in coordination with **Action 5**), which will help facility managers optimise energy consumption and inform future energy policies. This platform will enable efficient monitoring of energy performance and GHG reductions and will ensure continued sustainability.

Additionally, integrating automated controls, such as sensors that adjust ventilation openings based on temperature, air quality, or humidity levels, can further optimise their effectiveness, ensuring a seamless balance between energy savings and indoor air quality.

## Location of the implementation

The action will be implemented across public buildings throughout Novi Sad, with an initial focus on the largest energy-consuming buildings. The prioritisation of buildings will be done based on the outcomes of the energy audits.

## Correlation with other actions

Action	Explanation
Action 5. Energy management programme	Provision of data on consumption patterns, helping to identify priority buildings for energy rehabilitation and ensuring efficient implementation.
Action 7 Energy rehabilitation of private/residential buildings	Lessons learned from rehabilitating public buildings can inform best practices for private sector initiatives, creating a citywide energy efficiency model.
Action 8. Integration of RES into the district heating system of Novi Sad	Reduced overall energy demand of public buildings will make it easier to integrate renewable energy sources into heating systems.
Action 18 Construction and demolition waste processing facility	The generated construction and demolition waste from the rehabilitation can be efficiently processed at the new C&D waste facility.
Action 21. Smart city	Smart building management systems and automation will be integrated into rehabilitated public buildings.

# Action 7

## Energy rehabilitation of private/residential buildings



### GOAL OF THE ACTION

This action focuses on retrofitting residential buildings in Novi Sad to enhance energy efficiency. The programme aims to improve the energy performance of these buildings by reducing energy consumption and associated costs and implementing consumption-based billing models.

### CHALLENGE ADDRESSED

- High energy consumption in residential buildings
- Lack of efficient thermal insulation and energy systems
- District energy billing system not based on real consumption for most residential consumers
- High levels of energy poverty, especially in low-income households

### STRATEGIC OBJECTIVES

S01

S02



S03



### BENEFITS

- At least 35% energy savings in retrofitted buildings
- Reduced GHG emissions and energy costs
- Improved indoor air quality and thermal comfort
- Improved behaviours regarding energy saving through consumption-based billing systems

### TARGETS

- Achieve at least 16 GWh/year in energy savings by retrofitting around 100 buildings, 340,000 sqm residential buildings by 2029
- Transition all retrofitted buildings to a consumption-based billing system by 2029

### TIMEFRAME

2025–2029

### GHG SAVINGS

10,852 t CO<sub>2</sub>eq/year

### CAPEX (EUR)

102,500,000

## Context

A significant part of the residential buildings in Novi Sad were constructed before the adoption of energy efficiency codes, i.e. with little to no adherence to today's energy efficiency standards. In addition, many of these buildings have not undergone substantial rehabilitation, particularly in lower-income areas.



*Figure 16 Residential buildings in Novi Sad*

As a result, the housing stock has deteriorated and has a poor energy efficiency performance. Furthermore, due to the lack of individual, apartment-level, consumption-based metering, households are not incentivised to save energy, especially for heating.

These inefficiencies result in high energy consumption, significant GHG emissions, and high operational costs for residents. By aligning with Serbia's Integrated National Energy and Climate Plan (INECP), this action aims to significantly enhance energy efficiency and reduce GHG emissions in residential buildings.

## Description

The action includes a large-scale energy rehabilitation programme focused on privately owned residential buildings. The retrofit will include a range of measures such as:

- Insulation of the building envelope (walls and roofs);
- Replacement of windows and doors with energy-efficient models;
- Heating system improvements, including the installation of individual thermostatic radiator valves and apartment-level heat metering;
- Hot water system upgrades, such as hot water cylinder jackets and pipe insulation;
- Replacement of inefficient lighting with LED solutions;
- Seismic risk assessment.

To facilitate these rehabilitation efforts, the Municipality of Novi Sad will establish a one-stop shop (see **Action 9**) to support homeowners and homeowners' associations.

The program will provide subsidies and financing options for residents through national and local funding programs, encouraging wide participation. Vulnerable households and low-income residents will be prioritised.

The transition to consumption-based billing, i.e. to a billing system based on actual thermal energy consumption, is relevant to incentivise energy savings and engage citizens in responsible use of heating systems.

An innovative path to achieve even better energy efficiency, climate resilience and enhanced living conditions is to integrate nature-based solutions (NbS) in building retrofits. By harmonising the built environments with natural systems, NbS can significantly reduce energy demands and mitigate urban challenges such as heat islands and flood risks. In addition to achieving energy efficiency, measures like green roofs, living walls and urban greenery also foster biodiversity and improve air quality. Retrofitting external areas with permeable pavements, rain gardens and shading trees can further amplify the environmental benefits, creating more sustainable and attractive neighbourhoods. Such solutions align with modern sustainability goals, enriching communities with multifunctional spaces. Doing it at scale, these enhancements can help transform entire neighbourhoods, yielding safer, more appealing streetscapes and healthier living conditions while lowering overall energy use and emissions.

The selection of buildings to be supported and the monitoring of retrofit outcomes will ensure the success of the program and the quality of the rehabilitation works, contributing to improved energy efficiency in the residential sector of Novi Sad.

## Implementation steps

1. **Develop the terms of reference (ToR) of the energy audit programme:**
  - Develop the overall terms of reference for the energy rehabilitation programme, defining its scope, goals, and key performance indicators.
  - Ensure that the one-stop shop (**Action 9**) is integrated into the program for providing support to homeowners, including advisory services, access to financing, and guidance on energy efficiency improvements.
2. **Deploy the energy audit programme:**
  - Conduct energy audits across targeted residential buildings to assess current energy performance.
  - Prioritise buildings with the highest energy consumption for retrofitting.
3. **Develop terms of reference and tendering process for specific buildings or clusters of buildings**
  - Develop the detailed ToR for the retrofitting measures based on the results of the energy audits. This ToR will outline standard measures, including building-

specific solutions, energy-saving interventions, and maximum cost thresholds for each intervention.

- Launch the tendering process for contractors, with clear selection criteria based on quality, cost-efficiency, and previous experience in energy efficiency projects.

**4. Implement the retrofitting measures:**

- Carry out the identified retrofitting measures in selected residential buildings, including insulation, window replacement, and heating system upgrades.
- Transition all retrofitted buildings to a consumption-based billing system, encouraging residents to manage and reduce their energy consumption.

**5. Monitor energy savings and GHG reductions through digital tools and smart metering systems:**

- Use digital tools and smart metering systems to monitor energy savings and GHG reductions across all retrofitted buildings.
- Conduct a thorough evaluation of the retrofit program’s success by analysing energy data and GHG savings. Make necessary adjustments to improve program efficiency and achieve long-term sustainability goals.

## Stakeholders

Municipality of Novi Sad; homeowners and homeowners’ associations; Novosadska Toplana (Novi Sad Heating Plant); Energy Service Companies (ESCOs); private contractors; national and international donors; development and commercial banks

## Estimated costs

Item	CAPEX (EUR)	OPEX (EUR/year)
Develop ToR for the energy audits and deploy the audits	350,000	
Development of ToR for buildings retrofitting and tender process	150,000	
Retrofitting of 340,000 sqm of residential apartments @300 EUR/sqm, including smart elements	102,000,000	100,000
<b>TOTAL</b>	<b>102,500,000</b>	<b>100,000</b>

The current cost estimates are based on existing strategic documents and can suffer modifications during project development and implementation.

## Potential sources of financing

Municipality of Novi Sad; development and commercial banks: financing retrofitting projects through loans and investment grants; Energy Service Companies (ESCOs); donors

## Social and gender aspects

Vulnerable and low-income households will be prioritised to ensure they benefit from reduced energy bills and improved living conditions. The program aims to alleviate energy poverty, which disproportionately affects these groups.

The retrofitting program will improve indoor air quality and thermal comfort, directly benefiting women, children, and the elderly, who often spend more time indoors and are more vulnerable to poor living conditions.

This action is expected to have a **moderate positive impact** on social and economic inclusion, and gender equality aspects.

## Smart and digital aspects

Retrofitted buildings will be equipped with smart meters to monitor real-time energy usage, allowing residents to track consumption and make informed decisions on energy-saving behaviours.

During the energy audits and assessment programme, the Municipality can use aerial vehicles equipped with thermal imagery to identify buildings with the highest levels of energy loss. Data obtained will be made available to the public at large so that all citizens are informed about the program and available incentives/technologies.

## Location of the implementation

The program will focus on older residential buildings across Novi Sad, with a priority on low-income neighbourhoods and areas with high energy consumption. The specific buildings to be retrofitted will be selected based on energy audits.

The following table presents the distribution of residential consumers connected to Novi Sad DHS per specific heat consumption:

Energy class 2023	Specific consumption kWh/m <sup>2</sup> ,year	Number of buildings	Installed power MW	Percentage of consumption	Percentage of buildings
	SC>250	95	2.8	0.4%	2.9%
G	175<SC<=250	413	16.8	2.6%	12.5%
F	140<SC<=175	452	56.4	8.8%	13.7%
E	105<SC<=140	1,132	314.0	48.9%	34.3%
D	70<SC<=140	1,130	240.6	37.5%	34.3%
C	SC<70	74	11.4	1.8%	2.2%

Figure 17 Distribution of residential consumers (source: PUC "Novosadska Toplana", author: Dušan Macura, head of heat energy production and distribution at Novi Sad district heating plant)

## Correlation with other actions

Action	Explanation
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Action 5. Energy management programme	Energy monitoring and efficiency data from the management programme will help identify priority areas and best approaches for rehabilitating residential buildings.
Action 6. Energy rehabilitation of public buildings and facilities	Experience gained in public building rehabilitation can provide a model for private-sector initiatives.
Action 8. Integration of RES into the district heating system of Novi Sad	Energy-efficient residential buildings will support the transition to renewable district heating by reducing demand and improving heat distribution efficiency.
Action 9. Digital one-stop shop	Homeowners will benefit from a centralised digital platform offering guidance, incentives, and technical assistance for implementing energy efficiency measures.
Action 18 Construction and demolition waste processing facility	The generated construction and demolition waste from the rehabilitation can be efficiently processed at the new C&D waste facility.
Action 21. Smart city	Smart building technologies, such as automated energy management systems and digital metering.

# Action 8

## Integration of renewable energy sources into the district heating system of Novi Sad



### GOAL OF THE ACTION

This action focuses on modernising the district heating system of Novi Sad by integrating solar thermal energy and heat pump technologies to reduce dependence on fossil fuels and enhance system sustainability and efficiency.

### CHALLENGE ADDRESSED

- Complete dependency on natural gas, resulting in substantial greenhouse gas emissions
- Inefficiencies in older heating infrastructure that lead to energy losses and higher operational costs
- Absence of renewable energy sources in the energy mix
- Lack of sectoral connection with the power system and the absence of energy storage
- Increasing energy demand, placing additional strain on current energy resources

### STRATEGIC OBJECTIVES

S01

S02



S03



### BENEFITS

- Significantly reduced carbon emissions by substituting natural gas with solar energy and heat pumps
- Improved system efficiency and reliability through modern renewable technologies
- Enhanced local air quality and alignment with EU environmental standards
- Economic savings over time from reduced fuel consumption and operational costs

### TARGETS

- Reduce natural gas consumption by 16% through the effective use of solar thermal and heat pump technologies, as well as seasonal energy storage by 2030.
- Balancing the power system with a balance reserve of 60 MW in e-boilers, as well as by using heat pumps in periods when the price of electricity is low.

### TIMEFRAME

2025–2028

### GHG SAVINGS

17,350 t CO<sub>2</sub>eq/year

### CAPEX (EUR)

105,700,000

## Context

Novi Sad currently relies entirely on natural gas for district heating, leading to high emissions and energy inefficiency. The transition to a fourth-generation district heating system using solar thermal energy aligns with global sustainability targets and the energy policies of Serbia.

## Description

This action includes the transformative upgrade of the district heating system of Novi Sad through the integration of a solar thermal plant with two seasonal heat storages with a total volume of 870,000 m<sup>3</sup> (105 MW), solar collector fields with an area of about 37,000 sqm (31 MW), heat pumps with a capacity of 17 MW and two e-boilers with a total capacity of 60 MW. In the seasonal storage, thermal energy collected during the summer would be stored to be used in the winter months from the storage by a heat pump. A solar thermal plant with a large heat accumulator (pit thermal energy storage – PTES) uses renewable solar energy (solar collector field), energy from the Danube (by heat pump), and excess electricity from the power system (electric boiler) and distributes it to the district heating system. By using the existing infrastructure of the district heating system, which is located near the planned plant ("Novi Sad" CHP), about 243 GWh of thermal energy will be directed from the solar thermal plant into the district heating system and CO<sub>2</sub> emissions will be reduced by 17,350 tonnes annually. The construction of the solar thermal plant enables the direct connection of 2 systems: the power system of EPS („Elektroprivreda Srbije”, the national electricity distribution company) at the "Novi Sad" CHP facility, and the district heating system of Novi Sad. In this way, the conditions for balancing the power system with a balance reserve of 60 MW in e-boilers, as well as the use of a heat pump in periods when the price of electricity is low, are enabled.

The result of this project will be a scenario in which the "South", "Istok" and "North" heating plants of the city will not use natural gas, thus a 16% reduction in the total gas consumption can be achieved.

This action encompasses a transformative upgrade to the district heating system of Novi Sad through the integration of solar thermal energy and heat pump technologies. The project is designed to reduce reliance on fossil fuels, decrease greenhouse gas emissions, and improve the overall efficiency of the heating system.

The action involves the following key components:

- Solar thermal plant construction: A large-scale solar thermal plant will be constructed, featuring 37,000 square meters (31 MW) of solar collectors. These collectors will capture solar energy and convert it directly into heat, which will be stored in a seasonal heat storage facility.
- Seasonal heat storage facility (PTES): To maximise the efficiency of the solar thermal plant, seasonal heat storage will be developed. This 870,000 m<sup>3</sup> (105 MW) facility will store excess heat generated during the summer months and release it during the winter.

- Heat pump installation: Supplementing the solar thermal output, a 17 MW heat pump will be installed. This heat pump will serve a dual function:
  - The heat pump cools the PTES during the heating season. The energy extracted from the PTES is used to increase the temperature in the district heating system.
  - The heat pump extracts energy from the Danube outside the heating season when the temperature of the Danube is sufficient for the efficient operation of the heat pump. The heat produced by the heat pump from the river is supplied to the PTES. Heat pump operation has priority when electricity prices are low.
- Integration of electric boilers (e-boilers): The installation of 2 e-boilers (2x30MW) enables the direct connection of 2 systems - the EPS power system (at the "Novi Sad" CHP facility) and the district heating system. The e-boilers enable the balancing of the power system with a balance reserve of 60 MW.
- Upgrades to the existing infrastructure: To accommodate these new technologies, substantial upgrades will be made to the existing heating infrastructure. This includes the installation of advanced piping, pumps, and control systems that can handle the integration of renewable energy sources while maintaining efficient heat distribution across the network.
- System control and monitoring: An advanced monitoring and control system will be implemented to optimise the operation of the integrated heating system. This system will ensure that all components work synergistically, maximising energy savings and minimising operational costs.

The project is not only a step towards achieving the sustainability goals of Novi Sad, but also a model for the modernisation of the city heating system using renewable energy technologies. The project idea is relevant and in accordance with the strategy, plans and international obligations of the Republic of Serbia in terms of climate action, as it enables a significant increase in the share of renewable energy for heating purposes, as well as the flexibility of the EPS in connection with the balancing of renewable sources. An advanced monitoring and control system will be implemented to optimise the operation of the integrated heating system. This system will ensure that all components work in synergy, maximising energy savings and minimising operational costs.

## Implementation steps

### 1. Develop the terms of reference (ToR), system design and planning, tender process, procurement and contracting:

- Develop detailed Terms of Reference (ToR) and a comprehensive design for the integration of renewable technologies, ensuring compatibility with the existing district heating network.
- Prepare detailed plans for the installation of renewable energy components, including solar collectors and heat pump systems.
- Prepare tender documents and procure necessary equipment and services for renewable energy integration.

- Select contractors and suppliers with demonstrated experience in renewable energy projects.
- 2. Installation and integration of new technologies:**
- Install renewable energy components and connect them to the district heating system.
  - Implement necessary upgrades to the existing network to accommodate renewable energy inputs.
  - Test integrated systems to ensure operational efficiency and reliability.
  - Commission the system for full operational launch.
- 3. Public Engagement (throughout the project) – capacity building and training:**
- Conduct training programs for district heating operators and maintenance staff on managing and optimising renewable energy systems.
  - Conduct public engagement initiatives to inform and educate the community about the benefits and changes in the heating system.
- 4. Monitoring and optimisation:**
- Deploy monitoring tools to track the performance of integrated renewable energy sources.
  - Use data from monitoring to optimise system performance and ensure long-term sustainability.

## Stakeholders

Novosadska Toplana (Novi Sad Heating Plant); Municipality of Novi Sad; development banks; technology suppliers

## Estimated costs

Item	CAPEX (EUR)	OPEX (EUR/year)
Develop terms of reference for the investment and technical assistance	200,000	
Technical assistance / Project Implementation Consultants	1,000,000	
Solar thermal plant construction, seasonal heat storage facility, heat pumps, two e-Boilers, piping, pumps, control systems, SCADA	104,450,000	230,000
Awareness raising campaign	50,000	20,000
<b>TOTAL</b>	<b>105,700,000</b>	<b>250,000</b>

The current cost estimates are based on the existing strategic document and can suffer modifications during project development and implementation.

## Potential sources of financing

Western Balkan Investment Framework – 20% investment grants, the rest are loans from EBRD; development banks; local government funds.

## Social and gender aspects

The action will contribute to local community development through improved environmental conditions and potential reductions in heating costs, benefiting all demographic groups.

This action is expected to have a **marginal positive impact** on social and economic inclusion, and gender equality aspects.

## Smart and digital aspects

The action will make use of smart and digital technologies to monitor and efficiently control the district heating system, ensuring optimal performance and energy savings. AI-based solutions will be integrated to optimise the generation and distribution of heat according to electricity prices.

This action could go along with the development of a thermo-hydraulic system to optimise heat distribution in the network.

## Location of the implementation

The construction of the solar thermal plant is planned in the area immediately next to the existing district heating infrastructure and the "Novi Sad" CHP, which is part of the heating system of Novi Sad. The plots intended for the construction of the solar thermal plants are the public property of the Republic of Serbia or Novi Sad Municipality, without any encumbrances or notes.

## Correlation with other actions

Action	Explanation
Action 6. Energy rehabilitation of public buildings and facilities	Reduced overall energy demand of public buildings will make it easier to integrate renewable energy sources into heating systems.
Action 7. Energy rehabilitation of private/residential buildings	Energy-efficient residential buildings will support the transition to renewable district heating by reducing demand and improving heat distribution efficiency.
Action 21. Smart city	Smart grid technology and digital monitoring will support the efficient distribution of renewable energy within the DH system.

# Action 9 Digital one-stop shop



## GOAL OF THE ACTION

This action focuses on establishing a digital one-stop shop to centralise information and resources for energy efficiency, eco-friendly materials, and green building standards. It will serve as a hub for homeowners, builders, and stakeholders, providing access to tools, incentives, and guidelines for adopting sustainable building practices.

## CHALLENGE ADDRESSED

- Limited knowledge of energy-efficient and sustainable building materials among residents and builders
- Lack of access to information on green building standards and certification processes
- Fragmented support systems for homeowners and builders seeking to improve energy efficiency or adopt sustainable construction practice

## STRATEGIC OBJECTIVES

S01

S02



S03



## BENEFITS

- Increased adoption of energy-efficient materials and building practices
- Simplified access to incentives, financing options, and green building certification information
- Widespread awareness of eco-friendly materials and energy efficiency among homeowners and builders
- Reduced energy poverty
- Support for national and local climate goals, including energy savings and reduced GHG emissions

## TARGETS

- Establish the digital one-stop shop by 2026
- 500 users accessing services provided by the one-stop shop by 2029

## TIMEFRAME

2025–2026

## GHG SAVINGS

N/A

## CAPEX (EUR)

250,000

## Context

In Novi Sad, there is a growing need to promote sustainable building practices and make information on energy-efficient materials and green building standards more accessible to the general public. Current knowledge of these practices and existing support systems for retrofitting and new constructions is limited.

The establishment of a one-stop shop can also provide the required information and technical guidance to the interested investors facilitating the realisation of the planned investments in energy efficiency, self-consumption of renewable energy, and energy communities.

This action aims to support and promote sustainable urban development, building on national policies such as the Integrated National Energy and Climate Plan (INECP).

## Description

This action initiates a comprehensive digital one-stop shop to centralise resources and support for adopting energy-efficient and eco-friendly materials in Novi Sad enhancing awareness and disseminating knowledge across various sectors, with a particular focus on residential buildings. The digital one-stop shop will be coordinated by the Energy Agency in close cooperation with the municipal department for property and buildings. The one-stop shop will serve as a key platform for:

- Awareness raising and dissemination: Conducting specialised awareness campaigns targeted at homeowners and residential builders. These campaigns will inform about the benefits of energy efficiency, renewable self-consumption and energy communities, sustainable building practices, and available technologies.
- Advisory on financial support and project implementation: Support homeowners by providing a direct link to incentives and practical assistance for retrofit projects.
- Information and resource hub: Developing comprehensive databases that include details about the building stock, past energy efficiency interventions, and outcomes. This database will be crucial for tracking progress and identifying trends within the sector.
- Voluntary certification and ecological standards: Promoting and providing guidelines for voluntary certification schemes for ecological, green, and sustainable building certifications, encouraging builders and developers to adhere to higher sustainability standards.

This action not only fosters energy efficiency in Novi Sad but also aligns with broader national efforts to enhance sustainability, reduce GHG emissions, and improve overall energy knowledge and practices across sectors.

## Implementation steps

### 1. Design and develop the digital platform:

- Build the one-stop shop platform, ensuring it is user-friendly and accessible to homeowners, builders, and contractors.
- Integrate interactive features like cost calculators, resource calculators, building guides, and access to financing programs and certification services.
- Ensure compatibility with citywide digital infrastructure, such as the energy management platform – **Action 5**.

### 2. Launch training and awareness campaigns:

- Launch the platform through a citywide campaign, including online promotions and community events.
- Promote the platform to homeowners, builders, and architects through digital marketing, workshops, and community outreach programs.
- Highlight the benefits of the one-stop shop to encourage widespread adoption.

### 3. Provide support and technical assistance:

- Compile an extensive database of local and international resources, including case studies, best practices and technical guidelines.
- Offer advisory services through the one-stop shop, including help with selecting materials, navigating building standards, and accessing financial incentives.
- Develop training modules and e-learning materials for users.

### 4. Maintenance, monitor and evaluate platform usage:

- Regularly update content and features based on user feedback and emerging technologies.
- Perform technical maintenance and software updates.
- Implement analytics tool to track platform adoption rates and user satisfaction and measure their impact on the number of initiated projects for green buildings and retrofits.

## Stakeholders

Novi Sad Municipality; homeowners and builders; Energy Service Companies (ESCOs); green building professionals; national and international donors; local NGOs; academic institutions and environmental agencies

## Estimated costs

Item	CAPEX (EUR)	OPEX (EUR/year)
Development and operation of the digital platform	250,000	40,000
Training and awareness campaigns		50,000
Maintenance and update of the platform		10,000
<b>TOTAL</b>	<b>250,000</b>	<b>100,000</b>

## Potential sources of financing

Local budget; international donors; ESCOs and private sector; development and commercial banks

## Social and gender aspects

The platform will ensure that vulnerable populations (e.g., low-income households or marginalised groups) have access to the same information and incentives as larger property owners and developers.

Training programs offered through the platform will include gender-sensitive modules aimed at promoting equal opportunities for women in the construction and energy sectors.

## Smart and digital aspects

The one-stop shop will be entirely digital, providing easy access to information on energy efficiency and eco-friendly building materials. The platform will also have a searchable database for materials and suppliers.

The platform will collect data on the use of energy-efficient materials and building projects, offering insights into market trends and adoption rates. This data will inform future policy decisions and platform improvements. This action is expected to have a **marginal positive impact** on social and economic inclusion, and gender equality aspects.

## Location of the implementation

The platform will be citywide, accessible online, serving all parts of Novi Sad. However, specific target areas (low-income neighbourhoods, high energy consumption areas) may be identified for focused outreach and support.

## Correlation with other actions

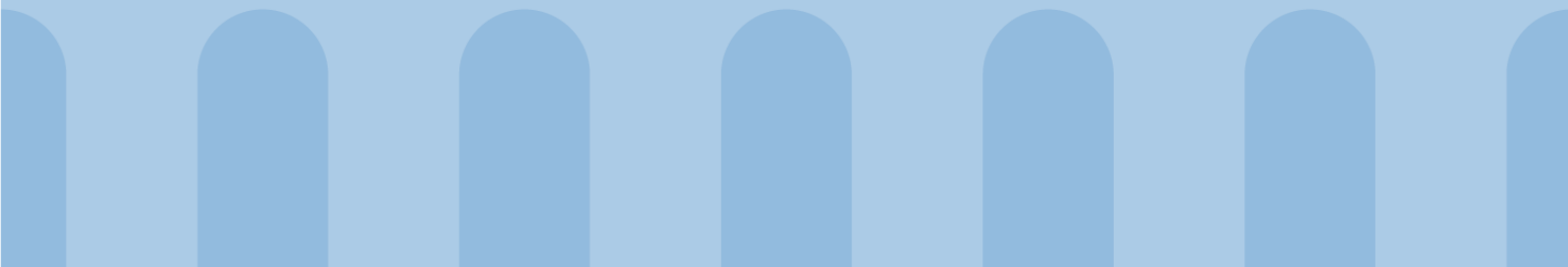
Action	Explanation
Action 5 Energy management programme	The digital platform will integrate energy data collection and monitoring, providing users with insights and recommendations for energy efficiency improvements.
Action 7. Energy rehabilitation of private/residential buildings	Homeowners will benefit from a centralised digital platform offering guidance, incentives, and technical assistance for implementing energy efficiency measures.
Action 21. Smart city	Digitalising energy-related services, enabling smart data analytics, and improving access to sustainable energy solutions.



**Novi Sad**

Green City Action Plan

# Water



# Sector overview

## *Baseline*

The water supply and sewerage network of Novi Sad is managed by the Water and Sewerage Public Utility Company (PUC), JKP „Vodovod i kanalizacija“ in Serbian. The area of operation of the PUC includes the city of Novi Sad and the suburban settlements of Sremska Kamenica, Sremske Karlovce, Petrovaradin, Popovica, Paragovo, Ledince (old and new), Čardak, Bukovac, Čenej, Kisač, Kač, Kovilj, Rumenka, Budisavu, Stepanovićevo, Futog and Veternik.

The citizens of Novi Sad are supplied with drinking water from three springs that exploit underground water, namely Ratno ostrvo, Petrovaradinska ada and Strand. Water treatment includes the following stages: aeration, filtration on quick sand filters, ozonation, filtration on granulated activated carbon and, finally, disinfection. In the Novi Sad distribution system, there are a total of fifteen drinking water reservoirs of different sizes and purposes, of which more than 135,000 households in Novi Sad and the surrounding settlements are provided drinking water. About 1,300 litres of water are distributed into the system every second, and the city and suburbs consume between 100 and 105 million litres of water per day, with the exception of the summer season, when consumption increases by 10 to 15%.

The water supply network was developed decades ago and is increasingly inadequate to meet the demands of the expanding urban area. This network consists of underground wells and an extensive pipeline system, primarily managed through a network of over 45 pumping stations. Unfortunately, these facilities have not kept pace with modern standards, leading to frequent leaks, unauthorised connections, and inefficiencies that increase both operational costs and strain on water resources.

Currently, approximately 80% of the population of Novi Sad is connected to the municipal sewer system, but, critically, there is no central wastewater treatment plant. This absence means that untreated wastewater is directly discharged into the Danube, which poses environmental and health risks.



*Figure 18 Danube River in Novi Sad*

The water supply system faces significant losses, both due to its age and infiltration from unauthorised or outdated connections. Further complicating matters, industrial wastewater is often not properly pre-treated, leading to increased pollution and degradation of infrastructure.

Both the water and wastewater infrastructure of Novi Sad face significant challenges due to their age, population growth, and the lack of a comprehensive wastewater treatment solution.

### *Policy Framework*

- Water Management Strategy of Vojvodina
- Danube River Basin Management Plan
- Energy Efficiency Program for the City of Novi Sad, 2025-2027 (2024)

## Prioritised Challenges, Short-term and Long-term GCAP actions

### Challenges

- Significant losses in the water supply and sewerage networks;
- Lack of a central facility for municipal wastewater treatment;
- Insufficient and inadequate treatment of industrial wastewater;
- Incomplete and inadequate sewerage network;
- Out of date water supply network;
- High sewerage infiltration rate due to unauthorised connections to the sewerage network damaging the infrastructure;
- Households and business entities using water from unauthorised deep wells, such practice putting pressure on the water resources and lacking control over the quality of water used by the population
- Illegal connections to the municipal water supply system;
- Enterprises without pre-treatment plants leading to illegal wastewater discharges into the municipal sewerage system or rivers;
- Lack of citizens' information and awareness campaigns related to preparedness to natural disasters.

#### Short-term actions

10. Drinking water system modernisation
11. Rehabilitation, upgrade and extension of the wastewater collection network
12. Central wastewater treatment plant – detailed design and construction
13. Preparatory steps to expand the network with a separate system for stormwater drainage and wastewater

#### Long-term actions

Integrated vision of sponge city  
Climate change risk assessment and sustainable urban drainage systems (SUDS)  
Smart in avoiding flooding  
Installing blue infrastructure in cities, for cooling and water retention  
Modernisation/applying of GIS data systems for water supply and wastewater networks, assets and customer management



# Action 10 Drinking water system modernisation



## GOAL OF THE ACTION

The goal of this action is to achieve a stable, reliable, and high-quality water supply in Novi Sad and in the suburban areas, for all categories of users through the expansion of water source extraction capacities and the accompanying infrastructure for the treatment and distribution of drinking water.

## CHALLENGE ADDRESSED

- Out-of-date water supply network
- Households and business entities using water from unauthorised deep wells, putting pressure on the water resources and lacking control over the quality of water used by the population
- Significant losses in the water supply network
- Illegal connections to the municipal water supply system

## STRATEGIC OBJECTIVES

S01

S02



S03



## BENEFITS

- Increased resilience of the water supply system to climate change
- Ensuring sufficient quantities of healthy drinking water for all categories of users and overall improvement of service quality
- Contribution to the adaptation to the changed climatic conditions
- Stable water supply throughout the year
- Extending the life of raw water extraction wells

## TARGETS

- Increase the capacity of the drinking water source by 300 l/s
- Achieve a 100% supply of high-quality water to the population in the city proper and suburban areas

## TIMEFRAME

2025–2028

## GHG SAVINGS

N/A

## CAPEX (EUR)

63,200,000

## Context

Novi Sad is rapidly expanding in terms of the number of inhabitants, economic activities, and territorial and urban development. This kind of development requires the appropriate accompanying communal infrastructure and maintaining the quality level of basic communal services, including the provision of drinking water for all categories of users.

Climate change – manifesting in changing weather patterns, droughts, floods, and rising temperatures – leads to stress on water systems and reduced availability of fresh water, making it harder to ensure consistent, safe drinking water. Population growth, particularly in urban areas, strains existing water systems, which may not have been designed to accommodate such growth. This can lead to overburdened systems and reduced water availability.

The expansion of water source capacities and the extension of the primary and secondary drinking water networks adjusted to the needs of the city is necessary, since current quantities of raw water are insufficient compared to the accelerated expansion of the city. In those terms, Novi Sad will require large and long-term investments in the expansion and modernisation of drinking water sources and accompanying infrastructure.

## Description

The action aims to increase the water source capacities by upgrading groundwater extraction capacity through the extension of existing and construction of new borehole drilled wells (BHD wells), construction of infiltration basins with wells, and building processing capacities through the construction of a drinking water treatment plant (DWTP) for the Ratno ostrvo water source.

In terms of GHG emissions, obtaining raw water from underground sources requires pumping water to the surface, and a larger amount of water obtained in this way requires more energy. The reliance on fossil fuels for this energy can increase GHG emissions. The use of efficient pumps relying on renewable energy sources can reduce emissions associated with groundwater extraction and will be considered as a mitigation measure.

## Implementation steps

### 1. Implementation of infrastructure upgrades, including smart elements:

- Construct new BHD wells, install hydromechanical and electrical equipment of wells, construct surface water intakes, construct a pretreatment facility with a capacity of 300 l/s, construct vertical wells.
- Install hydraulic and electrical equipment, construct the connecting pipelines, construct the infiltration basins.
- Construct DWTP with a capacity of 300 l/s.
- Construct the pumping station with a capacity of Q=900 l/s.
- Build a reservoir with a volume of 5,000 m<sup>3</sup>.
- Construct the transformer station.

- Install advanced monitoring systems, such as smart meters and sensors for real-time tracking of water quality and consumption and digital tools to enhance operational efficiency.
- 2. Monitoring and continuous evaluation:**
- Establish a robust monitoring framework to track improvements in water quality, reliability and system efficiency.
  - Use data to evaluate project success and guide future investments.

## Stakeholders

PUC (Water and Sewerage Public Utility Company Novi Sad); Novi Sad Municipality; the Department for Urban Planning and Construction and the Department for Environmental Protection within the Novi Sad Municipality; Vojvodina Provincial Secretariat for Agriculture, Water Management, and Forestry

## Estimated costs

Item	CAPEX (EUR)	OPEX (EUR/year)
Construction of new wells and associated infrastructure (new BHD wells, hydromechanical and electrical equipment, surface water intakes)	20,050,000	
Construction of the pretreatment facility	9,000,000	
Construction of vertical wells, installation of hydraulic and electrical equipment, connecting pipelines and infiltration basins	5,950,000	600,000
Construction of the DWTP	18,000,000	
Construction of the pumping station	4,000,000	
Construction of the transformer station and a water reservoir	6,200,000	
<b>TOTAL</b>	<b>63,200,000</b>	<b>600,000</b>

The current cost estimates are based on the existing strategic document and can suffer modifications during project implementation.

## Potential sources of financing

Local budget; PUC own sources; state budget; IFIs; international grants.

## Social and gender aspects

The modernisation of the water supply system and the increased capacity for providing drinking water will ensure that vulnerable and marginalised groups benefit from improved services. It will not only enhance technical infrastructure but also contribute to social well-being and gender equity by improving access to clean water, reducing environmental

pollution, and promoting inclusive growth. This action is expected to have a **moderate positive impact** on social and economic inclusion, and gender equality aspects.

## Smart and digital aspects

The new and extended water source will be incorporated into digital management systems for monitoring and controlling water supply networks based on the use of Supervisory Control and Data Acquisition (SCADA) systems, which allow operators to monitor and control water flow, pressure, and quality from a central location.

In the long-term, when the drinking water distribution network of the city is entirely rehabilitated, the Municipality will also introduce a leakage detection system and district metering, as well as flow and pressure sensors on the network in order to have a higher degree of control on the water distribution network system.

## Location of the implementation

Ratno ostrvo, near the Šangaj area of Novi Sad

## Correlation with other actions

Action	Explanation
Action 21 Smart city	Digital monitoring and smart metering technologies will be integrated into the drinking water distribution system, ensuring real-time water quality control and more efficient distribution.



# Action 11 Rehabilitation, modernisation, and extension of the wastewater collection network

## GOAL OF THE ACTION

This action aims to upgrade the sewerage network and modernise the wastewater system of Novi Sad through the construction of a new wastewater collection system and the rehabilitation of the outdated wastewater collection system.

## CHALLENGE ADDRESSED

- Significant losses in the sewerage networks
- Lack of a central facility for municipal wastewater treatment
- Insufficient and inadequate treatment of industrial wastewater
- Incomplete and inadequate sewerage network
- Out-of-date water supply network
- High sewerage infiltration rate due to unauthorised connections to the sewerage network damaging the infrastructure
- Enterprises that do not have pre-treatment plants leading to illegal wastewater discharges into the municipal sewerage system or rivers

## STRATEGIC OBJECTIVES

S01

S02



S03



## BENEFITS

- Enabling the development of new residential and commercial areas
- Improved overall sanitation, health and quality of life of the residents
- Reduced ecological footprint
- Increased resistance to future challenges
- Improved resilience by preventing urban flooding
- Reduction of operational and maintenance costs

## TARGETS

- Rehabilitation of approx. 3,200 m of sewage network
- Construction of 6,385 m of 3-meter diameter wastewater collectors
- 100% coverage of the wastewater collection system in the city, directed toward the future CWWTP

## TIMEFRAME

2025–2027

## GHG SAVINGS

N/A

## CAPEX (EUR)

20,755,000

## Context

The city has been dealing with an outdated sewage system in certain territorial areas, but efforts are being made to modernise and expand it. The sewage network in Novi Sad is undergoing substantial improvements as part of various infrastructure projects.

The upgrades to the sewage network are critical to improving the city's capacity to manage wastewater, reduce flood risks, and improve living conditions for residents while addressing environmental concerns like water pollution. The Municipality plans to continue these efforts to cover all areas that currently lack adequate sewage infrastructure.

## Description

The action aims to achieve the construction of missing collector lines, as well as the reconstruction of existing ones, all to divert wastewater to the future central wastewater treatment plant (CWWTP) – see **Action 12**. The approximation of costs for the elements in this action is done using the average costs of construction for a particular type of wastewater infrastructure. For the construction of a collector with a 3 m in diameter an average price of 3,000 EUR per meter was used, and for the reconstruction of the sewage a price of 500 EUR per meter was used for CAPEX calculation.

## Implementation steps

### 1. Infrastructure construction and integration of smart technologies:

- Construct the connecting collector between the Main Pumping Station 1 and the New Main Pumping Station 1 (GC1-NGC1) (collector with 3 m diameter which will be drilled underground by micro-tunnelling at a depth of over 7 m in a length of 1,935 m).
- Construct collector from New Main Pumping Station 1 (NGC1) to the CWWTP in Rokov Potok location in Petrovaradin area on the right bank of Danube River (collector with 3 m diameter approx. 4,450 m in length).
- Reconstruct the collector on Tsar Lazar Boulevard (approx. 700 m in length).
- Reconstruct the collector in Rumenačka Street (approx. 2,500 m in length).
- Install sensors and smart monitoring systems along the network to track flow rates, detect leaks and identify blockages, SCADA system.

### 2. Monitoring and evaluation:

- Establish a monitoring framework to assess system performance and ensure compliance with environmental standards.
- Use feedback and performance data to guide future network enhancements.

## Stakeholders

PUC (Water and Sewerage Public Utility Company of Novi Sad); Novi Sad Municipality; the Department for Urban Planning and Construction and the Department for Environmental Protection within the Novi Sad Municipality

## Estimated costs

Item	CAPEX (EUR)	OPEX (EUR/year)
Construction of the connecting collector GC1-NGC1	5,805,000	
Construction of collector from NGC1 to CWWTP	13,350,000	
Reconstruction of the collector on Tsar Lazar Boulevard	350,000	200,000
Reconstruction of the collector in Rumenačka Street	1,250,000	
<b>TOTAL</b>	<b>20,755,000</b>	<b>200,000</b>

The current cost estimates are based on the existing strategic document and can suffer modifications during project development and implementation.

## Potential sources of financing

Local budget; PUC own sources; state budget; IFIs; international grants.

## Social and gender aspects

The rehabilitation, modernisation, and extension of the wastewater collection network in Novi Sad will have important social and gender dimensions: it will reduce health risks associated with untreated sewage, which disproportionately affect vulnerable populations such as children, the elderly, and low-income groups.

This action is expected to have a **marginal positive impact** on social and economic inclusion, and gender equality aspects.

## Smart and digital aspects

Many parts of the wastewater network in Novi Sad are managed using Supervisory Control and Data Acquisition (SCADA) systems. These systems provide remote monitoring and control of the wastewater infrastructure, helping operators track the system's performance, detect issues early, and even automate certain processes, such as pump operations and valve adjustments. The SCADA system ensures better operational efficiency, reducing manual intervention and optimising energy use. The SCADA system will also cover the new infrastructure developed within this action.

In the long-term, the wastewater collection system will also include leakage detection sensors which will be connected directly to the overall monitoring and control system and will enable the company to take immediate measures when necessary.

## Location of the implementation

- Construction of the connecting collector GC1-NGC1, along the Quay, from Radnička Street to Marko Miljanova Street.

- Construction of collectors from NGC1 to CWWTP, from Marka Miljanova Street across the road-railway bridge to the Rokov Potok location in Petrovaradin.
- Reconstruction of the collector on Tsar Lazar Boulevard, from Stražilovska Street to GC1 in Radnička Street.
- Reconstruction of the collector in Rumenačka Street, from the roundabout (Bulevar Europa) to Bulevar Kralja Petar I.

## Correlation with other actions

Action	Explanation
Action 12. Central wastewater treatment plant – detailed design and construction	Modernised wastewater collection network will enhance the efficiency of the planned wastewater treatment plant, reducing pollution in the Danube River.
Action 21. Smart city	Smart monitoring and digital data collection to support efficient wastewater management – SCADA system

# Action 12

## Central wastewater treatment plant – detailed design and construction



### GOAL OF THE ACTION

The primary objective of this action is to construct the Central Wastewater Treatment Plant (CWWTP) in Novi Sad that can effectively process the city's wastewater before it is released into the Danube river, thereby reducing pollution and safeguarding the environment.

### CHALLENGE ADDRESSED

- Lack of a central facility for municipal wastewater treatment
- Insufficient and inadequate treatment of industrial wastewater

### STRATEGIC OBJECTIVES

S01

S02



S02



### BENEFITS

- Reduced water pollution, cleaner soil and groundwater, protected aquatic ecosystems, compliance with EU environmental standards
- Reduce GHG emissions from avoidance of direct discharge of wastewater into the Danube (estimated GHG savings below are not considering the emissions from construction and operation of the CWWTP)
- Reduced risk of the spread of diseases like cholera, hepatitis, and dysentery
- Employment opportunities in engineering, maintenance, and other related fields
- Boosting tourism, benefiting local businesses and the economy; attracting investors interested in eco-friendly regions
- Reduced healthcare costs, allowing funds to be redirected to other community needs

### TARGETS

- Construction of a CWWTP with a capacity of ~500,000 population equivalents
- Processing approximately 120,000 cubic meters of wastewater daily

### TIMEFRAME

### GHG SAVINGS

### CAPEX (EUR)

2025–2029

75,639 t CO<sub>2</sub>eq/year

120,100,000

## Context

The lack of a central wastewater treatment plant (CWWTP) in a city like Novi Sad presents several key challenges and vulnerabilities, including environmental degradation due to the discharging of wastewater into the Danube river and the ensuing contamination of water bodies and soil. This, in turn, diminishes agricultural productivity and harms local vegetation. In addition, non-compliance with EU standards could result in missing funding opportunities.

## Description

Prior to the implementation of this action, the connecting infrastructure needs to be created as a prerequisite for the construction of CWWTP. This is covered in **Action 11** above.

The construction and operation of the CWWTP in Novi Sad will lead to greenhouse gas (GHG) emissions. However, these emissions can be managed and minimised with careful planning and adoption of sustainable practices. Strategies for emission mitigation during the construction phase should include the use of low-carbon materials, efficient construction practices, and sourcing materials from local suppliers thus reducing transportation emissions. Potential mitigation measures in the operation phase could include the use of RES, such as incorporating solar panels, biogas production from sludge, and other options to offset energy consumption and reduce emissions, as well as optimisation of the treatment processes.

## Implementation steps

- 1. Preparing and launching tender documentation for detailed design and construction of CWWTP**
- 2. Construction of the CWWTP:**
  - Build core infrastructure, treatment tanks, piping and control systems and install advanced treatment technologies, adopt energy efficiency and resource recovery measures, SCADA system.
- 3. Testing, commissioning and monitoring:**
  - Conduct rigorous testing to verify the performance of the plant and its compliance with quality standards.
  - Establish a monitoring framework for operational efficiency, effluent quality and environmental impact.

## Stakeholders

Water and Sewerage Public Utility Company Novi Sad; Novi Sad Municipality; the Department for Urban Planning and Construction and the Department for Environmental Protection within the Novi Sad Municipality; Vojvodina Provincial Secretariat for Agriculture, Water Management, and Forestry; Ministry of Construction, Transport, and Infrastructure

## Estimated costs

Item	CAPEX (EUR)	OPEX (EUR/year)
Preparation and launch of a tender for detailed design and construction of CWWTP	100,000	
Construction of the Central Wastewater Treatment Plant (CWWTP)	120,000,000	3,000,000
<b>TOTAL</b>	<b>120,100,000</b>	<b>3,000,000</b>

The current cost estimates are based on the existing strategic document and can suffer modifications during project development and implementation.

## Potential sources of financing

Project Clean Serbia, local budget, PUC own sources

## Social and gender aspects

The CWWTP will create employment opportunities during both the construction and operational phases. Ensuring that hiring practices promote gender diversity can provide job opportunities for women, particularly in traditionally male-dominated fields like engineering, construction, and operations.

The CWWTP will improve sanitation and thus reduce the risk of waterborne diseases, benefiting all residents including women, children, the elderly, and other vulnerable groups.

Wastewater treatment infrastructure will reach marginalised areas and low-income neighbourhoods and will reduce environmental health risks.

Since wastewater treatment will be introduced as a new service, it will cause new costs in terms of utility services and thus might put pressure on low-income households and vulnerable groups. If needed, the Municipality will develop and implement a social support program for these population groups, which might include subsidies.

This action is expected to have a **significant positive impact** on social and economic inclusion, and gender equality aspects.

## Smart and digital aspects

Integrating appropriate smart and digital technologies, such as sensors and built-in algorithms to improve the performance of the CWWTP will be considered. These sensors can optimise operations, enhance environmental performance, and improve efficiency through digitalisation, better monitoring, automation, and data-driven decision-making. This, in time, can lead to lower costs, reduced emissions, and a higher quality of the treated output.

## Location of the implementation

Rokov Potok in Petrovaradin – the main pumping station; CWWTP to be located behind the former Pobeda factory in Petrovaradin (blue circle on map below)

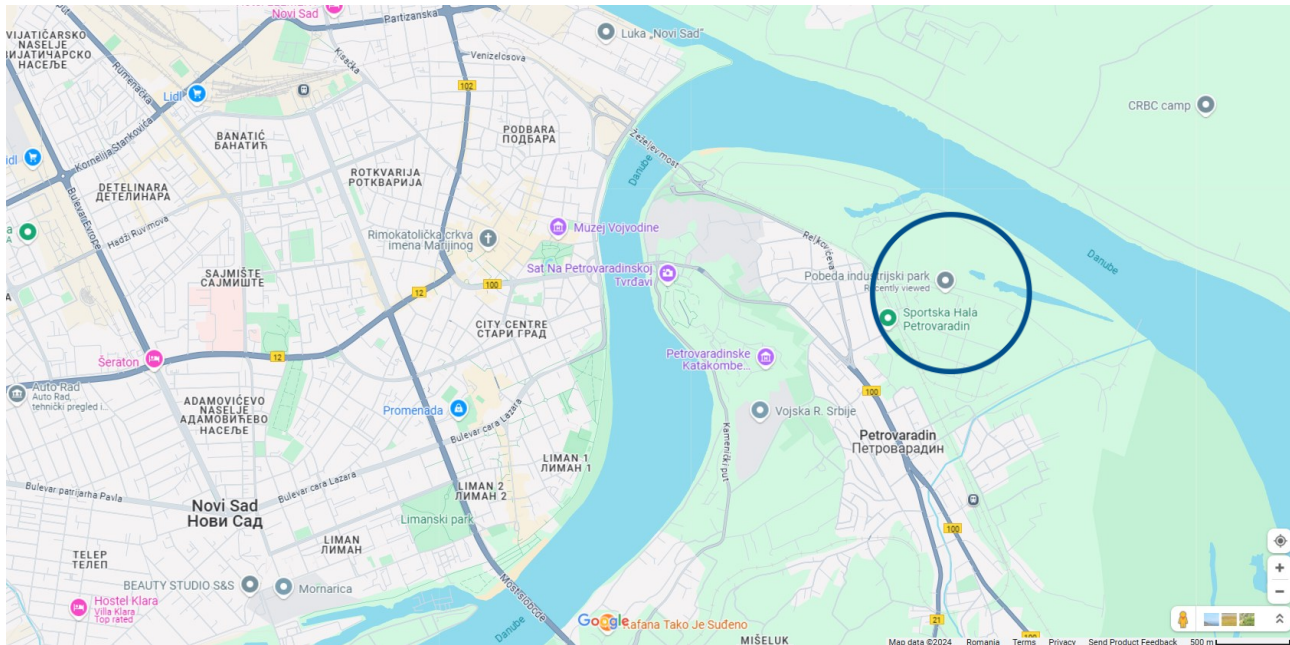


Figure 19 Tentative area of the future CWWTP location

## Correlation with other actions

Action	Explanation
Action 11. Rehabilitation, modernisation and extension of the wastewater collection network	An upgraded collection system will improve the efficiency and effectiveness of the central wastewater treatment plant by reducing leaks and untreated discharges.
Action 13. Preparatory steps to expand the network with a separate system for stormwater drainage and wastewater	The planning of separating stormwater from wastewater will lead closer to reducing treatment plant overload and improving operational efficiency.
Action 21. Smart city	Integration of smart sensors, automated monitoring and digital control systems.

# Action 13

## Preparatory steps to expand the network with a separate system for stormwater drainage and wastewater



### GOAL OF THE ACTION

This action aims at preparing a pilot project to construct separate stormwater and sewage drainage systems in suburban areas of the city that are still not entirely covered by the combined network, such as the areas of Paragovo and parts of Popovica and Sremska Kamenica.

### CHALLENGE ADDRESSED

- Incomplete and inadequate sewerage network
- Significant losses in the water supply and sewerage networks
- Illegal connections to the municipal water supply, hindering cost recovery in the system

### STRATEGIC OBJECTIVES



### BENEFITS

- Prevention of overflow of sewage during episodes of heavy rainfall
- Minimised risk of damage to the urban infrastructure
- Minimised risk of untreated sewage entering water bodies
- Reduced pressure during heavy rainfall episodes and optimised operational costs of future CWWTP in terms of energy use, reduction of additional resources (like chemicals) in the treatment process

### TARGETS

- Tender launched in the first year of action implementation
- Developed technical documentation preparing for the construction of a separate stormwater sewage system in the areas of Paragovo and parts of Popovica and Sremska Kamenica in the second year of project implementation.

### TIMEFRAME

2027–2029

### GHG SAVINGS

N/A

### CAPEX (EUR)

200,000

## Context

The transition to a separate sewage system offers significant benefits for public health, environmental protection, and community resilience. While initial investments may be higher, the long-term advantages of such systems make them a sustainable choice for urban planning and development. Implementing a separate sewage system not only improves the quality of life for residents but also contributes to a healthier environment and a more sustainable future.

Implementing a separate system in the entire urban area would entail a complete overhaul of the existing system, which is not desirable. The system in the city has long been made as a mixed system (sewage and stormwater), while all suburban areas are planned for the sewage (municipal wastewater) system only.

Thus, this solution would be easier and more desirable to be implemented in Novi Sad peripheral areas not yet entirely covered by the existing sewerage system.

## Description

The action includes the necessary steps to ensure adequate planning of the future separate system, for the targeted areas. Preparatory actions such as clear delimitation and mapping of the action study area are needed, in addition to commissioning the development of the conceptual design.

The underlying studies would need to take into account and coordinate connecting infrastructure in the design with specifications of the future Central Wastewater Treatment Plant, included in [Action 12](#).

The integration of nature-based solutions (NbS) for stormwater management should be explored in the conceptual design.

The action also allows for the implementation of smart solutions. The development of a clear digital geospatial mapping of the customers and system assets could be a starting point, as this would enable the identification of the needs, billing and collection, and efficient maintenance.

Implementing a separate sewage system, which separates wastewater from stormwater, can lead to significant GHG emission reduction arising from various factors, including enhanced efficiency in wastewater treatment, reduced emissions from combined sewer overflows, and improved stormwater management.

## Implementation steps

1. **Development of an opportunity study, which will include:**
  - Identify the geographical coordinates of pilot communities and the scope of the project.

- Research the baseline situation, and set out prerequisite requirements for design, including physical and digital elements and the possibility to apply NbS in stormwater management.
2. **Prepare and launch the tender for Conceptual Design.**
  3. **Contract the winning bidder(s), manage contracts and carry out project management throughout the deployment, administration and by obtaining permits/approvals.**

## Stakeholders

PUC (Water and Sewerage Public Utility Company Novi Sad); Novi Sad Municipality; Department for Urban Planning and Construction and the Department for Environmental Protection within the Novi Sad Municipality

## Estimated costs

Item	CAPEX (EUR)	OPEX (EUR/year)
Opportunity Study	50,000	
Conceptual Design	150,000	
<b>TOTAL</b>	<b>200,000</b>	

## Potential sources of financing

Local budget; PUC own sources; IFIs

## Social and gender aspects

Low-income communities and vulnerable groups (e.g., women, the elderly, and children) are particularly at risk due to limited access to adequate sewerage, as well as limited access to resources for coping with flood damage and health-related expenses caused by sewage overflows.

This action is expected to have a **marginal positive impact** on social and economic inclusion, and gender equality aspects.

## Smart and digital aspects

Expansion and improvement of the system allow for the installation of smart and digital elements within the network. A good starting point is the geospatial mapping and logging in the system of each customer, as well as installed assets. Conceptual design could include the exact location coordinates of each pump, the installed sensors/elements and technical specifications for each of the infrastructure elements.

## Location of the implementation

Areas of Paragovo, Popovica, and Sremska Kamenica on the right bank of the Danube river could be possible candidates for this action, as they are not currently entirely covered by the existing combined sewerage and stormwater drainage system.

## Correlation with other actions

Action	Explanation
Action 12. Central wastewater treatment plant – detailed design and construction	Planning separate networks will bring the water system a step closer to preventing the overload of the treatment plant, ensuring more efficient wastewater processing.
Action 21. Smart city	Smart drainage systems with real-time monitoring and predictive analytics can improve flood management, optimise stormwater collection, and enhance climate resilience.

# Waste

## Sector overview

### *Baseline*

The waste management sector in Novi Sad is actively adapting to meet the dual challenges of increasing waste volumes and EU compliance. Through international funding, local initiatives, and a robust policy framework, the Municipality is gradually building the infrastructure and systems needed to shift from landfill dependency toward a circular waste economy. With continued investment and policy support, Novi Sad is poised to make substantial environmental gains in the coming years. Public utility company Čistoća Novi Sad is the entity responsible for delivering essential waste management services, encompassing the collection, processing and disposal of waste, alongside responsibilities for urban sanitation and cleanliness.



*Figure 20 Vehicle fleet of PUC Čistoća (source: website of PUC Čistoća)*

The total generated municipal solid waste (MSW) translates to approx. 550 kg/capita/year, an indicator that has an ascending trend in recent years. Its composition shows that biodegradable waste represents the majority (approx. 50%) of the total generated MSW. The biodegradable fraction includes green waste from gardens and parks, food waste and other organic materials. Recyclables such as plastic, paper, cardboard, glass and metal represent approx. 20% of the total, with more than half being plastic and packaging materials. The rest consists of other waste, including textiles, composite materials and bulky waste. The waste collection coverage is high, reaching 100% of the population, with the collection frequency varying between urban and suburban areas. Still, illegal waste dumping is occurring in the city, with the waste management company needing to make efforts to clean up these areas.

The waste collection infrastructure is constantly being enhanced, the most recent upgrades being the introduction of separate bins for recyclables, although source separation remains limited. Upgrades have also been made to transfer stations, and separate waste collection for specific recyclable materials such as PET is underway through partnerships with local recycling facilities. The Municipality is piloting a range of measures to support source separation via different projects. One such example is the project focused on the introduction of an incentive scheme for the recycling of plastic bottles and aluminium cans through reverse-vending machines, called Reciklomats. Public education and awareness campaigns are also part of this effort aimed at prioritising sustainable waste practices among residents.

The Municipality initiated the tendering procedure for a Regional Waste Management Centre (RWMC), which will include facilities for waste sorting, recycling and a sanitary landfill compliant with EU standards. The RWMC will be constructed in three phases; the project is currently in the tendering phase, and the funding for this investment is already secured. Thus, this project was no longer included in the GCAP, but all the actions included are complementary to this. The first phase will include works for two zones:

- Working zone with a Mechanical Biological Treatment (MBT) facility, including:
  - Material Recovery Facility (MRF) – this facility will imply the mechanical sorting of waste within an existing hall for sorting, equipped with two sorting lines – one existing that needs to be upgraded and a new one.
  - Bio-drying Plant – for the aerobic biological treatment of organic waste in bio-drying tunnels
  - Biogas Plant – biological treatment through dry anaerobic digestion, the facility will be equipped with a CHP unit
  - Refuse-Derived Fuel (RDF) preparation Plant – representing a mechanical treatment, separation of waste dried in the bio-drying plant and preparation and storage of RDF
- Landfill zone, including:
  - Sanitary landfill, with Landfill Gas Extraction System and leachate drainage
  - Leachate Treatment Plant (LTP) – mechanical pretreatment, correction of pH value, three-stage reverse osmosis

The collected waste is currently deposited at the Novi Sad controlled disposal site. This is in the proximity of the city and has a total surface of approximately 30 ha. The average height of deposited waste is between 5 and 7 meters. Assuming an average waste density of about 0.9 t/m<sup>3</sup>, the total amount of waste at the landfill is estimated to be 1.6 million tons. The total annual amount of waste deposited at the city's controlled disposal site is currently around 290,000 tons per year, of which approximately 170,000 tons per year consist of MSW and cover material for the landfill, while the rest is construction and demolition waste. The existing disposal site will be closed once the new RWMC will be functional. The Municipality has already initiated the preliminary steps related to disposal site closure, and a technical assistance project focused on this aspect is currently undergoing.

An estimated 3-5% of municipal waste is currently recycled, while some types of packaging waste managed under EPR schemes achieve slightly higher recycling rates but are still below EU benchmarks. While the infrastructure for waste treatment and recycling within the RWMC is under development, a significant portion of the generated waste still ends up in non-compliant landfills.

Novi Sad has invested in a green waste composting facility since 2020, initially designed for handling 5,000 tons of green waste per year. This has laid the foundation for an expanded composting infrastructure aimed at regional biowaste treatment. In 2022, a pre-feasibility study was developed to expand the facility further to serve the South Bačka region,

proposing scenarios for including additional organic waste types, such as garden and food waste from households, with the potential to increase capacity to over 12,000 tons annually.

The collection of bulky waste is organised as a paid service provided to the population by PUC Čistoća Novi Sad. 5 m<sup>3</sup> containers can be rented upon request anytime during the working hours of the company. The containers are collected the next day. Additionally, there are seasonal campaigns for the removal of bulky waste, enabling free removal directly from local communities throughout the city. The operator is working based on a pre-defined calendar, posted on its official website. The removal of the generated garden and green waste is also carried out according to an established calendar, available on the company's website.



Figure 21 Collection of bulky waste (left) and green waste (right) - source: website of PUC Čistoća

Not all special waste streams are properly managed, and the majority of the generated waste, including small amounts of hazardous waste is disposed of at the landfill.

The figure below represents the integration of the proposed GCAP actions (marked with purple colour) in the current MSW management system and future RWMC. The proposed actions aim to tackle the identified and prioritised challenges of the waste sector.

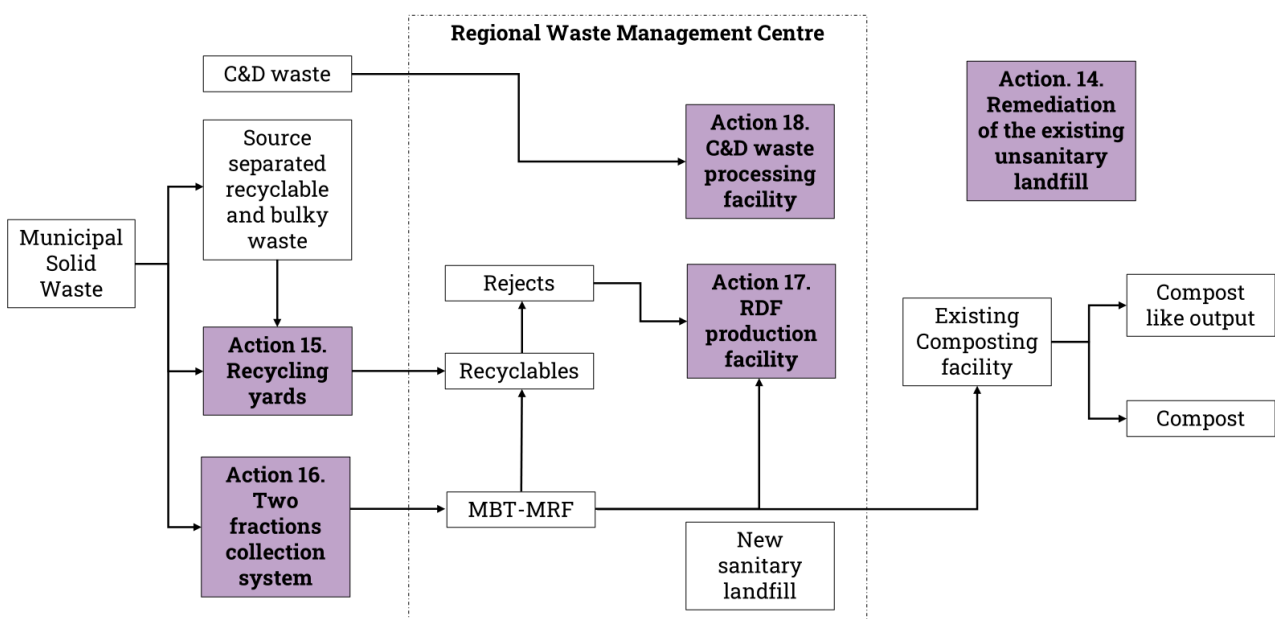


Figure 22 Overview of the municipal waste management system in Novi Sad

*Policy Framework*

- Novi Sad Sustainable Development Strategy 2016-2020
- National Waste Management Strategy (NWMS), including National Waste Management Plan 2020-2025
- Waste Management Program of the Republic of Serbia for the period 2022-2031
- Regional Waste Management Plan for South Bačka for the period 2019-2028 (2019)
- Green Agenda for the Western Balkans (EU) (2020)
- Pre-feasibility Study for Novi Sad Composting Expansion (2023)

*Prioritised challenges, short-term and long-term GCAP actions*

**Challenges**

Lack of sufficient capacity in the existing location for waste depositing

Very low recycling and composting rates

Limited treatment options for special waste streams

Lack of waste treatment capacities and financial resources for the reduction of landfilled waste

Inadequate separate waste collection system

**Short-term actions**

**14. Remediation of the existing unsanitary landfill**

**15. Construction of two new recycling yards and expansion of the Reciklomat system**

**16. Implementation of a citywide two fractions waste collection system**

**17. Waste treatment facility for refuse-derived fuel production**

**18. Construction and demolition waste processing facility**

**Long-term actions**

Integrated information system for waste management

Establishing the waste collection system on 3 bins

Introduction of a pay-as-you-throw system

Establishing a collection system for household hazardous waste

Investments for implementing circular economy principles in waste management

Start of implementation

Year 5

Year 15

# Action 14 Remediation of the existing unsanitary landfill



## GOAL OF THE ACTION

This action aims to transform the unsanitary landfill into a safe, environmentally stable, and community-friendly site by implementing comprehensive remediation measures. This will include waste compaction, disposal site reshaping, soil and groundwater decontamination, collection of landfill gas, restoration of the vegetation, implementation of a final capping layer and the monitoring and aftercare system, all following regulatory standards and best environmental practices.

## CHALLENGE ADDRESSED

- Remediation need of the existing unsanitary landfill
- Lack of sufficient capacity in the existing location for waste depositing

## STRATEGIC OBJECTIVES

S01

S02



STRATEGIC OBJECTIVE 2  
Towards  
net-Zero  
Emissions

S03

## BENEFITS

- Reduced pollution and biodiversity recovery
- Improved public health
- Climate change mitigation through methane capture and potential for energy recovery
- Economic benefits through increased property value, cost saving by preventing environmental damage and future job creation
- Enhanced community spaces
- Reduction in fire hazards
- Compliance with regulations and promotion of sustainability

## TARGETS

- Current disposal site closed by 2029
- Capturing 50% of landfill gas emissions by full landfill closure
- Functional leachate collection and treatment

## TIMEFRAME

2027–2029

## GHG SAVINGS

28,227 t CO<sub>2</sub>eq/year

## CAPEX (EUR)

9,000,000

## Context

The existing landfill in Novi Sad, located near the Klisa settlement, has been in operation since 1980 and has reached its capacity limits. The landfill spans approximately 30 hectares and has been the primary disposal site for municipal solid waste generated in the city. This unsanitary landfill has been a longstanding environmental issue, reflecting broader challenges related to waste management in Novi Sad. Waste received at the landfill is compacted using compactors and bulldozers. There is no engineered leachate collection system in place, although leachate is managed through surface canals surrounding the landfill which connect with two lagoons.

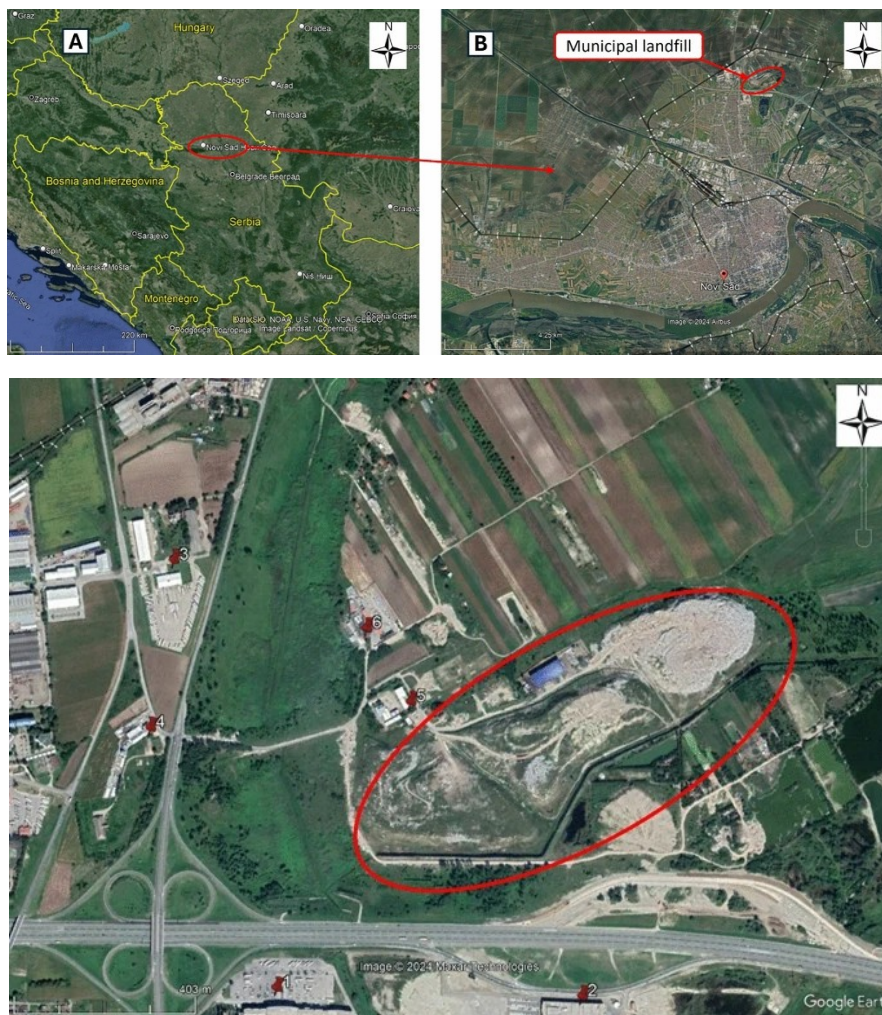


Figure 23 Location of the current unsanitary landfill. Source: Google Earth Pro

Novi Sad Municipality is currently working to develop a Regional Waste Management Centre (RWMC) which will include a new sanitary landfill. Thus, the current disposal site will be closed once the new RWMC is functional.

## Description

The remediation of the unsanitary landfill in Novi Sad involves a series of planned and coordinated actions aimed at addressing the environmental, public health, and safety risks posed by the existing landfill.

Below is a detailed description of the key actions required for the remediation process:

- Compacting and reshaping the waste mass
- Capping and sealing of the landfill, including impermeable cap installation, soil cover and vegetation
- Remediation of the contaminated soil through excavation and removal of hazardous waste and soil stabilisation
- Leachate management and control including a leachate collection system installation and leachate treatment
- Gas collection system installation and gas flaring or utilisation for proper methane and landfill gas management
- Monitoring and aftercare system

The remediation of the unsanitary landfill in Novi Sad involves a comprehensive, multi-phase process that addresses both immediate environmental hazards and long-term sustainability goals. By capping the landfill, managing leachate and methane emissions, and restoring the site, Novi Sad can significantly reduce the environmental and public health risks associated with the landfill, while transforming the area into a useful space for future generations.

## Implementation steps

- 1. Development of feasibility study for landfill closure:**
  - Conduct a detailed assessment of the landfill site, including waste composition, environmental impact and leachate characteristics.
  - Perform geotechnical and hydrological studies to evaluate site stability and groundwater contamination risks.
  - Develop a comprehensive remediation plan, specifying methods for waste stabilisation, reshaping and soil coverage.
  - Include provisions for landfill gas capture, leachate treatment and revegetation.
- 2. Permitting, procurement and contracting construction works and supervision:**
  - Obtain necessary permits for landfill closure.
  - Prepare tender documents for the procurement of specialised equipment and construction, as well as for technical assistance - supervision.
  - Select contractors with expertise in landfill remediation and environmental restoration.
- 3. In situ works: site preparation, waste stabilisation, leachate and landfill gas management, capping:**
  - Stabilise the landfill through compaction and reshaping to improve site stability.

- Install systems for leachate collection and treatment.
  - Construct a system for the capture and utilisation or flaring of landfill gas.
  - Install a multi-layer capping system to prevent water infiltration and control gas emissions.
  - Implement revegetation using native plant species.
- 4. Monitoring and post-closure management:**
- Establish a long-term monitoring program to track environmental parameters.
  - Monitor gas extraction rates and system efficiency continuously.
  - Maintain the site, including periodic inspections and repairs.

## Stakeholders

Novi Sad Municipality; National Government; Urban planning and environmental Consultants; PUCs and waste management companies

## Estimated costs

Item	CAPEX (EUR)	OPEX (EUR/year)
Feasibility study, detailed design, permitting and tendering process for landfill closure and technical assistance	1,000,000	
Remediation of the unsanitary landfill	8,000,000	100,000
<b>TOTAL</b>	<b>9,000,000</b>	<b>100,000</b>

The current cost estimates are based on the existing strategic document and can suffer modifications during project development and implementation.

## Potential sources of financing

Local budget; government funds; development banks/IFIs

## Social and gender aspects

The action will contribute to local community development through improved environmental conditions and significant social impacts, particularly on vulnerable groups and communities living near the landfill. The project should promote women’s involvement at all levels, from planning to implementation and oversight. By involving local communities, providing equitable access to job opportunities, and addressing the specific needs of vulnerable populations, the project can lead to more sustainable and inclusive outcomes. This action is expected to have a **moderate positive impact** on social and economic inclusion, and gender equality aspects.

## Smart and digital aspects

The action incorporates smart and digital technologies to monitor and control the leachate levels with sensors and IoT (Internet of Things) devices, ensuring optimal monitoring of the

site conditions. Also, the project will implement data-driven decision-making. Real-time waste management data will be fed into the Municipality’s digital platform (see **Action 21**), where algorithms analyse trends and make predictions. This can help identify risks early and guide remediation activities in real-time, optimising the remediation timeline and reducing costs.

## Correlation with other actions

Action	Explanation
Action 21. Smart city	Tracking environmental parameters such as soil and groundwater and leachate quality, gas emissions, and site stability.

# Action 15

## Construction of two new recycling yards and expansion of the Reciklomat system



### GOAL OF THE ACTION

The goal of the action is to enhance the waste management infrastructure of Novi Sad and promote sustainable recycling practices, by constructing two new recycling yards for recyclables and expanding the Reciklomat system, thereby increasing accessibility, convenience, and community engagement in waste separation and recycling. This action aims to reduce landfilled waste, improve resource recovery, and encourage environmental responsibility among residents.

### CHALLENGE ADDRESSED

- Very low recycling and composting rates
- Lack of waste treatment capacities and financial resources for the reduction of landfilled waste
- Inadequate separate waste collection system

### STRATEGIC OBJECTIVES

S01		S02		S03
	<small>STRATEGIC OBJECTIVE 1</small> <b>Urban Green Renewal</b>		<small>STRATEGIC OBJECTIVE 2</small> <b>Towards net-Zero Emissions</b>	

### BENEFITS

- Increased recycling rates
- Reduced landfilled waste
- Environmental protection and resource conservation
- Support for circular economy and long-term sustainability
- Public health, public engagement and awareness
- Job opportunities

### TARGETS

- Two recycling yards fully functional by the end of 2027
- Citywide extension of „Reciklomat“ programme by 2027
- Increasing the municipal waste recycling to 35% by 2029

### TIMEFRAME

2025–2027

### GHG SAVINGS

8,100 t CO<sub>2</sub>eq/year

### CAPEX (EUR)

2,400,000

## Context

The construction of two new recycling yards in Novi Sad is a response to the growing waste management challenges faced by the city and the broader environmental and regulatory context. The initiative complements the development of the planned Regional Waste Management Centre (RWMC), which is expected to be operational by 2026. Within the RWMC, Novi Sad will establish three recycling yards, out of which one has already been opened in May 2025 near the existing landfill. Citizens can bring their cardboard, plastic, aluminium waste and similar waste materials to this location, as well as tires, accumulators and batteries.



*Figure 24 Recently opened recycling yard in Novi Sad<sup>14</sup>*

The extension of the "Reciklomat" program in Novi Sad is an important step toward further promoting recycling and waste management within the city. "Reciklomat" refers to an innovative initiative that incentivises recycling through the installation of smart recycling machines (reverse vending machines) allowing citizens to deposit recyclable materials such as plastic bottles and cans in exchange for rewards or credits. The existing system has shown success in raising public awareness and participation in recycling efforts. However, the limited number of Reciklomats in the city restricts access and the potential impact of the program. By a citywide expansion of the system, Novi Sad aims to make recycling more convenient and accessible for all residents, encouraging widespread engagement in waste separation.

<sup>14</sup> <https://www.021.rs/story/Novi-Sad/Vesti/375104/Otvoreno-prvo-reciklazno-dvoriste-u-Novom-Sadu-planirana-jos-dva.html>, accessed in October 2024.

## Description

Waste collection centres and recycling yards are facilities frequently used in Europe and are suitable for receiving a diverse range of special waste streams. These centres generally charge little to no fee for accepting waste.

The construction of two recycling yards in Novi Sad involves a series of planned and coordinated actions aimed at addressing the city's waste management challenges. The capacity of each of the two future recycling yards will be between 10 and 20 tons per day. The facilities' purpose will be the receiving, sorting, processing and recovery of separately collected (dry) recyclable waste. The centres will provide modern infrastructure for waste separation, support environmental sustainability goals, and enhance public participation in recycling efforts.

The following is a description of the project's components:

- Facility infrastructure, including identification and preparation of suitable locations for recycling, ensuring optimal waste collection and sorting efficiency (possible locations are Futog and Petrovaradin). Each recycling yard will be designed to accommodate different types of recyclable materials.
- Designated waste receiving and sorting areas for the unloading of recyclables, equipped with manual and automated sorting systems.
- Processing equipment, shredders, crushers and bailing machines.
- Each centre will focus on maximising the recovery of valuable materials, and reducing the volume of waste sent to landfills.
- Implementation of Environmental Management Systems (EMS) and technologies to minimise emissions during operations to ensure compliance with environmental regulations.
- Community engagement and education through programmes aimed at the promotion of recycling initiatives to encourage participation in waste reduction programs.

The citywide expansion of the Reciklomat programme aims at transforming Novi Sad's approach to recycling, embedding accessible recycling options in all major public spaces and fostering an environmentally responsible attitude.

The installation of additional Reciklomats would involve a strategic placement across the city, aiming at high-traffic locations, such as shopping malls, schools, public transport stations, parks and residential areas. Additionally, centralised recycling zones can be developed, where multiple Reciklomats are grouped, especially in larger neighbourhoods or areas with a higher population density. A citywide Reciklomat program would position Novi Sad as a leading example of urban sustainability in the country, fostering a deeply rooted culture of environmental responsibility. This could serve as a replicable model for other cities in Serbia and the Balkan region.



Figure 25 Reciklomat system in Novi Sad

Monitoring the system is an essential part of the efficiency of the program. Using data from Reciklomats can help understand resident participation patterns and adapt the program as necessary. Data regarding usage frequency, contamination rates and geographic trends will help optimise the placement and functionality of the machines.

## Implementation steps

- 1. Development of feasibility study and tendering for construction and equipment:**
  - Develop detailed designs for the recycling yards.
  - Assess the current capacity and coverage of the Reciklomat system to determine priority areas for expansion and plan the expansion of the system.
- 2. Procurement and contracting procedures:**
  - Prepare tender documents for the construction of recycling yards and the procurement of Reciklomat units.
  - Select contractors with experience in waste management infrastructure.
- 3. Construction phase and installation of new Reciklomat units:**
  - Construct the two recycling yards, including necessary infrastructure for waste handling and storage.
  - Obtain all the necessary permits for construction and operation.
  - Install new Reciklomat units.
  - Development of recycling digital application where users can access information related to location of recycling facilities, complementary services, operational hours, etc.
- 4. Public awareness and educational campaigns:**
  - Launch citywide campaigns to promote the use of recycling yards and the Reciklomat system.
  - Provide educational materials to encourage waste segregation and responsible recycling.

## 5. Monitoring and optimisation:

- Establish monitoring systems to track the usage and performance of the recycling yards and Reciklomat units.
- Use collected data to optimise operations and plan for future expansions.

## Stakeholders

Novi Sad Municipality; PUCs and waste management companies; urban planning and environmental consultants; construction companies, contractors and technology providers; local NGOs; academic institutions and environmental agencies.

## Estimated costs

Item	CAPEX (EUR)	OPEX (EUR/year)
Feasibility study and tendering for construction and equipment	100,000	
Construction and infrastructure development	1,500,000	50,000
Expansion of Reciklomat system	700,000	70,000
Digital app for recycling	100,000	5,000
Information campaign for recycling yards		20,000
<b>TOTAL</b>	<b>2,400,000</b>	<b>145,000</b>

## Potential sources of financing

Local budget; government funds; EPR schemes

## Social and gender aspects

By addressing issues of accessibility, employment, education, and environmental justice, the project will contribute to greater social cohesion, gender equality, and long-term sustainability in the region. This action is expected to have a **moderate positive impact** on social and economic inclusion, and gender equality aspects.

## Smart and digital aspects

The action will incorporate smart and digital technologies to enhance efficiency, improve user experience, and contribute to the broader goals of sustainability and environmental responsibility. The recycling yards will be operated through a digitalised system, including sensors and data collection systems correlated with the overall waste management system.

A mobile application is envisaged for user engagement, providing information on the location of centres, prices, complementary services provided by these centres, operation hours, etc. This application will be compatible with the database envisaged to be developed in **Action 21**.

## Correlation with other actions

Action	Explanation
Action 16 Implementation of a citywide two fractions waste collection system	A more efficient recycling collection system will increase waste diversion rates and optimise the use of recycling yards.
Action 21. Smart city	Digital monitoring of Recikloamat machines will improve efficiency, track recycling trends, and encourage greater community participation.

# Action 16

## Implementation of a citywide two fractions waste collection system



### GOAL OF THE ACTION

The further improvement of the waste collection system in Novi Sad through a citywide two-bin system is a proactive approach to enhancing waste management practices in the city. This system aims to reduce landfill dependency, increase recycling rates, and promote the responsible management of organic and non-organic waste streams, fostering a cleaner urban environment and supporting long-term ecological and economic benefits for the community.

### CHALLENGE ADDRESSED

- Lack of sufficient capacity in the existing location for waste depositing
- Very low recycling and composting rates
- Inadequate separate waste collection system

### STRATEGIC OBJECTIVES

S01

S02



S03



### BENEFITS

- Increased recycling rates and resource efficiency
- Reduction of landfilled waste
- Environmental protection and improved public health

### TARGETS

- Increasing the municipal waste recycling rate to 35% by 2029
- 100% of the city coverage with separate bins for the two fractions

### TIMEFRAME

2025–2028

### GHG SAVINGS

N/A

### CAPEX (EUR)

9,050,000

## Context

Novi Sad faces significant challenges in managing the growing volumes of MSW generated by its residents, businesses and institutions. Waste collection service coverage is 100% and waste is generally collected as mixed MSW, with areas where there are already underground collection points.



*Figure 26 Underground waste collection points*

Recently, the Municipality placed 50 bell containers for the glass packaging, and these are collected and treated separately. Additionally, several waste collection points have been expanded with separate containers for plastic waste.

The Regional Waste Management Plan envisages the introduction of a citywide waste collection system designed for two fractions:

- Dry fraction – recyclables (packaging and non-packaging waste from paper, cardboard, glass, plastic and metal, composite materials, rubber etc.)
- Wet fraction – all remaining waste (mostly organic waste, as well as textiles, leather etc.)

A third fraction is also planned in the future for the separate collection of bio-waste. The ultimate goal of the Municipality is to have a separate collection system for each waste fraction.

The two-bin system in Novi Sad is also part of a broader initiative targeting improved waste management, driven by both environmental and regulatory pressures. It is a key initiative to meet the Municipality's sustainability goals, reduce environmental impacts, align with EU directives, and enhance public engagement in recycling.

## Description

The improvement of the waste collection system in Novi Sad through the introduction of a two-fraction system is a key initiative aimed at enhancing the efficiency of waste

management in the city, improving recycling rates, and reducing environmental impacts. The program seeks to modernise waste collection practices by implementing a two-bin approach, where waste is separated at source into two distinct categories: recyclable waste and non-recyclable waste. According to the regional waste management plan for establishing a separate waste collection system, it is necessary to procure 1,300 underground containers with a capacity of 3 m<sup>3</sup>, around 350 metal containers with a capacity of 1.1 m<sup>3</sup>, approximately 3,200 plastic containers (1.1 m<sup>3</sup>) for dry waste fraction, and 2,100 containers (1.1 m<sup>3</sup>) for wet waste fraction. Additionally, about 10,000 bins with a 120-litre capacity are needed for the wet waste fraction, and around 93,000 bins with a 120-litre capacity for the dry waste fraction. It is also necessary to procure around 50 trucks with various capacities between 10 m<sup>3</sup> to 22 m<sup>3</sup>.

The two-fraction waste collection system in Novi Sad represents a forward-looking approach to waste management that promotes recycling, reduces environmental impact, and engages the public in sustainable practices. Through better waste segregation, improved infrastructure, and public participation, Novi Sad aims to create a cleaner, greener, and more sustainable city.

## Implementation steps

### 1. Design and planning phase:

- Develop the feasibility study for citywide two-fraction waste collection system, detailing logistics, equipment needs, collection schedules and points.
- Design uniform bins and labelling to ensure clarity and ease of use for residents.
- Obtain all the necessary permits.

### 2. Infrastructure procurement:

- Acquire necessary equipment: bins for residential use, specialised collection vehicles, storage facilities etc. including smart and digital elements.

### 3. Citywide implementation of the two-fraction waste collection system:

- Roll out the system across all neighbourhoods. Distribution of the bins to households, businesses, and institutions (ensuring the two-fraction approach for every type of waste generator):
  - Bin 1: Dry – Recyclable Waste
  - Bin 2: Wet – Non-Recyclable Waste
- Smartification – use smart waste management technologies, including sensors in bins to monitor waste levels and optimise collection schedules, as well as digital tools for tracking recycling performance and engaging the public.
- Ensure regular and efficient collection of segregated waste.

### 4. Public awareness and educational campaigns:

- Launch a comprehensive outreach campaign to educate residents about the new system, including the importance of waste segregation.
- Use workshops, community events and digital platforms to promote participation and provide guidance on proper waste sorting.

## 5. Monitoring and continuous improvement:

- Establish monitoring systems to track participation rates, waste diversion and system efficiency.
- Use data and community feedback to address challenges and optimise operations.

## Stakeholders

Novi Sad Municipality; PUCs and waste management companies; urban planning and environmental consultants; residents and businesses; local NGOs; academic institutions and environmental agencies

## Estimated costs

Item	CAPEX (EUR)	OPEX (EUR/year)
Feasibility study for the citywide expansion of the two-fraction collection system	200,000	
Development of waste collection infrastructure – dedicated bins and /or underground collection points	5,000,000	100,000
Dedicated collection trucks, 30 trucks @ average 120,000 EUR/unit	3,600,000	200,000
Sensors for smart bin technology, equipment and software for smart collection routes and fleet management	200,000	10,000
Information campaign	50,000	10,000
<b>TOTAL</b>	<b>9,050,000</b>	<b>320,000</b>

The current cost estimates are based on the existing strategic document and can suffer modifications during project development and implementation.

## Potential sources of financing

Local budget; government funds; development banks/IFIs; private sector investments

## Social and gender aspects

By ensuring equitable access, incorporating gender considerations, and fostering inclusive community participation, the program will improve environmental outcomes while promoting social equity and gender equality. Engaging women and vulnerable communities, and providing safe, fair employment opportunities can enhance the program's long-term sustainability and societal impact. This action is expected to have a **moderate positive impact** on social and economic inclusion, and gender equality aspects.

## Smart and digital aspects

The action will implement smart and digital technologies to enhance efficiency, optimise resource use, and improve overall sustainability. Here are key smart and digital aspects that can be integrated into the waste collection system in Novi Sad:

- Smart bin technology,
- Smart collection routes and fleet management,
- Digital public awareness campaigns.

All collected data will be included in the waste management dataset envisaged to be integrated into the overarching municipal digital platform (see **Action 21** – Smart City).

## Location of the implementation

A separate collection system for waste with two fractions and public awareness campaigns will be implemented on the entire territory of the city of Novi Sad.

## Correlation with other actions

Action	Explanation
Action 4. Improved traffic management system	Optimising waste collection routes and schedules will reduce congestion, improve road safety, and enhance the efficiency of urban logistics.
Action 15. Construction of two new recycling yards and expansion of the Reciklomat system	The proposed segregation system will increase the efficiency of recycling yards and improve resource recovery.
Action 21. Smart city	Collected data will be included in the overarching municipal digital platform.

# Action 17

## Waste treatment facility for refuse-derived fuel production



### GOAL OF THE ACTION

This action focuses on reducing landfilled waste, recovering energy from non-recyclable materials, and promoting environmental sustainability. By integrating advanced waste sorting and processing technologies within a Regional Waste Management Centre, the proposed facility will be a modern Mechanical Biological Treatment plant with refuse-derived fuel (RDF) production line..

### CHALLENGE ADDRESSED

- Lack of sufficient capacity in the existing location for waste depositing
- Very low recycling and composting rates
- Lack of waste treatment capacities and financial resources for the reduction of landfilled waste

### STRATEGIC OBJECTIVES

S01

S02



S03

STRATEGIC OBJECTIVE 2  
Towards  
net-zero  
Emissions

### BENEFITS

- Waste diversion from landfills
- Energy recovery
- Reduction of GHG emissions
- Economic and job opportunities
- Enhanced waste management efficiency

### TARGETS

- Reduce the volume of landfill waste by 30% after the MBT facility, including the RDF line is fully functional

### TIMEFRAME

2025–2028

### GHG SAVINGS

3,579 t CO<sub>2</sub>eq/year

### CAPEX (EUR)

20,300,000

## Context

This action focuses on reducing landfilled waste, recovering energy from non-recyclable materials, and promoting environmental sustainability. By integrating advanced waste sorting and processing technologies, the action transforms waste management into a resource-efficient process generating energy, benefiting both the environment and the local or regional economy.

The City of Novi Sad, together with seven surrounding municipalities forming the South Bačka Waste Management Region, produced approximately 204,000 tons of solid waste in 2020. The future RWMC is planned to have a working zone, where an MBT facility with an RDF preparation plant will be developed. To estimate the required capacity for the MBT facility and the RDF line, aspects considered were waste composition, suitable waste for RDF production, and future increases in waste generation.

According to the waste composition presented in the sectoral overview, approximately 40% of the total amount of waste is suitable for RDF production but only about half of this quantity will be used for RDF production, as the rest would be recycled. Waste fractions suitable for RDF production typically consist of non-recyclable plastics, paper, textiles, and other non-recyclable combustible materials.

## Description

The MBT will include biological treatment of waste, bio-drying and additional technical elements, and an RDF production system. The RDF facility will be designed to handle approximately 150,000 tonnes of waste per year in order to accommodate current and future waste quantities.

The MBT facility, including the RDF production line, will include the following components:

- Waste reception and pre-processing area – A designated area with machinery to sort and preprocess waste materials. This includes screens, shredders, and magnetic and air separation units to remove non-combustible materials and prepare the waste for biological treatment and RDF production.
- Biological treatment – bio-drying plant for the aerobic biological treatment of organic waste
- RDF production process – Sorting and shredding, drying, pelletising or baling.
- Quality control and testing - Implementation of procedures to monitor and maintain the quality of RDF.
- Environmental management systems – Implementation of real-time monitoring systems to minimise emissions and environmental impact, thus complying with regulatory standards.
- Facility infrastructure – The facility will also feature dedicated areas for waste storage, maintenance workshop, and administration offices.

The MBT facility outputs will play a key role in supporting waste recovery. The main output, namely RDF can be delivered to cement kilns or power plants. Additional opportunities arise when taking into consideration the possibility of integrating RDF into the district heating system, which would enhance the district heating system with renewable energy input, thereby maximising regional energy efficiency and reducing environmental impact through decreased reliance on fossil fuels.

The implementation of the RDF production facility in Novi Sad involves a systematic approach that emphasises feasibility, stakeholder engagement, and adherence to environmental standards. By following these steps, the project aims to successfully transform non-recyclable waste into a valuable fuel resource, contributing to sustainable waste management and energy recovery while benefiting the local community and economy.

## Implementation steps

### 1. Feasibility study and other specific studies:

- Conduct a feasibility study to determine the technical and economic viability of the MBT facility, including the RDF production line in Novi Sad.
- Develop a detailed engineering design for the MBT facility.
- Carry out market analysis for RDF usage to identify potential markets and end-users for RDF, such as cement plants and power generation facilities; examine the possibility of a collaboration with the district heating plant.
- Carry out specific studies necessary for obtaining the construction and operation permits.

### 2. Procurement and tendering procedures:

- Prepare tender documents specifying the technical and operational requirements for the MBT facility.
- Conduct a competitive bidding process to select contractors and technology providers.

### 3. Construction of the facility, installation of equipment and commissioning of the facility:

- Construct the MBT facility, including the RDF production line.
- Install emission control technologies to ensure environmental compliance.
- Initiate RDF production and integrate it with regional waste management practices.
- Establish monitoring systems to track facility performance, fuel quality and environmental impact.

### 4. Capacity building and training:

- Train staff on facility operations.
- Implement health and safety protocols for workers and facility management.

## Stakeholders

Novi Sad Municipality; PUCs and waste management companies; urban planning and environmental consultants; construction companies; contractors and technology providers; local NGOs, academic institutions and environmental agencies

## Estimated costs

Item	CAPEX (EUR)	OPEX (EUR/year)
Feasibility study and specific studies	200,000	
Tendering process for construction and equipment	100,000	
Construction and start of operation of the MBT facility, including the RDF production line and capacity building for the operation of the new facility	20,000,000	200,000
<b>TOTAL</b>	<b>20,300,000</b>	<b>200,000</b>

## Potential sources of financing

Local budget; government funds; development banks/IFIs; private sector investments

## Social and gender aspects

This action will provide job opportunities and will ensure equal chances to all for obtaining the new jobs. This action is expected to have a **moderate positive impact** on social and economic inclusion, and gender equality aspects.

## Smart and digital aspects

The MBT facility will also include smart and digital elements such as sensors integrated into an IoT application to optimise the production process. All collected data will be included in the waste management dataset envisaged to be integrated into the overarching municipal digital platform (see [Action 21](#)).

## Location of the implementation

At the location of the future Regional Waste Management Centre in Novi Sad.

## Correlation with other actions

Action	Explanation
Action 21. Smart city	Smart waste sorting and digital tracking of RDF production will optimise operations, improve efficiency, and enhance the integration of circular economy principles.

# Action 18 Construction and demolition waste processing facility



## GOAL OF THE ACTION

The construction and demolition (C&D) waste processing facility in Novi Sad is essential for addressing the increasing challenges of C&D waste management. By focusing on resource recovery, waste diversion, and community engagement, the facility will contribute to the sustainable development in the region and promote responsible waste management practices. This project represents a significant step towards a circular economy and a cleaner, more sustainable future for Novi Sad.

## CHALLENGE ADDRESSED

- Lack of sufficient capacity in the existing location for waste depositing
- Very low recycling and composting rates

## STRATEGIC OBJECTIVES

S01		S02		S03
	STRATEGIC OBJECTIVE 1 Urban Green Renewal		STRATEGIC OBJECTIVE 2 Towards net-Zero Emissions	

## BENEFITS

- Reduction in the volume and quantities of waste sent to landfills
- Resource recovery and recycling
- Reduced GHG emissions and mitigation of soil and water contamination risk
- Economic growth and job creation
- Improvement of the overall environmental resilience of the city
- Long-term cost savings

## TARGETS

- Construction of the C&D waste processing facility by 2028
- Eliminating illegal dumping of C&D waste in one year after the facility becomes functional
- 40% of collected C&D waste is processed and ready for reuse and recycling, one year after starting the operation

## TIMEFRAME

2025–2027

## GHG SAVINGS

200 t CO<sub>2</sub>eq/year

## CAPEX (EUR)

2,000,000

## Context

The construction of a C&D waste processing facility in Novi Sad is set out in a framework of environmental, regulatory, economic, and social factors. Currently, C&D waste is either landfilled at the controlled disposal site of the city or illegally dumped by generators<sup>15</sup>.

Landfilling of unprocessed C&D waste poses significant challenges for the operation of the landfill, due to its bulky nature and the wear and tear or damage it causes on landfill equipment. In addition, it causes high transportation costs and is a missed opportunity for the reuse and recycling of high carbon-encompassing materials, such as concrete.

The city of Novi Sad is developing at a steady pace, leading to ever-increasing quantities of C&D waste which needs to be processed. By addressing the challenges associated with C&D waste management and aligning this action to sustainability goals, the project aims to create a positive impact on the environment and the community, promoting a more sustainable urban future for Novi Sad.

## Description

The primary goal of the C&D waste processing facility is to enhance waste management practices by diverting construction and demolition waste from landfills or illegal dumping, promoting recycling, and recovering valuable materials.

C&D waste holds significant potential for recycling as a secondary material. Key C&D waste types prioritised for recycling include concrete and reinforced concrete, asphalt concrete, building ceramics (e.g. bricks), broken rock, and mineral/inert waste. Together, these materials represent approximately 80-85% of all generated C&D waste. After processing, predominant waste types such as concrete and bricks can replace primary resources like gravel and sand in road construction. Depending on the initial quality of the concrete, it may be directly reused for similar construction applications. Common uses for recycled concrete include soil reinforcement, noise barriers, embankments, drainage materials, temporary roads, and sports facilities.

The proposed facility will require a designated area for crushing and separating C&D waste fractions and storage space for ready-to-reuse materials. Approximately 5,000 m<sup>2</sup> would be needed, with at least 800 m<sup>2</sup> concrete paved surfaces. Non-recyclable fractions can be directed to the future sanitary landfill for use as cover material. The capacity of the future CDW processing facility is estimated at 100,000 tons per year.

The facility will be equipped with a mobile crusher capable of processing 50-70 tons per hour across all C&D waste types, including concrete, aerated concrete, and bricks. The crusher's sieve can adjust output size, and it can be deployed to active construction sites upon request from private companies, representing a valuable service provision.

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<sup>15</sup> Regional waste management plan for the City of Novi Sad and the municipalities of Bačka Palanka, Bački Petrovac, Bеоčин, Žabalj, Srbobran, Temerin and Vrbas for the 2019-2028 period.

The C&D waste facility project in Novi Sad represents a significant step towards sustainable waste management and environmental protection in the region. It is a key element of a sound waste management system. By providing the infrastructure needed for efficient recycling and resource recovery, the facility aims to reduce the environmental impact of construction and demolition activities.

## Implementation steps

### 1. Feasibility study, site selection, detailed design and permitting:

- Assess the volume, types and distribution of C&D waste generated within the city.
- Identify and map illegal dumpsites.
- Prepare a feasibility study to decide on the required capacity and suitable processing technologies.
- Develop engineering designs for the facility, specifying equipment.
- Consult with construction companies, waste generators and regulatory agencies to align objectives and secure support.
- Develop specific studies for permitting procedures.

### 2. Tendering and contracting procedures:

- Prepare tender documents for facility construction and equipment procurement.
- Select contractors and suppliers through a transparent bidding process.

### 3. Construction, equipment installation and testing, commissioning:

- Prepare the site by clearing and levelling the land and constructing access roads.
- Build the facility and install processing equipment – integrate systems for dust and noise control.
- Ensure compatibility with waste collection and transport logistics.
- Develop operational manuals and establish workflows for efficient waste processing and material recovery.
- Hire and train staff on facility operations, safety protocols and equipment maintenance.

### 4. Monitoring, optimisation and maintenance:

- Install monitoring systems to track processing efficiency, material recovery rates and environmental compliance.
- Regularly review operations to identify areas for improvement and ensure long-term sustainability.

### 5. Clean up illegal dumpsites:

- Plan and execute the cleanup of identified illegal dumpsites.
- Recover usable C&D materials from the dumpsites for processing or recycling where feasible.
- Safely dispose of non-recyclable materials in compliance with environmental standards.

## Stakeholders

Novi Sad Municipality; PUCs and waste management companies; urban planning and environmental consultants; construction companies, contractors and technology providers; local NGOs, academic institutions and environmental agencies

## Estimated costs

Item	CAPEX (EUR)	OPEX (EUR/year)
Design and engineering services, specific studies, permitting	200,000	
Tendering and contracting	50,000	
Construction and infrastructure development, including smart elements and staff training	1,750,000	200,000
Cleaning up of illegal dumpsites		50,000
<b>TOTAL</b>	<b>2,000,000</b>	<b>250,000</b>

## Potential sources of financing

Local budget; government funds; private sector investments

## Social and gender aspects

Staffing requirements and development of specifications for procurement, implementation and operation will need to take full consideration of gender equality and equal rights for job opportunities. This action is expected to have a **marginal positive impact** on social and economic inclusion, and gender equality aspects.

## Smart and digital aspects

The facility will include smart and digital technologies to enhance efficiency, optimise operations and resource use, and improve overall sustainability.

The facility will be part of the integrated waste management information system, allowing for real-time data collection, monitoring and analysis. All collected data will be included in the waste management dataset envisaged to be integrated with the overarching municipal digital platform (see [Action 21](#)).

The action would also be complementary to online reporting of illegal waste dumping, via a feature in the app developed in [Action 15](#).

## Location of the implementation

At the location of the future regional waste management centre in Novi Sad.

## Correlation with other actions

Action	Explanation
Action 6. Energy rehabilitation of public buildings and facilities	The generated construction and demolition waste from the rehabilitation can be efficiently processed at the new C&D waste facility.
Action 7. Energy rehabilitation of private/residential buildings	
Action 15. Construction of two new recycling yards and expansion of the Recyklomat system	The digital app developed in Action 15 will include a feature for reporting illegal waste dumping in the city.
Action 21. Smart city	Collected waste management data will be integrated into the municipal digital platform.



**Novi Sad**

Green City Action Plan

# Land use



## Sector overview

### Baseline

Novi Sad, the second largest city in Serbia and the administrative centre of the Autonomous Province of Vojvodina, is a vital hub for economic, educational, and cultural endeavours in the region. Situated strategically along the Danube river, Novi Sad plays a key role in the E-VII European Transport Corridor, reinforcing its status as a central point for regional economic and transit activities.

Guided by an overarching General Urban Plan and supported by detailed zonal plans, the urban landscape of Novi Sad is carefully organised and developed through extensive annual planning. The Urban Planning Institute of Novi Sad coordinates over 50 planning documents yearly, addressing a spectrum of land uses, including public zones, residential areas, business hubs, agricultural land, and natural conservation spaces. Residential zones vary widely, from low-density family housing to high-density multi-family developments. Notable locations like the historic Petrovaradin Fortress and the scenic Danube embankment have been designated as key areas for preservation and tourism, reflecting the city's dedication to maintaining its cultural and natural heritage.

In recent years, Novi Sad has made significant progress in enhancing its Geographic Information System (GIS) cadastre. The city is currently working towards launching the new NSMaps GIS Portal, an interactive platform that provides comprehensive geospatial data, including detailed information on infrastructure and zoning. This development has improved the accessibility and precision of the city's spatial data, contributing to efficient infrastructure and green space management.

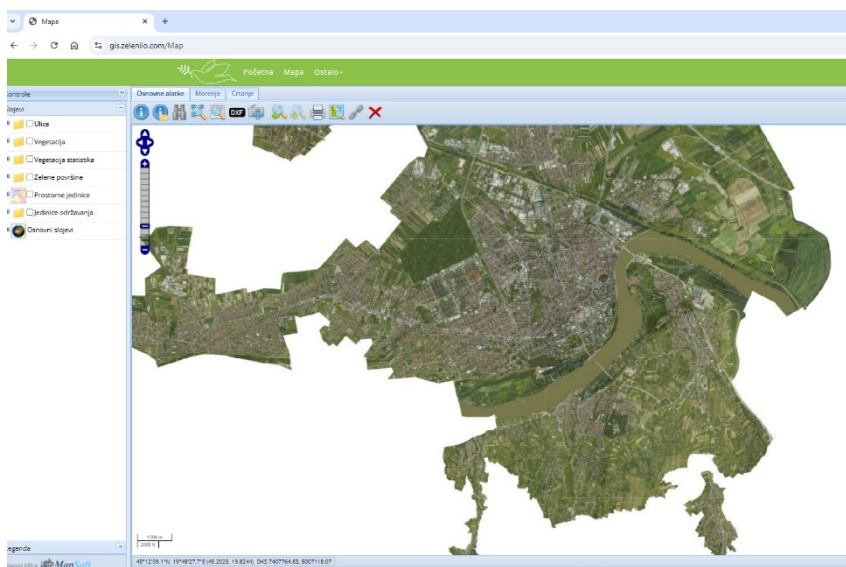


Figure 27 Green Area Cadastre (source: <https://gis.zelenilo.com/Map>, Novi Sad, 2024)

The city's land-use strategy places a strong emphasis on green space expansion and connectivity, integrating green trails and preserving natural areas within its urban framework. The city has set a goal of increasing public green spaces by 10% by 2030,

compared to the percentage of existing greenery. Currently, the City is maintaining around 450 ha of green areas within its boundaries. A green area cadastre has been developed and is available online.

Green corridors and park spaces around residential zones enhance both environmental quality and accessibility of green areas for residents. Multifunctional green infrastructure is a cornerstone of the urban strategy of Novi Sad, offering environmentally friendly transportation options like pedestrian and bike paths that connect to the EuroVelo 6 route along the Danube. The newly conceived development strategy of the city presents also the planned green areas where investments will be directed in the coming years. The strategy acknowledges the strengths and weaknesses of Novi Sad, including the high potential of using the Danube and the existing blue infrastructure of the city for future developments.



Figure 28 Planned distribution map of green and recreational areas in Novi Sad up to 2030  
(source: General Urban Plan)

Despite these advancements, some challenges in the land use sector persist. Former industrial areas pose planning hurdles due to complex land ownership issues. To address rising urban density, Novi Sad is expanding pedestrian and cycling infrastructure, with plans for dedicated pedestrian and bicycle bridges over the Danube.

Looking ahead to 2030, Novi Sad envisions itself as a sustainable, economically resilient, and inclusive city. The development plan outlines a commitment to harmonising urban growth with environmental conservation to sustain a high quality of life for its citizens. A central pillar of this vision is the smart city framework, which combines digital technology with participatory planning to enhance transparency and streamline land-use policies. Through

these forward-thinking strategies, Novi Sad aims to become a model for sustainable urban living in the region.

### *Policy Framework*

- Development Plan for the City of Novi Sad (2024)
- Smart City Action Plan for Novi Sad (2023)

### *Prioritised Challenges, short-term and long-term GCAP actions*

#### **Challenges**

Insufficient use of blue opportunities in the city

GIS cadaster of the city is incomplete

There is no 3D model of the city along with topographical morphology to facilitate the urban planning process

Ownership issues within former industrial sites in certain zones make it difficult to plan the revitalisation of these areas

Planning and implementing solutions to alleviate traffic jams is challenging given the growing number of private cars

#### **Short-term actions**

**19. Green urban landmarks**

**20. Establish a city-wide blue-green network**

**21. Smart city**

**22. Development and implementation of a sustainable tourism strategy**

#### **Long-term actions**

Living labs for circular economy in Novi Sad

Full urban digital twin with urban development monitoring

Integrating blue-green design principles at street and city level – urban planning

Improve the equity of green and public open space distribution

Sustainable management of blue-green infrastructure at the neighbourhood level

Start of implementation

Year 5

Year 15

# Action 19

## Green urban landmarks



### GOAL OF THE ACTION

This action aims to enhance the urban environment of Novi Sad and its tourist attractions (together with **Action 20**) by creating iconic green spaces and infrastructure that promote sustainability, improve quality of life, and foster economic opportunities. These iconic elements will become the city’s green urban landmarks.

### CHALLENGE ADDRESSED

- Insufficient current use of blue opportunities in the city for tourism and mobility purposes
- The GIS cadastre of the city is incomplete; it does not reflect the existing situation in terms of municipal infrastructure
- Planning and implementation of solutions to alleviate traffic jams has a hard time keeping up with the growing number of cars

### STRATEGIC OBJECTIVES

S01



STRATEGIC OBJECTIVE 1  
Urban  
Green  
Renewal

S02

S03

### BENEFITS

- Increased accessibility of green spaces
- Improved public health by enabling a more active lifestyle
- Increased recreational spaces, improving the young generation’s well-being, their options to learning and playing, while contributing to the communities ecological health, social cohesion, and climate resilience
- Enhanced community cohesion
- Boosted tourism, new business opportunities, and increased property values

### TARGETS

- Development of the new Botanical Garden – 4 ha of new green area
- Construction of a new pedestrian/cycling bridge connecting the city with Petrovadarin fortress and the Botanical Garden
- Establishment of 3 green urban landmarks areas and/or car-free and pocket-park street initiatives across the city. 5% increase in population living within 500 m distance of green areas

### TIMEFRAME

2025–2029

### GHG SAVINGS

956 t CO<sub>2</sub>eq/year

### CAPEX (EUR)

42,000,000

## Context

Urban sprawl is increasingly a challenge for Novi Sad, therefore the Municipality and the community acknowledge the need for sustainable urban planning enabling the improvement of living conditions and a more dynamic environment for tourism and investment. The city's Strategy for the Development of Green Areas in the City of Novi Sad 2030 specifically mentions the aim to make Novi Sad a 'green city'.

Green urban landmarks are natural or built-up infrastructure elements that are iconic for a city and have the potential to provide multifaceted ecosystem benefits, including improved environmental quality, increased biodiversity, improved flood and drought management, carbon sequestration opportunities and reduction of the urban heat island effect. In addition, they can also provide socio-economic benefits for local communities such as better air quality and the creation of more attractive and comfortable environments that promote social interaction and walkability, which will ultimately improve the physical and mental health of such communities. These iconic sites will revitalize key urban locations and spark broader urban regeneration by boosting local identity, attracting tourists and businesses and improving residents' well-being.

## Description

This action involves three main components:

**A) Green Heart along the Danube River:** Development of a green corridor along the Danube, connecting rowing facilities, tourism amenities, and boat houses including the new Botanical Garden near the fortress. This garden will be located on a public land of 4 ha area and will include several tourist facilities. This area will serve as a model green corridor for enhancing green space quality and accessibility, connecting to a broader green network across the city. The Botanical Garden will be situated along the Danube, near Petrovaradin fortress.



Figure 29 Proposed locations for Urban Green Landmarks

**B) Development of new pedestrian/cycling bridge:** this will be an iconic development in Novi Sad since it will bring together two areas – one urbanised and one green area (an area around the Petrovaradin fortress where the Botanical Garden will also be developed). Thus, the construction of this bridge will ease access to high-quality green areas for all citizens of Novi Sad. This action is complementary to **Action 2 – Improvement of the cycling network** and will also contribute to achieving the goals defined in **Action 22 – Development and implementation of a sustainable tourism strategy**. On the long term, the bridge will become a green landmark of the city by adding green infrastructure elements, such as trees, climbing plants for shadowing the bridge, etc.

**C) Car-Free and Pocket-Park Streets Initiative:** This initiative extends car-free zones and creates pocket parks, for example, in dead-end streets. It aims to transform underutilised urban spaces into vibrant public areas, promoting social interaction and environmental sustainability, thereby addressing the need for more parks and green areas in different residential neighbourhoods.

## Implementation steps

### A) Green Heart along the Danube River

- Develop and launch the tender documentation for the proposed investments.
- Implement the current concept for the Botanical Garden.

### B) Development of a new pedestrian/cycling bridge:

- Build the bridge using sustainable materials and techniques and integrate the bridge with broader urban mobility initiatives.
- Conduct an opportunity study for the integration of green infrastructure elements once the bridge is finalised.

### C) Car-Free and Pocket-Park Streets Initiative:

- Identify and prioritise the streets suitable for car-free initiatives or pocket parks based on traffic flow, accessibility and community needs.
- Develop detailed designs and plans for the green areas near the bridge, green heart, and pocket parks.
- Set up a pilot or demonstration project. In parallel, consider installing a working group to guide and evaluate the process.
- Implement construction in phases, starting with the most prioritised areas.

## Stakeholders

Novi Sad Municipality: Department of Urban Planning and Construction (for components 1 and 2), Department of Water Management (for component 2), Department of Environment (for components 1 and 3).

## Estimated costs

Item	CAPEX (EUR)	OPEX (EUR/year)
Development of the new Botanical Garden	1,000,000	100,000
Construction of the new pedestrian/cycling bridge	40,000,000	400,000
Car-Free and Pocket-Park Streets Initiative	1,000,000	100,000
<b>TOTAL</b>	<b>42,000,000</b>	<b>600,000</b>

The current cost estimates are based on the existing strategic document and can suffer modifications during project development and implementation.

## Potential sources of financing

Local budget; government funds; IFIs; private investors; crowdfunding, revenue-generating activities such as events

## Social and gender aspects

Public green areas should be accessible to wheelchairs and strollers and provide regular benches for elder people and children to rest.

Health and safety aspects will be considered when designing the new infrastructure.

The car-free and pocket-park street initiatives should be realised in both the poor neighbourhoods and the richer parts of the city. Eco-gentrification must be avoided.

This action is expected to have a **significant positive impact** on social and economic inclusion, and gender equality aspects.

## Smart and digital aspects

Smart lighting will be installed in new green areas and along the new bridge.

New green urban landmarks or ideas for the car-free and pocket-park street initiatives could be submitted for approval in a digital format, with georeferencing of structures and site amenities.

## Location of the implementation

Green Heart along the Danube river, the Botanical Garden and adjacent areas

Pedestrian / cycling bridge: connected to Petrovaradin fortress

Car-Free and Pocket-Park Streets – dead-end streets and underutilised urban spaces throughout the city.

## Correlation with other actions

Action	Explanation
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Action 2. Improvement of the cycling network	Integration of the cycling/pedestrian bridge with cycling routes.
Action 3. Network of connected sidewalks around schools & kindergartens	The combined components are envisaged to improve walkability, provide shaded pedestrian routes, and create safer, more attractive public spaces.
Action 21. Smart city	Digital tools such as smart irrigation, environmental sensors, and interactive green spaces can optimise the maintenance and functionality of urban green areas.
Action 22. Development and implementation of a sustainable tourism strategy	All three components are envisaged to enhance the city's attractiveness as a tourist destination.

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# Action 20

## Establish a citywide blue-green network

LU  
Land use

### GOAL OF THE ACTION

This action aims to develop a comprehensive blue-green network in Novi Sad that integrates green infrastructure with mobility and urban planning. This network aims to enhance environmental protection, economic development, and climate resilience by creating interconnected green and blue spaces that manage stormwater sustainably and provide social, recreational, and touristic benefits.

### CHALLENGE ADDRESSED

- Insufficient current use of blue opportunities in the city for tourism and mobility purposes

### STRATEGIC OBJECTIVES

S01



S02

S03

STRATEGIC OBJECTIVE 1  
Urban  
Green  
Renewal

### BENEFITS

- Improved stormwater management, reduced urban heat, enhanced biodiversity, and better air and water quality
- Increased aesthetic value, property values and tourism attraction
- Job creation in blue-green infrastructure maintenance
- Enhanced public health and well-being, increased recreational opportunities, and stronger community cohesion
- Improvements in air quality, reduced health costs
- Better adaptation to climate change impacts
- Increased comfort for pedestrians and alternative for commuters
- Enhanced ecological connectivity and local biodiversity

### TARGETS

- Develop new blue-green connections to connect existing green spaces (10% of unconnected green spaces to be connected every year for the next 5 years), aiming to establish a blue-green ecological network within 5 years.
- Have an up-to-date management plan for urban greenery, including best practices for green management.
- Reduce unit costs for maintenance of greenery by 5% through well-thought planning and development of the green areas and via ecologically responsible management.

### TIMEFRAME

2028–2029

### GHG SAVINGS

1 t CO<sub>2</sub>eq/year absorbed for an estimate of 100 trees planted

### CAPEX (EUR)

565,000

## Context

Novi Sad has an extended network of green areas both along the Danube and in the inner part of the city: according to the Cadastre of Green Areas for 2016, PUC "Gradsko Zelenilo" Novi Sad maintained about 488 ha of public green areas in the City. Following the Law on Nature Protection, four parks and several dendroflora species are protected within the boundaries of Novi Sad. However, many of the city's green areas are not yet officially designated as green areas. The aim is to connect all these green areas into an integrated multifunctional network of blue and green open spaces and corridors. This will contribute to improved air quality, reduced traffic because of slow mobility practices, increased mobility due to an extended cycling network, more sustainable drainage infrastructure, enhanced quality of life, and an improved urban landscape.

The city's Strategy for the Development of Green Areas in the City of Novi Sad 2015-2030 specifically mentions the aim to create a well-planned network of attractive, easily accessible green spaces that enhance the well-being and health of its citizens and visitors, environmental enjoyment, and biodiversity.

The city also has a Strategy for Developing Green Areas in the City of Novi Sad 2015-2030. The goal is to protect green areas from uncontrolled construction of facilities, to adequately plan public and other urban areas, and to design and construct all areas where regulations require greenery.

## Description

In order to achieve a connected blue-green network throughout the city, it is first necessary to map the already existing (public) green space and to identify the opportunities to link green spaces with each other, where implementation of nature-based solutions can make the difference, and where there are shortages of public and even private green space. Subsequently, it is necessary to protect the existing green spaces, maintain them sustainably, and initiate new blue-green spaces.

The Danube, flowing through the city, presents an opportunity to ensure a high-quality natural environment for metropolitan area citizens. The river already serves part of the city as a blue-green network with slow mobility between the urban and peri-urban areas.

A management plan for these green areas is needed to preserve and enhance the city's blue-green areas and the ecological network. Creating and including a municipal strategy for green and blue areas can help protect the ecological and hydrological values of the urban landscape and its resilience against climate change. This plan starts from the current state of the blue-green network and includes future development plans and targets. Initially, this encompasses public green spaces but can later be extended to consider private green space. Further, it holds good practices for maintenance and development and builds from transparent regulations on building permits in the vicinity of green or blue structures and modification requests.

A pilot project can be set up to connect the green area surrounding the Danube river with green fingers extending into the city, linking these areas with the city's green ring and integrating mobility elements, including e-bikes, bike-sharing systems, etc. By connecting the city's green spaces and waterways, residents will enjoy continuous, functional corridors for recreation, commuting and ecological services. Linking the pockets of greenery across the city catalyses urban renewal by improving air quality, water management and public health.

This translates into the following actions to evolve towards a connected blue-green network:

1. To become a green city with a connected blue-green network, the first step consists of **conducting a citywide feasibility study to upscale blue-green infrastructure and integrate it with biking and walking networks**. The study should focus on identifying existing green and blue infrastructure at the city level and NbS that can make a difference and improve the environment and well-being of the inhabitants. NbS such as wadis, green roofs, and ecological infiltration basins can mitigate urban heat islands, decrease flood risks, and improve local biodiversity when placed at adequate locations. Furthermore, the functionality of the existing (and connected) blue-green areas can be assessed. The goal of the feasibility study should be to recommend clear measures to be taken to define the blue-green network at the city level. The pilot project will be selected based on the outcomes of the feasibility study.

2. Secondly, **appropriate and ecological management procedures for the existing and new blue-green infrastructure should be developed**. Good management extends the life of the green spaces, and healthy green spaces can provide more ecosystem services. The management procedures will define the most ecologically responsible and cost-effective measures required for blue-green infrastructure maintenance.

Ecological management, such as limited grass mowing, can benefit biodiversity and budgets. Less mowing and aiming for nutrient-poor conditions allow a more diverse plant community to develop. Less mowing also reduces the likelihood of the grass drying out, requiring less summer irrigation.

Green and blue elements should be kept free from litter, for example, by providing enough litter bins, organising clean-up actions, and general awareness raising.

3. To manage the blue-green network effectively, the Municipality will develop and implement a **Green Flag Award**. This system will generate innovation and target green spaces that meet high standards of environmental management, maintenance, and accessibility. At the city level, this award signifies that urban parks, green spaces, or entire districts have achieved excellence in environmental care, quality visitor services, and community engagement.

## Implementation steps

1. **Conduct a comprehensive feasibility study to develop a vision for the citywide blue-green network to upscale green infrastructure:**

- Evaluate the city's various challenges (flooding, summer drought, landslides) and use this to list the priority locations for potential investments. Cover a range of timeframes and climate projections to inform future spatial planning and disaster risk reduction actions.
  - Develop the citywide blue-green network vision study.
- 2. Update rules and regulations for green areas in (re)development projects and the Green Flag Award:**
- Integrate the citywide strategy in urban planning and the building code, for example, restrictions in the vicinity of green areas, marking public green space in the urban plan, including priority actions to preserve existing green spaces, etc.
  - Create a Green Flag Award system to recognise and encourage high-quality maintenance and innovation in green spaces. The award will target green areas managed by private or community-based organisations. Develop criteria, adopt regulations and establish an annual evaluation process to grant the award at the city level.
  - Engage the local community in developing the rules and regulations and foster community involvement in maintaining shared-use green spaces through participatory planning and public consultations.
  - Build partnerships with local organisations and residents to ensure long-term stewardship of the network.
- 3. Implement a pilot project based on the outcomes of the blue-green network vision study and run the first competition for the Green Flag Award at the city level.**
- 4. Monitoring and continuous improvement:**
- Establish a robust monitoring framework to assess the network's performance in addressing urban challenges and enhancing biodiversity.
  - Use monitoring data to inform updates to the city's spatial planning and blue-green network strategy.

## Stakeholders

Novi Sad Municipality and its Department for the Environment, Urban Planning, and Water Management; citizen stakeholder groups, homeowners' associations, local nature or community concerned associations; general public; NGOs; developers; universities and research centres

## Estimated costs

Item	CAPEX (EUR)	OPEX (EUR/year)
Conducting a citywide blue-green network vision study to upscale green infrastructure, including mapping the current blue-green network	150,000	
Development of regulations and management plan for blue-green network	80,000	10,000

Develop the Green Flag Award regulation	10,000	5,000
Implement a pilot project based on the outcomes of the blue-green network vision study	300,000	10,000
Implement the Green Flag Award – at least once	25,000	5,000
<b>TOTAL</b>	<b>565,000</b>	<b>30,000</b>

## Potential sources of financing

Local budget; government funds; IFIs

## Social and gender aspects

The implementation of this action will be mindful of the following aspects:

- Make walking and cycling paths accessible to wheelchairs and strollers and provide regular benches for older people and children to rest.
- Consult with women and youth organisations to understand their expectations and needs. When retrofitting or designing new blue-green infrastructure features, consider these needs and general health and safety aspects.
- International best practices regarding inclusivity and gender equity will be incorporated into the conceptual design of the Green Flag Reward system.

This action is expected to have a **significant positive impact** on social and economic inclusion, and gender equality aspects.

## Smart and digital aspects

A combined hydraulic model, that mimics the interaction between the watershed and the city's drainage system will be developed to optimise the design of NbS and mitigate flooding risks, in line with **Action 21 on Smart city**.

The feasibility study for the blue-green network will also consider all the potential smart infrastructure (e.g., sensors, Wi-Fi, etc.) that could be integrated into such a network.

Also, modern communication facilities – i.e. smart apps – will be used to disseminate the Green Flag Award system requirements and competition.

## Location of the implementation

Citywide

## Correlation with other actions

Action	Explanation
Action 19. Green urban landmarks	The two actions will integrate into a connected ecological system, enhancing climate resilience and urban biodiversity.

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Action 21. Smart city

The use of smart environmental monitoring and digital mapping will enhance the efficiency and management of the blue-green network.

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# Action 21 Smart city



## GOAL OF THE ACTION

The Municipality has already taken some steps towards integrating digital technology in data collection and in creative ways of processing information. The natural next step is to gradually include smart components and ICT system applications in all public services, as well as in monitoring environmental parameters at the city level and preventing and controlling pollution.

## CHALLENGE ADDRESSED

- GIS cadastre of the city is incomplete, and it does not reflect the existing situation in terms of municipal infrastructure

## STRATEGIC OBJECTIVES

S01

S02

S03



STRATEGIC OBJECTIVE 3  
Smart  
Innovative  
City

## BENEFITS

- Better cooperation among institutions
- Integrated database on land use, utilities and transport infrastructure, natural environment and historic assets, on planning documentation and procedures
- Improved decision-making capacity, improved outcomes in land use and general spatial planning
- Effective monitoring and adaptive city management
- Provision of targeted geospatial information
- Improved public health, access to services and public safety
- Employment opportunities

## TARGETS

- Achieve 100% GIS data coverage of the city within 5 years
- Install and activate 200 environmental sensors across the city within the first year
- Reduce average PM<sub>2.5</sub> levels by 20% within three years
- Reduce average traffic congestion by 15% within two years
- Integrate GIS data into 100% of new urban planning policies and strategies within two years
- Provide GIS training to 100 city officials and stakeholders

## TIMEFRAME

2025–2029

## GHG SAVINGS

N/A

## CAPEX (EUR)

1,200,000

## Context

Novi Sad benefits from one of the most important educational and research institutions in Serbia and South-East Europe, the University of Novi Sad. The university contributes significantly to enhancing local living standards, since highly educated graduates remain in the city and decide to open new businesses, especially in the Information and Communication Technology (ICT) sector. This also contributes to a higher degree of solutions for digital connectivity, automation and robotisation in Novi Sad. The city acknowledged already that the ICT systems – as an enabling, integrative, and constitutive technology of the 21<sup>st</sup> century – will be instrumental in addressing many of the challenges presented by urbanisation.

The Municipality has already taken some steps towards integrating digital technology in data collection and in creative ways of processing information. It also made significant progress in enhancing its Geographic Information System (GIS) cadastre and is currently working towards launching the new NSMaps GIS Portal, an interactive platform that provides comprehensive geospatial data, including detailed information on infrastructure and zoning. Other smart initiatives developed or under development by the Municipality:

- It has included Smart City development as one of the objectives in its Sustainable City development.
- It has set up several projects that test the possible benefits of smart applications. Transport and e-governance are two of the main focus areas.
- The recently developed NOvi Sad Transportation Model (NOSTRAM) will serve as the backbone of actions on smart and sustainable mobility.
- Most of the initiatives can still be characterised as smart in an ad-hoc manner. Except for Transport and e-Governance, there is no clear evidence on how the produced digital data will be integrated and interpreted.
- Broadband internet and 4G networks are widely available in Novi Sad. Public internet (Wi-Fi) is available at multiple points in the city.
- The Municipality has already developed a publicly available online platform where information on land use and urbanisation aspects is easily accessible and timely updated. The platform includes cadastral information, parking data, roads, etc.

## Description

The natural next step for the Municipality in the process of integrating digital technology in city governance is to include smart components and ICT system applications in all public services, as well as in monitoring environmental parameters at city level and in pollution prevention and control.

The update and expansion of the GIS-based land use and environmental database of Novi Sad should, therefore, be developed to become a useful tool for urban planning, research, analysis and monitoring. City data needs to be digitised, allowing data to be processed, analysed and displayed quickly for various urban planning purposes. The GIS system and

database could also provide a comprehensive monitoring system. The GIS could also form the backbone for a possible later development into a 3D city model.

This action aims to leverage advanced technologies to further improve Novi Sad's smart city features by improving the collection of GIS data and utilising GIS data to monitor various aspects of the city in real time. This data will be used to track environmental conditions (air quality, water quality, GHG, green spaces, noise, etc.), infrastructure status, and other critical urban metrics and facilitate evaluation systems for planning and management.

The GIS portal will be updated with a newly developed database of environmentally valuable areas and risk mapping. This is intended to support urban planning in taking appropriate actions, primarily in establishing better regulations for important natural areas and green spaces to protect, manage and monitor them. The database will be populated with the continuous and periodic monitoring of sensors located around the city, together with data from surveys and third-party information. This action will make use of specialised software to record data and create a database about environmentally valuable areas, as well as spatial information systems with spatial planning and cadastral data and other databases maintained in offices.

Innovative solutions will be designed and integrated into all municipal services. For example, the waste management sector will switch from basic functioning, which includes collecting and disposing of waste, to a system based on resource efficiency and circular economy principles, combined with modern solutions for the treatment of specific waste streams. The waste management data will be centralised and included in the overarching datasets behind the city digital platform. The first step would be to include the tracking system for waste collection vehicles, followed by other data on waste prevention, waste recycling, material circularity, etc.

This action will enhance collaboration among public stakeholders to exchange geospatial data and better cooperation among institutions to create an integrated database centred on land use, growth areas, utilities and transport infrastructure, natural environment and historical assets, and planning documentation and procedures. The GIS data and web map should also be used to provide evidence and inform plans, policies, strategies, and investment decisions, while also taking into account local environmental challenges and climate risks. The database and web map will require regular updates and maintenance to display correct and up-to-date information.

## Implementation steps

1. **Development of the database concept, GIS system and webpage structure, including coding:**
  - The database and webpage should be established as a central repository of geospatial data, which will enable continuous monitoring and evaluation of environmental data, land use, utilities and transport infrastructure and encourage intersectoral coordination.

- Smart technologies, such as Artificial Intelligence and the Internet of Things, could be deployed to develop the database and webpage.
- 2. Development of protocol and data governance system for data collection and data sharing:**
    - Development of an application programming interface (API) to interact with other applications and stakeholders.
    - The protocol and data governance system will also cover aspects related to data security and privacy.
  - 3. Full-scale implementation and data collection:**
    - Procurement of equipment and software
    - Once the platform is fully developed, the database can be integrated into the website of the Municipality as an interactive web map, allowing stakeholders and the general public to access and utilise geospatial information as needed.
    - Alongside the development of the database concept, activities related to enhancing the digitalisation of spatial data and collection of GIS data from different stakeholders should be undertaken and incorporated into the database; this includes transport, utilities, hydrology, contaminated land sites, community and public facilities, environment, green spaces and protected areas, biodiversity, demographics and socioeconomics, land use types and ownership, cadastral information, buildings and historic sites, topography, areas at risk, environmentally sensitive areas, etc.
    - The data collected during the GCAP implementation will be also integrated into the platform. All the indicators foreseen for monitoring the GCAP actions will be considered for integration.
  - 4. Capacity building and training sessions for governmental stakeholders and other users of the developed digital resources.**

## Stakeholders

Novi Sad Municipality and its departments; universities, statutory bodies, utility companies, NGOs

## Estimated costs

Item	CAPEX (EUR)	OPEX (EUR/year)
Development of the GIS system and webpage including coding	500,000	100,000
Servers (cloud solutions will be considered as well) and other equipment, software	350,000	
Data gathering (installing sensors for environmental monitoring) and GIS data digitalisation	250,000	

Capacity building and training sessions for government staff on system operation and data uploading (approx. 10 sessions for 20 staff for half a day)	100,000	
Training and support for vulnerable groups and other target users to access the web-map (approx. 10 sessions up to 10 people for 2 hours/session)	50,000	
<b>TOTAL</b>	<b>1,250,000</b>	<b>100,000</b>

## Potential sources of financing

Local budget, donors, local businesses and events advertising in web-map

## Social and gender aspects

A web map hosted on the city website would allow for the provision of targeted geospatial information to vulnerable groups, for example, information related to the accessibility of green spaces, the location of public toilets or features of the bus network. It is important to note that some vulnerable groups may have challenges in accessing the internet or lack digital literacy. Therefore, targeted training and support on using the web-map should be offered to upskill local citizens where possible. This should also consider people with different impairments and learning styles, such as learning difficulties or audio/visual impairments. There is also potential for job creation regarding data collection and server maintenance, in which equal access for women to jobs should be ensured.

This action is expected to have a **moderate positive impact** on social and economic inclusion, and gender equality aspects.

## Smart and digital aspects

Collecting GIS data and creating a web-map coupled with a comprehensive monitoring system are inherently smart initiatives which will enable users to make more effective management decisions. Additionally, a combined hydraulic model that mimics the interaction between the watershed and the city's drainage system will be developed to optimise the design of NbS and mitigate flood risks.

## Location of the implementation

Citywide implementation, starting with critical infrastructure and high-traffic areas.

## Correlation with other actions

Action	Explanation
All actions	This action is a cross-cutting initiative that enhances the efficiency, sustainability and digital integration of all urban systems outlined in the present GCAP.



# Action 22

## Development and implementation of a sustainable tourism strategy



### GOAL OF THE ACTION

The aim of this action is to develop a comprehensive strategy and roadmap to promote sustainable tourism in Novi Sad and its vicinity. This involves identifying and enhancing high-value touristic spots near the city, creating thematic tours, and optimising infrastructure to ensure easy and eco-friendly access to these sites. The goal is to boost tourism while minimising environmental impact and promoting sustainable practices.

### CHALLENGE ADDRESSED

- Insufficient current use of blue opportunities in the city for tourism and mobility purposes

### STRATEGIC OBJECTIVES

S01



STRATEGIC OBJECTIVE 1  
**Urban  
Green  
Renewal**

S02

S03



STRATEGIC OBJECTIVE 3  
**Smart  
Innovative  
City**

### BENEFITS

- Boosting local economy through tourism
- Enhancement of touristic attractiveness
- Easier navigation in the city and vicinity
- Renewed appreciation of residents and visitors for the city and vicinity, improved social cohesion

### TARGETS

- Increase in the number of tourists using eco-friendly transportation by 20% within 5 years
- Development of at least 3 touristic routes, connecting the viewpoints, with extra green infrastructure, clear signage and floor markings within the next 5 years
- Placement of interactive digital panels at strategic positions along the routes (river crossings, viewpoints, etc.) in the next 5 years

### TIMEFRAME

2025–2027

### GHG SAVINGS

1 t CO<sub>2</sub>eq/year absorbed for an estimate of 100 trees planted and 9 t CO<sub>2</sub>eq/year for an estimated 20 persons swapping car usage for cycling/walking

### CAPEX (EUR)

2,550,000

## Context

Novi Sad has a rich history and offers several historical sites that can attract tourists. The city is located along the Danube river, the riparian zone representing the most significant resource for developing urban ecotourism.

Novi Sad has a high potential to develop as a sustainable tourism hub. The city is home to several ethnic communities and has a vibrant cultural scene. It is this cultural identity and vibrant potential that the Municipality aims to capitalize on in its goals to become an example of sustainable development and climate-minded urban regeneration. A well-sustained tourism sector boosts local appreciation of residents for their city and vicinity, likely encouraging more young people to build their future in Novi Sad. Developing a sustainable tourism strategy is a good opportunity to boost the local economy and ensure the city grows sustainably. The strategy may also include sustainable rural tourism to nearby villages and could consider public transport or bike connections to Belgrade.

Still, the city faces challenges related to environmental sustainability as a growing tourist destination for its cultural heritage and festivals, with ca. 220,000 tourists per year. The increase in tourism has led to increased environmental pressures, such as higher energy consumption, waste generation, and traffic congestion. The need for a sustainable tourism strategy arises from the desire to balance tourism growth with environmental protection, ensuring long-term benefits for both the city, its vicinity and its visitors.

## Description

The essence of this action is to develop and implement a comprehensive strategy and roadmap that promotes sustainable tourism in Novi Sad and its vicinity. This investment action involves the identification of existing and planned high-value spots for tourism in the city, the enhancement of their multipurpose character, the creation of thematic tours along these points of interest, and the streamlining of access and slow-mobility options to connect these points of interest in the city and along tours. For a holistic coverage of tourism-related aspects, the baseline studies will identify locations and ways to designate specific hubs for tourist information and support, as these will be included in the key stops of the routes. The goal is to attract tourists while minimising the environmental footprint and enhancing the quality of life for residents.

The action involves the identification of high-value tourism spots and the creation of thematic tours along the city. In line with international good practice, cycling and walking facilities should be planned, designed and installed based on visibility, accessibility, safety and security, maintenance and monitoring, availability and capacity, connectivity and attractiveness. Potential touristic routes should be identified and further developed as part of this action, integrating blue-green infrastructure. While the city centre of Novi Sad already has good pedestrian infrastructure, enhancing connectivity and expanding pedestrian zones could further improve walkability. In addition, there is already an agreement to develop a new pedestrian bicycle bridge connecting the Bačka and Srem sides of the city. Another

addition to the slow-mobility network could be the establishment of a seasonal river taxi for an alternative and attractive way to connect the riverbanks and develop a range of tourist tours by boat. The routes can be indicated on interactive panels or guided by a digital app.

Finally, fostering sustainable tourism also stimulates local restoration efforts, such as refurbishing cultural or historic zones, upgrading public amenities and integrating nature-based solutions. This can spark further investments in environmental quality and local entrepreneurship, strengthening overall regeneration.

## Implementation steps

### 1. Preliminary assessments and baseline studies:

- Assess current tourism trends, infrastructure and environmental impacts within the city.
- Identify key challenges and opportunities for sustainable tourism development.
- Map the high-value tourism spots in and near the city (e.g. Petrovaradin Fortress, parks, and the Botanical Garden – see [Action 19](#)).
- Conduct a study on the most sustainable slow-mobility routes connecting touristic locations and viewpoints.

### 2. Develop the Sustainable Tourism Strategy:

- Develop a comprehensive Sustainable Tourism Strategy focusing on eco-tourism, cultural preservation and community engagement.
- Include guidelines for sustainable tourism practices, such as waste management, energy efficiency and support for local businesses.
- Collaborate with local tourism operators, community groups and environmental organisations to ensure alignment with the strategy.

### 3. Implement the Sustainable Tourism Strategy:

- Develop sustainable touristic routes that highlight cultural (e.g. locally sourced gourmet dining), historical, and natural attractions, coupled with eco-friendly transportation options and environmentally conscious behaviour.
- Develop additional walking and cycling paths and infrastructure (e.g. parking lot for bicycles, pedestrian-bicycle bridges over the Danube, correlation with [Action 19](#)) and ensure easy access to tourist spots. Develop sustainable dedicated slow-mobility routes that connect the touristic locations and viewpoints in Novi Sad. Develop clear signage and floor markings to indicate the touristic routes.
- Identify suitable locations for hubs for tourists and incorporate them in the routes
- Develop interactive digital panels. Integrate digital panels with interactive features in multiple languages, informing on the touristic locations and the sustainable routes connecting them. This could potentially be extended with a digital app that tourists can use as a tour guide.

### 4. Launch marketing campaigns and educational programs to promote sustainable tourism:

- Provide training programs for tourism operators on sustainable practices.

- Develop educational materials to promote sustainable tourism among visitors and residents.
- Promote the strategy through marketing campaigns emphasising the city's commitment to sustainability.

**5. Monitoring and evaluation:**

- Establish a monitoring framework with indicators to assess the impact of the strategy on tourism, environment and local communities.
- Use feedback to refine the strategy and ensure continuous improvement.

## Stakeholders

Novi Sad Municipality, Department of Transport and Communication, Architecture and Urban Planning Department; regional and national tourism associations, Novi Sad Tourist Agency (TONS); Museum of Vojvodina, City Museum of Novi Sad, Museum of Contemporary Art of Vojvodina; local hotels and B&Bs, local restaurants and bars; NGO's (Ecological Movement and Nature Conservation Movement); citizens

## Estimated costs

Item	CAPEX (EUR)	OPEX (EUR/year)
Sustainable Tourism Strategy, including a study to identify slow-mobility routes and tourism hot-spots	200,000	
Development of sustainable touristic routes, walking and cycling paths	1,800,000	100,000
Digital infrastructure (e.g. app and interactive maps)	500,000	50,000
Campaigns to promote sustainable tourism	50,000	50,000
<b>TOTAL</b>	<b>2,550,000</b>	<b>200,000</b>

## Potential sources of financing

Local budget; government funds; IFIs; private sector (investments from tourism business); EU funds; national funding programmes, etc.

## Social and gender aspects

Make walking and cycling paths accessible to wheelchairs, and strollers, and provide regular benches for older people and children to rest where not yet the case. Consult with women and youth organisations in order to understand their expectations and needs and consider health and safety aspects when designing the new cycling routes in order to encourage women and youth to use them.

This action is expected to have a **significant positive impact** on social and economic inclusion, and gender equality aspects.

## Smart and digital aspects

A digital interactive app can complement information on info panels and contain more features, to enhance the visibility of the city and target tourists. The new routes can be equipped with smart street lighting.

## Location of the implementation

High-value tourism spots, across and near the city.

## Correlation with other actions

Action	Explanation
Action 2. Improvement of the cycling network	Expanding and improving cycling routes will enhance sustainable tourism by providing eco-friendly mobility options for visitors.
Action 19. Green urban landmarks	The establishment of green urban landmarks will enhance Novi Sad's attractiveness as a touristic destination while promoting environmental sustainability.
Action 20. Establish a citywide blue-green network	Integrating blue-green infrastructure will improve the city's natural appeal, making it more attractive for visitors and ecotourism initiatives.
Action 21. Smart city	Smart tourism initiatives, such as digital maps, interactive guides, and smart infrastructure, will enhance visitor experiences and promote Novi Sad as a smart and sustainable destination.

## Summary of actions and financial details

Total investment needs defined by the GCAP for the 2025–2029 period are estimated at the amount of EUR 614 million. Energy and Buildings and Water Sectors are the ones where most of this budget will be directed. The chart below shows the division of the overall GCAP budget per sector.

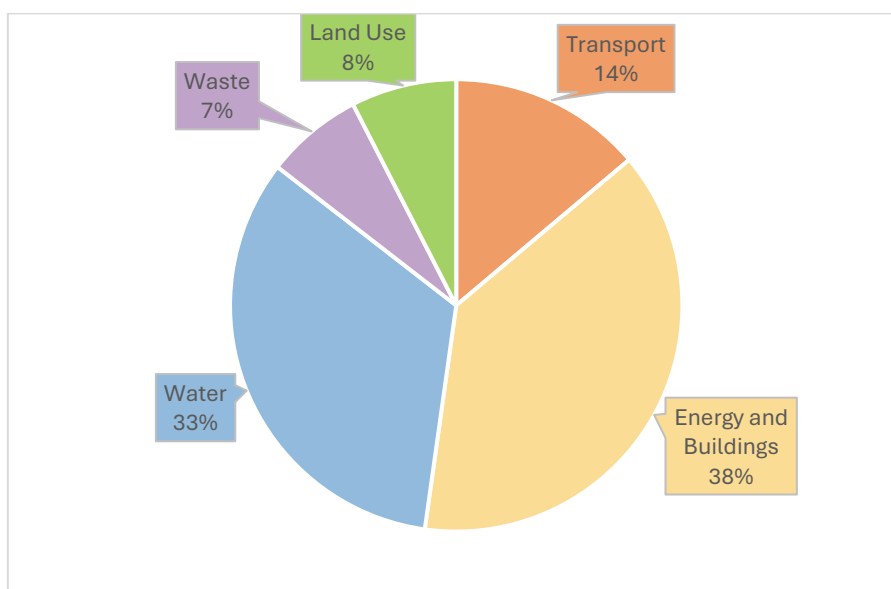


Figure 30 Distribution of GCAP CAPEX for actions per sector in percentage from total CAPEX

### Energy and Buildings

Most substantial investments are envisaged in the Energy and Buildings sectors, with a total of over 235 million EUR. The rehabilitation and upgrading of the district heating network focused on the integration of renewable energy sources into the system is the most budget-demanding action, with potential funding from National Funding and IFIs' concessional finance.

The financing of deep energy retrofit of blocks of flats is the major investment planned for the sector to be implemented through national funds. Retrofitting of public buildings coupled with the modernisation of heating and hot water systems and small-scale renewable energy is also implementable through national funds and IFI grants and loans. Services offered by specialised companies in the field (ESCO) through long-term energy performance contracts could contribute to accelerating the rate of renovation and energy efficiency of public and private buildings.

The digital one-stop shop for building retrofit, including local financing facility for energy efficiency and renewable energy measures may be financed by Zero Carbon Cities, European Urban Initiative, URBACT or other similar funding sources coupled with funds from the Municipality's own budget.

## Water

The construction of the Central Wastewater Treatment Plan is the most expensive GCAP action, with more than 120 million EUR as the total budget. Novi Sad's wastewater collection and treatment system represents the main environmental challenge for the city. Thus, the Municipality has already taken several steps and is currently ready to build the new CWWTP. The financing for this investment is already secured via national funds and international investors.

## Transport

Public transport modernisation focuses on new, less polluting vehicles and public transport interchanges and the bus stops represent the main investments in the Transport sector. These activities can be co-funded through EBRD loans and national funds.

The extension and modernisation of the cycling infrastructure can be co-financed via different international donor organisations and other IFI funds.

## Waste

Financing for the investments in the remediation of the existing unsanitary landfill and the construction of new recycling yards can be secured via EU financing programmes, funds from national development agencies and international financing institutions implementing climate change financing programmes. Other actions in improved waste management require relatively small investments that can be financed by the private sector and/or by the municipal budget.

## Land use

Municipal budget and crowdfunding are most relevant for financing the development of green infrastructure. Also, green urban landmarks can be financed by private investors and/or governmental funds.

## Conclusion

Opportunities to secure finance for GCAP actions are many, including green bonds, power purchase agreements, EU funding programmes, including grant schemes, national and local budget allocation and IFIs Climate Funds and loans.

The Municipality's additional borrowing capacity may be utilised if needed. The total revenues of the Municipality are expected to add up to 356 million EUR in 2024 with an annual debt repayment (principal + interest) of approximately 5.5 million EUR, which represents up to 2% of total revenue, while the ceiling for municipal indebtedness is allowed to raise up to 50% of the total revenues from the previous year, depending on the loan contracting period.

Sector	Short-term actions	Total CAPEX (EUR)	Yearly CAPEX (EUR)					Yearly OPEX (EUR)
			2025	2026	2027	2028	2029	
TR Transport	1. Public transport modernisation	€ 63,610,000	€ 13,000,000	€ 13,000,000	€ 13,000,000	€ 13,000,000	€ 11,610,000	€ 1,323,500
	2. Improvement of the cycling network	€ 12,100,000	€ 2,000,000	€ 3,000,000	€ 3,000,000	€ 3,000,000	€ 1,100,000	€ 117,500
	3. Network of connected sidewalks around schools & kindergartens	€ 8,170,000	€ 2,000,000	€ 4,000,000	€ 2,170,000			€ 90,000
	4. Improved traffic management system	€ 1,250,000		€ 700,000	€ 550,000			€ 130,000
E&B Energy and Buildings	5. Energy management programme	€ 2,000,000	€ 500,000	€ 1,000,000	€ 500,000			€ 45,000
	6. Energy rehabilitation of public buildings and facilities	€ 25,100,000	€ 1,500,000	€ 5,600,000	€ 6,000,000	€ 6,000,000	€ 6,000,000	€ 170,000
	7. Energy rehabilitation of private/residential buildings	€ 102,500,000	€ 500,000	€ 25,000,000	€ 26,000,000	26,000,000	25,000,000	€ 100,000
	8. Integration of RES into the district heating system of Novi Sad	€ 105,700,000	€ 26,425,000	€ 26,425,000	€ 26,425,000	€ 26,425,000		€ 250,000
	9. Digital one-stop shop	€ 250,000	€ 50,000	€ 200,000				€ 100,000
WA Water	10. Drinking water system modernisation	€ 63,200,000	€ 10,000,000	€ 25,000,000	€ 25,000,000	€ 3,200,000		€ 600,000
	11. Rehabilitation, modernisation and extension of the wastewater collection network	€ 20,755,000	€ 5,000,000	€ 7,755,000	€ 8,000,000			€ 200,000
	12. Central wastewater treatment plant – detailed design and construction	€ 120,100,000	€ 24,020,000	€ 24,020,000	€ 24,020,000	€ 24,020,000	€ 24,020,000	€ 3,000,000
	13. Preparatory steps to expand the network with a separate system for stormwater drainage and wastewater	€ 200,000			€ 50,000	€ 100,000	€ 50,000	
WS	14. Remediation of the existing unsanitary landfill	€ 9,000,000			€ 3,000,000	€ 3,000,000	€ 3,000,000	€ 100,000

Sector	Short-term actions	Total CAPEX (EUR)	Yearly CAPEX (EUR)					Yearly OPEX (EUR)
			2025	2026	2027	2028	2029	
Waste	15. Construction of two new recycling yards and expansion of the Reciklomat system	€ 2,400,000	€ 600,000	€ 1,200,000	€ 600,000			€ 145,000
	16. Implementation of a citywide two fractions waste collection system	€ 9,050,000	€ 450,000	€ 2,000,000	€ 3,300,000	€ 3,300,000		€ 320,000
	17. Waste treatment facility for refuse-derived fuel production	€ 20,300,000	€ 1,300,000	€ 5,000,000	€ 10,000,000	€ 4,000,000		€ 200,000
	18. Construction and demolition waste processing facility	€ 2,000,000	€ 500,000	€ 750,000	€ 750,000			€ 300,000
LU	19. Green urban landmarks	€ 42,000,000	€ 5,000,000	€ 10,000,000	€ 10,000,000	€ 15,000,000	€ 2,000,000	€ 600,000
Land use	20. Establish a citywide blue-green network	€ 565,000				€ 280,000	€ 285,000	€ 30,000
	21. Smart city	€ 1,250,000	€ 210,000	€ 260,000	€ 260,000	€ 260,000	€ 260,000	€ 100,000
	22. Development and implementation of a sustainable tourism strategy	€ 2,550,000	€ 1,050,000	€ 750,000	€ 750,000			€ 200,000
<b>Total</b>		<b>€ 614,050,000</b>	<b>€ 94,105,000</b>	<b>€ 155,660,000</b>	<b>€ 163,375,000</b>	<b>€ 127,585,000</b>	<b>€ 73,325,000</b>	<b>€ 8,121,000</b>



**Novi Sad**

Green City Action Plan

PART III

# Monitoring Framework

bridging the past

touching the future

## Monitoring framework, evaluation and reporting

The monitoring and evaluation framework for GCAP implementation is designed to understand and assess the results and outcomes of implementing the plan. It focuses on identifying the most impactful actions and guiding the implementation team in refining or adjusting those that do not yield sufficient results. The primary aim is to measure the impact of GCAP actions on the quality of environmental factors in Novi Sad while also tracking progress toward achieving the established targets for each action. As a result, both the progress and impact of the implementation will be consistently and systematically monitored.

The Monitoring Framework for GCAP implementation serves as a dynamic tool, enabling the tracking of progress for each action and its associated measures. This framework was developed based on the actions' both measurable and qualitative targets, sub-elements and the related available data which display progress. The framework is structured in separate spreadsheets for each GCAP sector and has an additional spreadsheet for keeping track of the environmental or impact indicators. On average, each action has 4-5 progress indicators out of which some relate directly to the impact indicators.

For ease of use, the monitoring framework is designed in an MS Office Excel file and detailed in Annex 1. An example of the monitoring of the first action from the GCAP is provided in the figure below.

No.	Action	Monitored indicators	Measurement unit	GCAP reference values	GCAP objectives
1	Public Transport Modernization	Number of new acquisitions for the public transport fleet (new or used but newer vehicles) by vehicle type per year	# / year		25 new buses (10 electric buses, 15 buses with pollution norm of EURO4 or higher) / year
		% of the public transport fleet according to EURO4 or higher standards	%		70%
		Bus stops modernized per year	# bus stops / year		10 modernized bus stops / year
		Dedicated priority lanes for public transport	km		1 km / year
		Charging stations constructed	#		3 charging stations until 2029
		Vehicle-Related Integration (VRI) systems installed per year Target Action 1: 10% city-wide increase in the punctuality of PT vehicles and 5% decrease in the average PT travel time due to the installation of 5 VRI systems and adding 1 km of priority lanes per year	# installations / year		5 installations / year 25 installations over 5 years
		Number of passengers transported / year	# passengers / year		10% increase in the amount of regular PT users due to improved service

Figure 31 Snapshot of the Monitoring Framework

Within the Municipality, the implementation of the GCAP will be closely supervised by the Environmental Department within Novi Sad Municipality. The daily monitoring and evaluation responsibilities will lie with the sectoral entities responsible for each corresponding GCAP Action. A project working group was established for the development of

the GCAP and its members will continue with monitoring and evaluation of the sectoral activities.

The Environmental Department will compile all the data received from sectoral departments and will produce an annual progress report for the GCAP implementation period. The coordination of the monitoring and evaluation process of the GCAP will be done by the Head of the Environmental Department within Novi Sad Municipality.

Effective monitoring and evaluation of the GCAP process require skilled and well-trained personnel. The team responsible for monitoring, evaluation and reporting activities will receive training and technical support during additional planned audits.

Additionally, two types of audits are foreseen during the first 5-year period of GCAP implementation:

- Internal audits – conducted annually in line with internal procedures. These audits will focus on verifying whether internal procedures have been followed correctly and if the Municipality's specific targets have been achieved.
- Third-party audit – conducted after 5 years. These comprehensive audits will assess the entire GCAP implementation process, considering technical and financial elements as well as the overall use of resources.



**Novi Sad**

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