Interreg
EUROPEAN UNION
Danube Transnational Programme
Danube Cycle Plans

Danube Cycle Plans

Danube Cycling Infrastructure Investment Plan

http://www.interreg-danube.eu/approved-projects/danube-cycle-plans

PP2 HU KTI – Institute for Transport Sciences

T2.5.1: Danube Cycling Infrastructure Investment Plan

Version 1.3

Date: November 2022

A stream of cooperation

Project is co-funded by the European Union funds (ERDF, IPA).

Danube Cycle Plans | Policies, plans and promotion for more people cycling in the Danube region

www.interreg-danube.eu/danube-cycle-plans

Contact

Coordinator:
KTI Institute for Transport Sciences
András Munkácsy PhD
Email Address: munkacsy.andras@kti.hu
Web: www.kti.hu

Authors:
Dániel Tordai
István Kövesdi
Tamás Andrejszki PhD
Bálint Csendes PhD
András Munkácsy PhD

More information about Danube Cycle Plans
and the project activities & results are available on:
www.interreg-danube.eu/danube-cycle-plans

Project is co-funded by the European Union funds (ERDF,IPA).

Table of contents

1. Executive summary

As an outcome of the Danube Cycle Plans project, this document contains a rough cost-estimation for the DanuVelo cycle route network, a more detailed investment plan for EuroVelo 6, an extension of the traditional Cost-Benefit Analysis (CBA) methodology to be more precise with the estimation of cycling infrastructure and the results of an application of this CBA for a selected cross-border infrastructure section along EuroVelo 6.

- Partners from each country participating in the Danube Cycling Plans project have created a National Cycle Route Network.
- The DanuVelo cycle route network has been created by focusing on connecting partnering countries' "Core Networks" consisting of EuroVelo routes and the highest (long-distance) level of national cycle routes, connecting national and regional centres, allowing access to international cycle routes and connection to the rail network.
- The investment necessities have been estimated for the DanuVelo network by classifying the routes into one of four categories: Good enough cycling infrastructure (GECI), Adjusting Existing Adequate Roads (AEAR), Construction improvement needed for existing service, forest and field roads (CINE) and New cycling infrastructure needed (NECI). A fifth category, called public transportation (PUTR) was used to link sections between which building dedicated cycling infrastructure is not feasible.
- After setting the cost of building good infrastructure in the case of each country, the necessary amount of founding needed to complete the DanuVelo network has been estimated to be 5 200 million €. Per country estimation can be found in the table below.

Country	Investment necessities
Austria	150 173 106 €
Czechia	247 806 061 €
Slovakia	761 909 576 €
Hungary	964 117 700 €
Slovenia	214 380 487 €
Croatia	253 818 955 €
Serbia	220 455 776 €
Romania	1 959 708 746 €
Bulgaria	428 080 032 €
SUM	**5 200 450 438 €**

1. Table Investment necessities in the DanuVelo network per country.

- The investment necessities of the EuroVelo 6 route (running from the Atlantic Sea to the Black Sea) in the Danube region, i.e. for its section from Austria to Romania along the river Danube have been estimated to be around 438 million €
- An upgrade to cost-benefit analysis (CBA) methodology has been proposed that takes into account benefits that are specific to cycling and not mentioned in the traditional methodology, like health benefits of regular cycling, the value of safer environment for cyclists, or the less parking space needed in urban environments. By missing out on these benefits, the real value of these cycling projects can be underestimated, leading to less-than-optimal funding.

- We showcase our new methodology by applying it to a currently underdeveloped section of the EuroVelo 6 route, from Šturovo (SK) to Szob (Hungary). We estimate the economic return of the construction of this 20 km long section with the traditional and the upgraded method, and find that the net present value of the project is negative with the traditional methodology (- 2 380 893 €), but positive with our new methodology (1 582 390 €), illustrating the need for the use of a CBA methodology in the case of cycling projects that reflect the benefits of this mode of transportation better.
- Recommendations are also provided as a summary of how decision-makers can and shall promote cycling, particularly the development of cycling infrastructure. It is recommended that governments on all levels be committed, harmonize their efforts in the macroregion and create their own cycling infrastructure investment plan. They shall not only access international funds addressing cycle route developments but also create their own national programme to improve their national (and cross-border) network. Decision makers should promote the realization of the proposed DanuVelo cycle route network by dedicating money from all potential funds. When calculating budgets and planning projects, it is suggested to apply the updated Cost-Benefit Analysis methods.

2. Introduction

Countries in the European Union face multiple mobility challenges: the high and growing number of cars on the road emit CO_2 and other greenhouse gases that contribute significantly to global warming. Vehicles with internal combustion engines also produce other toxic gases that are responsible for respiratory diseases. In addition, cars are also responsible to a large number of traffic accidents, killing thousands of people every year. Cars also take a large portion of valuable public space in urban areas when they are parked on the road that could be used for other activates.

Cycling is a great solution to all of these problems: it does not emit any kind of emissions, it is very unlikely to cause serious traffic accident due to the usually low speeds, and uses way less space while riding and parking. Furthermore cycling comes with additional advantages: the infrastructure needed for cycling is relatively cheap compared to the needs of cars, and cycling is also cheaper for the user than a car. Finally, regular cycling has significant health benefits.

To increase the modal share of cycling, increase the number of cyclist and hence harvest the benefits of this mode of transportation, proper infrastructure has to be in place. This requires a serious commitment and coordination from policy makers, since a good cycling network has to be carefully designed, and then built and maintained over several years, coming with significant financial cost.

The Danube Cycle Plans project addresses these challenges by setting actions to strengthen three main pillars of cycling promotion: (1) Facilitate the development of cycling policies at national and transnational level supported by National Cycling Plans based on a common transnational Danube Cycling Strategy; (2) Support the provision of adequate cycling infrastructure by defining the Danube Cycle Route Network, developing common standards and deriving an investment plan to upgrade current conditions; (3) Increase the awareness of relevant stakeholders for the needs of cyclists and increase their capacity to promote cycling in the whole Danube region by implementing a mentoring system, inspiration events and national cycling conferences. The project is embedded in THE PEP Partnership Active Mobility (UNECE/WHO) whose pan-European Masterplan gives valuable input for the project and vice versa, the project´s outputs will backflow to the pan-European level.

These aims are reached via several different activities, like creating national cycling plans in the participating countries, conducting promotional activities, or organizing conferences for stakeholders to encourage them put more emphasis on cycling. One of the main products of this project is the creation of the Danube Cycle Route Network (DCRN), a cycle route network that connects the – in many cased newly defined - networks of the countries in the Danube region, and provides good infrastructure to both regular and recreational users.

There are 9 countries participating in the DPC project: Austria, Czech Republic, Slovakia, Hungary, Slovenia, Croatia, Serbia, Romania and Bulgaria. Conditions for cycling promotion are rather different in these countries, as it can been seen from this document as well.

This Danube Cycling Infrastructure Investment Plan includes the following sections:

- details about how National Cycle Route Networks were created, what is the common catalogue of cycling-friendly infrastructure and how was the route inspectors and action planning training organized in the frame of this project;

- a rough cost-estimation for the Danube Cycle Route Network (DanuVelo) network defined by country experts and members the National Cycling Working Groups of the participating countries;
- a more detailed investment plan for EuroVelo 6, one of Europe's long-distance cycle routes, namely the Rivers Route, linking the Atlantic Sea and the Black Sea along major rivers (in this macroregion, EuroVelo 6 runs along the Danube River);
- the suggested extension of the CBA (Cost Benefit Analysis) methodology and its showcase on a cross-border section of EuroVelo 6;
- finally, concluding remarks and recommendations.

Our goal is to show the level of investment needed for good cycling infrastructure in the region, and to provide decision-makers on regional, national and international level with information to be not only committed to the promotion of cycling but also well-equipped with evidences to take steps towards a better network of cycling infrastructure in the Danube region.

3. The assessment of cycling infrastructure and investment necessities

The structure of Work Package T2 was elaborated to prepare all the necessary background studies and to gain the required knowledge for a realistic investment plan.

The first step was to create National Cycling Route Networks. A guideline was elaborated for the definition of these networks but the basic status quo of the National Cycle Route Networks differed a lot between each Danube country. This meant that there were countries who could follow exactly the guideline, but there were others who just adapted it as much as they could. After having structured plans of future networks, the infrastructure standards needed to be investigated to be able to harmonise these rules for having coherent, safe and transparent routes regardless of the country that cyclists are leaving or entering. The current infrastructure practices of Danube countries and some other European examples were put together in the "Catalogue of Cycling-friendly Infrastructure Standards for the Danube Countries" document which also gave recommendations for upgrading (or creating) national design standards for cycling infrastructure.

As our goal was an assessment of routes, it was clear that the existing assessment methods should be investigated. The European Certification Standard (ECS) is the most known methodology (developed by the ECF) to assess cycling routes, EuroVelo or not, and evaluate their quality. To learn this methodology and the usage of the software provided by the ECF a Route Inspector Training was organised in Ruse on the 21-22nd of October 2021. The aspects of ECS clarified how the partners should assess (in a bigger scale) their core networks – the Danube Cycle Route Network (nicknamed DanuVelo). The guideline for "Assessment of cycling infrastructure and investment necessities for DanuVelo" defined the appropriate method that was simple and gave quality data of the planned network.

The last piece was to deal with the economic side of the potential investments. As the European CBA guidelines do not expect to calculate with health effects, it was crucial to investigate the current CBA methodologies to be able to recommend an update of these. The document of "Updating the CBA methodology to include the economic benefits of cycling" looks through the external effects, costs and benefits of cycling and gives a recommendation how to integrate these issues to the current practises.

After these steps the background studies and required knowledge were available to be able to elaborate the investment plan of the Danube Cycle Route Network.

3.1. DEFINING NATIONAL CYCLE ROUTE NETWORKS

As part of the DCP project, a guideline to define a National Cycle Route Network (NCRN) was created to ensure that the development of the NCRNs follows a common transnational approach in the participating countries.

When creating a National Cycle Route Networks, the focus was on the cycle routes, the equipment of the national (long-distance) cycling routes and routes both for tourists and for residents who use the same routes for their daily commute. Therefore, when creating a National Cycle Route Network, the key questions to answer were:

- How many levels of cycle route network do we need?
- What purpose will they serve?
- What are the concerns, needs and priorities of different users (a traveller vs. a daily commuter)?

The steps for the definition of a National Cycle Route Network are:

- Step 1 – Defining the methodology: Definition of key concepts, activities and specifications for cyclists that support the development of the cycle route network, based on literature studies and existing legislation.
- Step 2 – State of the art: Analysis of the current state of the cycle route network at national level. The level of analysis of the actual state depends on the administrative organization of each country. In Slovenia, for example, there is no administrative regional division, so the state also assumes tasks related to the development of infrastructure at regional level.
- Step 3 – Defining network criteria: Selection of criteria for the establishment of a comprehensive cycle route network at national level
- Step 4 – Drafting the cycle route network: Elaboration of a proposal for the concept of a comprehensive cycle route network at national level with links to the international cycle route network.
- Step 5 – Public consultation: Communication with all stakeholders involved, such as administrative bodies at national, regional and local level, cycling organizations and associations, tourism organizations and others lead to a wider acceptance of the network.
- Step 6 – Detailed planning: The next step is more detailed planning of cycle routes with the possibility of temporary routes and facilities in line with existing infrastructure until the missing infrastructure is built.
- Step 7 – Follow up activities: In the final phase, responsibilities, guidelines and measures for the planning, construction and maintenance of the cycle routes should be defined horizontally by each department and vertically between the national (and regional) and local levels.

Partners participating in the DCP project adapted this process to the existing practise and network - and created the NCRNs of their respective countries.

3.2. CATALOGUE OF CYCLING-FRIENDLY INFRASTRUCTURE STANDARDS FOR THE DANUBE COUNTRIES

A comprehensive analysis of national, and international cycling infrastructure standards was performed. Scope of relevant national documents was given by all 9 national project partners through the project questionnaire at the beginning of the project and follow-up communication.

On top of 9 country standards, several advanced countries or advanced recommendations have been used. While 4 of them have been consistently used through the whole analysis and for the comparison with 9 country standards, many additional sources have been used for additional information, mostly to obtain best practice information and for inspiration. In addition, European Certification Standard (ECS) was used and referenced where applicable.

On top of document analysis, the Catalogue also included examples of good (and bad) practices in DCP countries, and referenced cycling infrastructure costs. Finally, the Catalogue contained recommendations based on the standards described and situation in practice. It turned out that the best structure was to compare the situation aspect by aspect across all 9 countries and to place the recommendations right after each respective aspect.

Following the DCP project objectives, this catalogue was the basis for BG (Bulgaria), HR (Croatia), RO (Romania), SK (Slovakia), and RS (Serbia) to develop recommendations for national standards, adapting the international key principles for national use. After discussing the draft standards during National Cycling Working Group meetings BG, HR, RO, SK, SI, and RS elaborated road maps with recommendations for the integration of new/updated standards into existing national regulations. These road maps consider implications for other standards, highway codes and other relevant legislation.

This Catalogue of standards also contributed to the convergence of European standards related to the cycling infrastructure. European countries are more and more connected due to tourism, temporary assignments and migrations. Having different standards is inconvenient and risky, so common standards could increase safety, comfort and efficiency. Therefore, UNECE documents are included in this analysis and experts from UNECE participated in the review process of this Catalogue.

3.3. ROUTE INSPECTORS AND ACTION PLANNING TRAINING

In the EuroVelo Route Inspectors Training the participants learn how to survey cycling routes using the methodology and software provided by the ECF. The training courses are based on the European Certification Standard (ECS) which is a methodology developed by the ECF to assess cycling routes, EuroVelo or not, and evaluate their quality. It can be used to survey and assess the quality of national/regional routes, and to certify EuroVelo routes if the criteria are met. It can help set up national standards where they do not exist and harmonise the different regulations in the European states. The main goals of the European Certification Standard (ECS) are to:

- Improve the quality of EuroVelo routes and other routes by identifying critical deficiencies and motivating decision-makers to invest in solutions to the identified problems.

- Provide quality control to motivate different target groups with varying levels of experience to use the certified trans-national routes.

A thorough explanation of the categories and criteria for monitoring the quality level of EuroVelo routes and assessing any long-distance cycle route according to the ECS methodology is available in the European Certification Standard Handbook for Route Inspectors. This manual is shared with trained EuroVelo Route Inspectors and relevant partners. The European Certification Standard can be used in different stages of the route development:

- Planning of the route: Identify a viable corridor with a strong theme;
- Route survey: Identify strong and weak points of the route;
- Action plan: Plan and prioritise actions to ensure consistent quality;
- Certification: Verify the results of implemented actions;
- Certified route: Periodically check the quality of the product.

EuroVelo Route Inspectors use an app specifically designed to evaluate long-distance cycle routes: the European Certification Standard app. With the ECS application, data can be collected offline in the field, using an Android phone with a functioning GPS system. The ECS application for surveying the route has been newly updated from 2019 to 2021 in collaboration with Cartographia. It is a tool to improve the collection of data, which is uploaded from the field with the app and can then be analysed on the desktop.

From the DCP partners nine delegated participants attended the training in Ruse on the 21-22nd of October 2021. All of them passed the (theoretical and practical) exams and became a certified route inspector.

3.4. UPDATE OF THE CBA METHODOLOGY

Economic appraisal is a major step in the preparation of any infrastructure project. The results of these assessment show if a project is feasible, and help decision makers prioritize the projects that can yield the highest returns.

The most important economic appraisal tool in the transportation sector has been the cost-benefit analysis (CBA). This tool is used to show the economic and financial return of a project, by summing present value of all costs and benefits, and then comparing the two to each other. Estimating a financial value of the major benefits of transportation projects is challenging, because they are not present in monetary terms. I.e. usually the most important benefit is time saved by travellers as a result of faster connection between two places that can be calculated in hours. To express it monetary terms, economists use the value of travel time (VOT), a measure which says what the amount of money individuals is would be willing to save an hour on their travel.

Similar benefits are regularly included in CBAs: reduction in CO2 and GHG emissions, reduction of noise pollution in residential areas, reduction in the number of accidents, etc. However, usually CBA guidelines consider only the benefits that are present in the case of motorized transportation modes, cars and public transport, therefore these guidelines are ill-suited for the appraisal of cycling infrastructure projects, since they do not mention several key benefits that are special to cycling.

There is strong scientific evidence that regular cycling provides significant health gains, by decreasing the chance of a number of illnesses and increasing overall fitness. Constructing safer environment for cyclists to ride, for example segregated bike path increases cyclists perceived safety, which can also be expressed in monetary terms. If individuals in dense urban areas give up individual car ownership, and instead use their bikes to get around the city, public space could be freed up and be used for other, more beneficial activates, which is another benefit of cycling. Neglecting these unique benefits can result in underestimation of the benefits of cycling, and henceforth cycling infrastructure projects can be seen as economically less favourable compared to other projects.

In the current programming period, (2021-2027) the European Commission promotes the application of other economic appraisal tools, like the multi-criteria analysis or the cost-effectiveness analysis. These tools are easier to use, requiring less data as input, and are better suited to incorporate policy perspectives as well that cannot be included in a CBA analysis.

As part of the DCP project, we have created an update to the CBA methodology that, based on strong scientific evidence gives suggestions on how these special benefits of cycling listed above could be taken into account. Section 5 of this investment plan details the application of this updated CBA methodology on a cross-border EuroVelo 6 section, highlighting the importance of taking the special benefits of cycling into account.

3.5. CREATING THE DANUBE CYCLE ROUTE NETWORK (DCRN) AND ESTIMATED INVESTMENT NECESSITY

To create the Danube Cycle Route Network (DCRN) partners were focusing on connecting partnering countries' "Core Networks" consisting of EuroVelo routes and the highest (long-distance) level of national cycle routes, connecting national and regional centres, allowing access to international cycle routes and connection to the rail network. These serve as a backbone for development and connection to regional and local cycle route networks. To put it in other words, DanuVelo will be in hierarchy somewhere between EuroVelo and National Network, although it will sometimes use small parts of a regional or even local network, for the purpose of cross-border connection.

One of the guiding principles for outlining the DanuVelo is regional connectivity of the defined national core networks leading to a consolidated transnational cycle route network.

4 categories for classifying the status of current (cycling) infrastructure were defined:

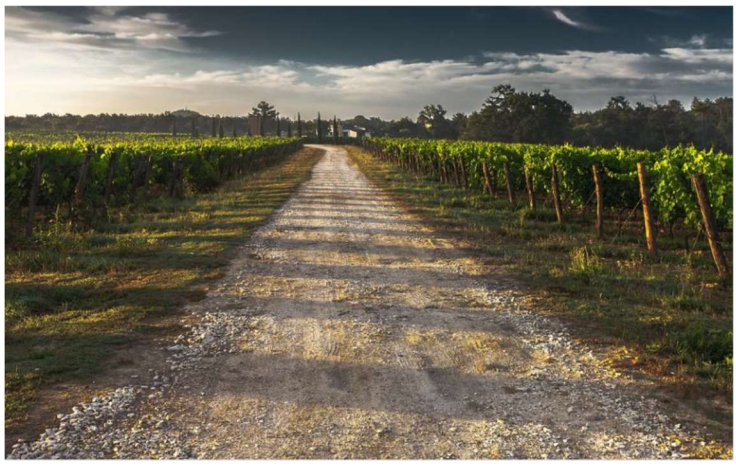
1. Good enough cycling infrastructure (GECI) - fulfilling the current minimum standards in the country, investment is not needed apart from marking the road as a cycling route.

1. Figure Illustration of Good enough cycling infrastructure (GECI) category

2. Adjusting Existing Adequate Roads (AEAR) - local roads fulfilling the criteria of good visibility, low traffic, firm surface that can be adjusted for cycling with calming the traffic, speed barriers, painting cycle lanes, sharrows, etc.

2. Figure Illustration of Adjusting Existing Adequate Roads (AEAR) category

3. Construction improvement needed for existing service, forest and field roads (CINE) – compacting gravel, improving drainage, maybe paving, etc. for the usage of cyclist



3. Figure Illustration of Construction improvement needed for existing service, forest and field roads (CINE) category

4. New cycling infrastructure needed (NECI) – where traffic volume exceeds 2000+ cars/day on a route section with speed limits over 40km/h (even better 30 km/h) or where it is not safe for cycling regardless of the traffic volume and speed or where the existing cycling infrastructure doesn't meet the current minimum standards in the country.

4. Figure Illustration of New cycling infrastructure needed (NECI) category

In addition to these four categories, and additional one was created called Public Transport (PUTR). This category was used to cover sections where no cycling infrastructure could be possibly built at a reasonable cost due to geographical or other technical reasons. At those locations, the installation of some kind of public transportation connection is used to make the network continues. Such location could be a river crossing, where a ferry could provide connection between the two sides of the river.

These categories were used to classify the infrastructure on the entire proposed DanuVelo network. After estimating the cost of building infrastructure of each category in every country, the investment necessity of the entire DanuVelo network had been estimated. The estimated cost is 5 200 million €, as it can be seen in the table below. Detailed costs per categories and maps showing the network for each country can be found in section 3.4. The cost of public transportation connections (PUTR) is not included in this estimate as those are not narrowly defined cycling infrastructure. The following table sums up the length of each category in a given country.

	GECI	AEAR	CINE	NECI	PUTR	SUM
Austria	2 860 688	314 053	303 975	149 811	28 989	**3 657 516**
Czechia	1 631 735	1 194 250	235 318	360 340	-	**3 421 643**
Slovakia	389 083	26 282	450 184	1 474 582	92 032	**2 432 163**
Hungary	1 606 676	1 888 752	601 192	1 157 537	404	**5 254 561**
Slovenia	188 627	542 432	299 994	299 994	-	**1 331 047**
Croatia	101 715	3 651 054	122 861	402 026	137 768	**4 415 424**
Serbia	411 274	2 906 561	57 009	840 263	-	**4 215 107**
Romania	295 535	1 495 884	3 842 140	2 701 096	-	**8 334 655**
Bulgaria	8 620	3 687 167	99 991	862 054	-	**4 657 832**
SUM	**7 493 953**	**15 706 435**	**6 012 664**	**8 247 703**	**259 193**	**37 719 948**

2. Table Length of each category per country (meters)

5. Figure Overview of the DanuVelo cycle route network

3.6. COUNTRY SPECIFIC COSTS AND INVESTMENT NECESSITIES

The following tables contain the calculated costs and the investment necessities of the countries in the Danube region, and the maps show where the cycle routes belonging to the certain infrastructure categories are located.

The basis of the cost-estimates have been the comprehensive analysis done by the Slovenian partners for each infrastructure category, and they are the following:

Category	Cost/unit (€)	Unit	Width
NECI	188	m^2	3,5
CINE	50	m	1
AEAR	10	m	1
GECI	1	m	1

3. Table Recommended cost estimates of the infrastructure categories

Partners were asked to consult with national experts about the cost of these categories in their countries. They had the opportunity to use the Slovenian values as a starting point for their work. We justify in case of every country if there are deviations from these cost estimates.

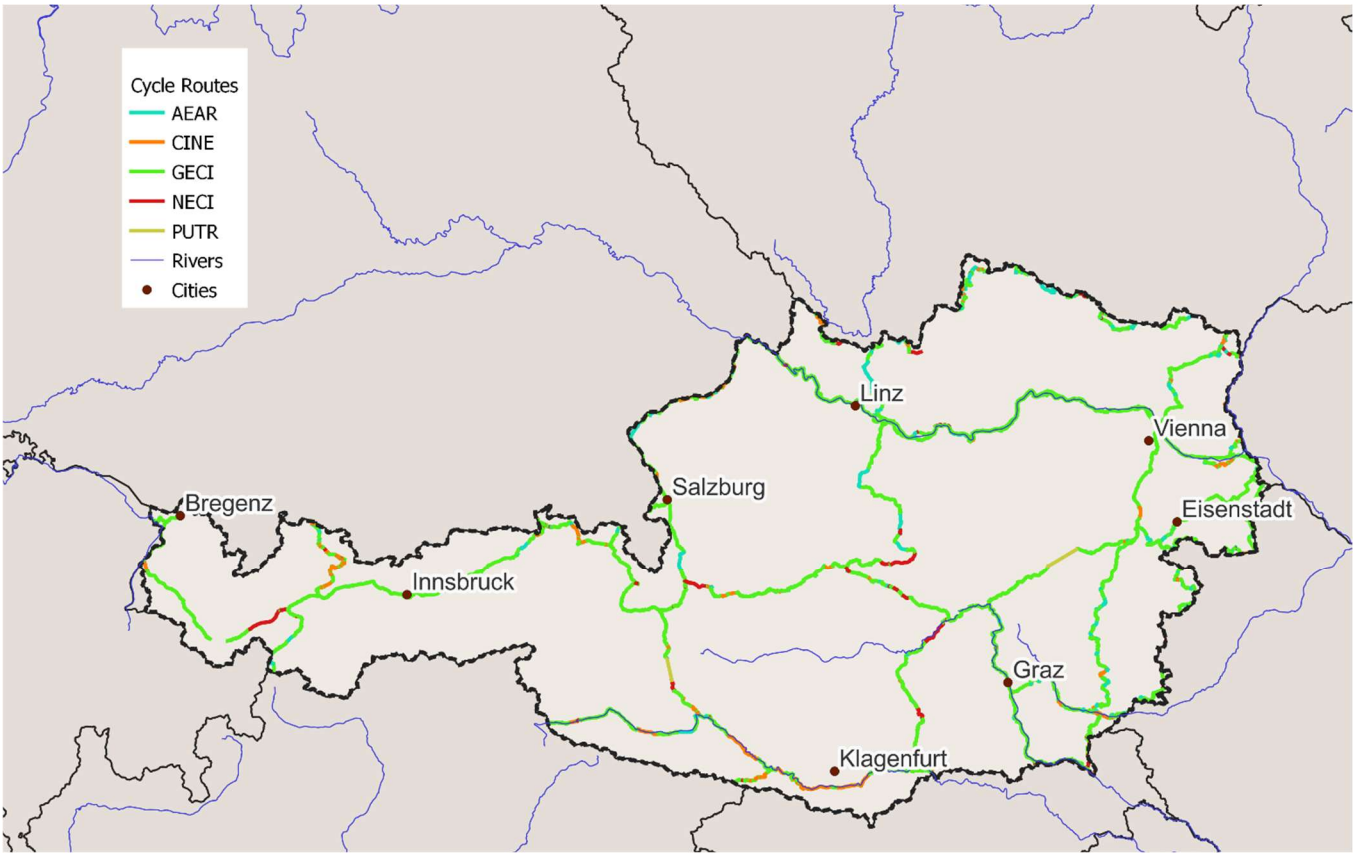
3.6.1. Austria

For Austria, the cost of the CINE category is higher than the commonly applied one (150 €/m instead of 50€/m). The figure comes from the Austrian Cycling Investment Plan where this figure was used for upgrading existing small streets. The amount was brought up by the responsible authorities from Lower Austria region and is an estimation of these experts.

Austria has assigned a limited part of its cycling network to the DanuVelo cycling network, most of that is in good condition. Due to a few larger mountains impasses would have been present in the network, those has to be overcome with public transportation.

AT	Length (m)	Cost/unit (€)	Unit	Width	Sum
NECI	149 811	188	m²	3,5	98 575 638 €
CINE	303 975	150	m	1	45 596 250 €
AEAR	314 053	10	m	1	3 140 530 €
GECI	2 860 688	1	m	1	2 860 688 €
PUTR	28 989				
SUM	**3 657 516**				**150 173 106 €**

4. Table Investment necessities in the Austrian part of the DanuVelo network



6. Figure Overview of the Austrian part of the DanuVelo network

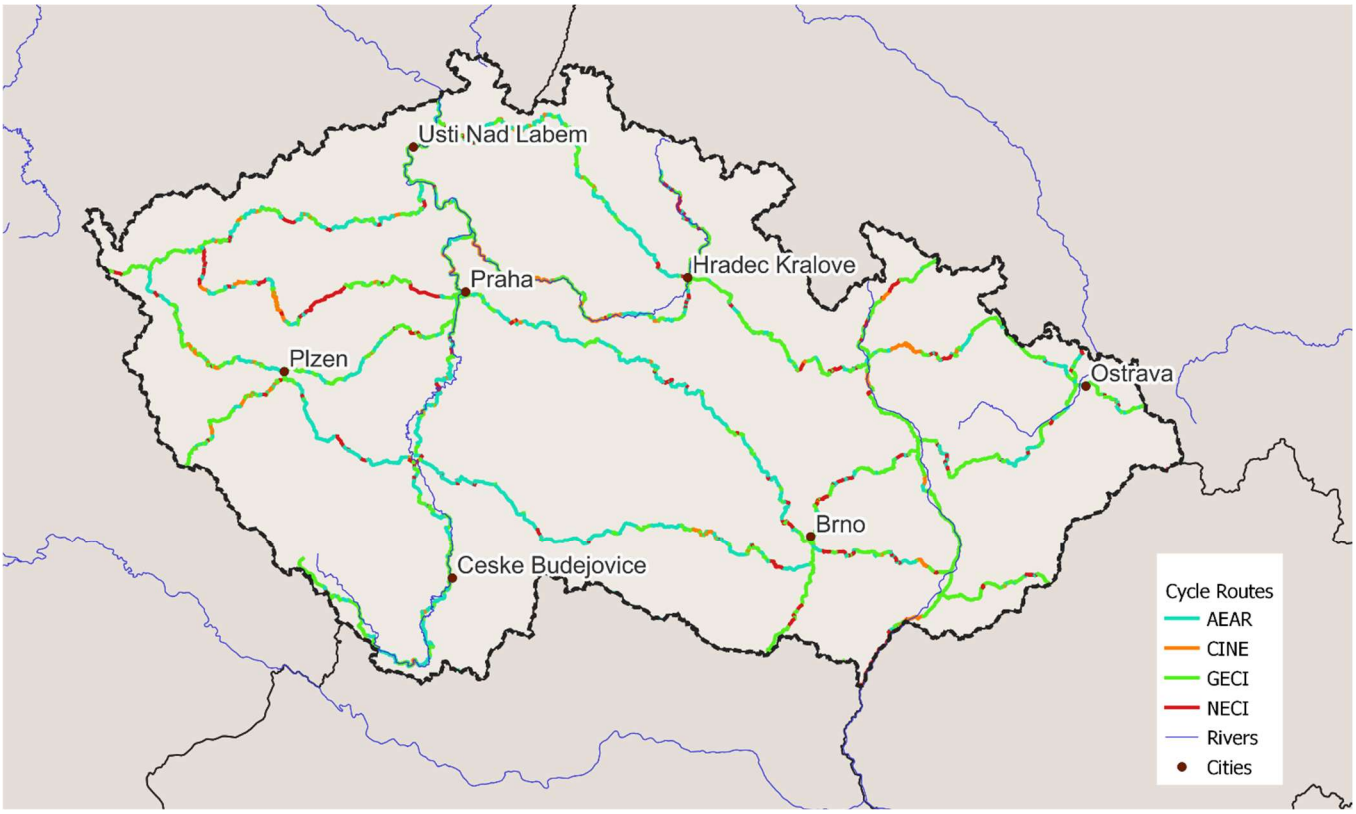
3.6.2. Czechia

The foundation for the cost estimates in the Czech Republic were the Hungarian cost estimates, since both the cost of construction materials and labour are similar. Per Czech experts however, the cost of NECI is lower than in Hungary.

Czechia has a large national network, and it assigned a portion of it, their core network to be in the DanuVelo network. Most of the routes are in the AEAR and GECI category, however there are sections waiting for construction/reconstruction.

CZ	Length (m)	Cost/unit (€)	Unit	Width	Sum
NECI	360 340	135	m²	3,5	170 260 650 €
CINE	235 318	282	m	1	66 359 676 €
AEAR	1 194 250	8	m	1	9 554 000 €
GECI	1 631 735	1	m	1	1 631 735 €
PUTR	-				
SUM	**3 421 643**				**247 806 061 €**

5. Table Investment necessities in the Czech part of the DanuVelo network



7. Figure Overview of the Czech part of the DanuVelo network

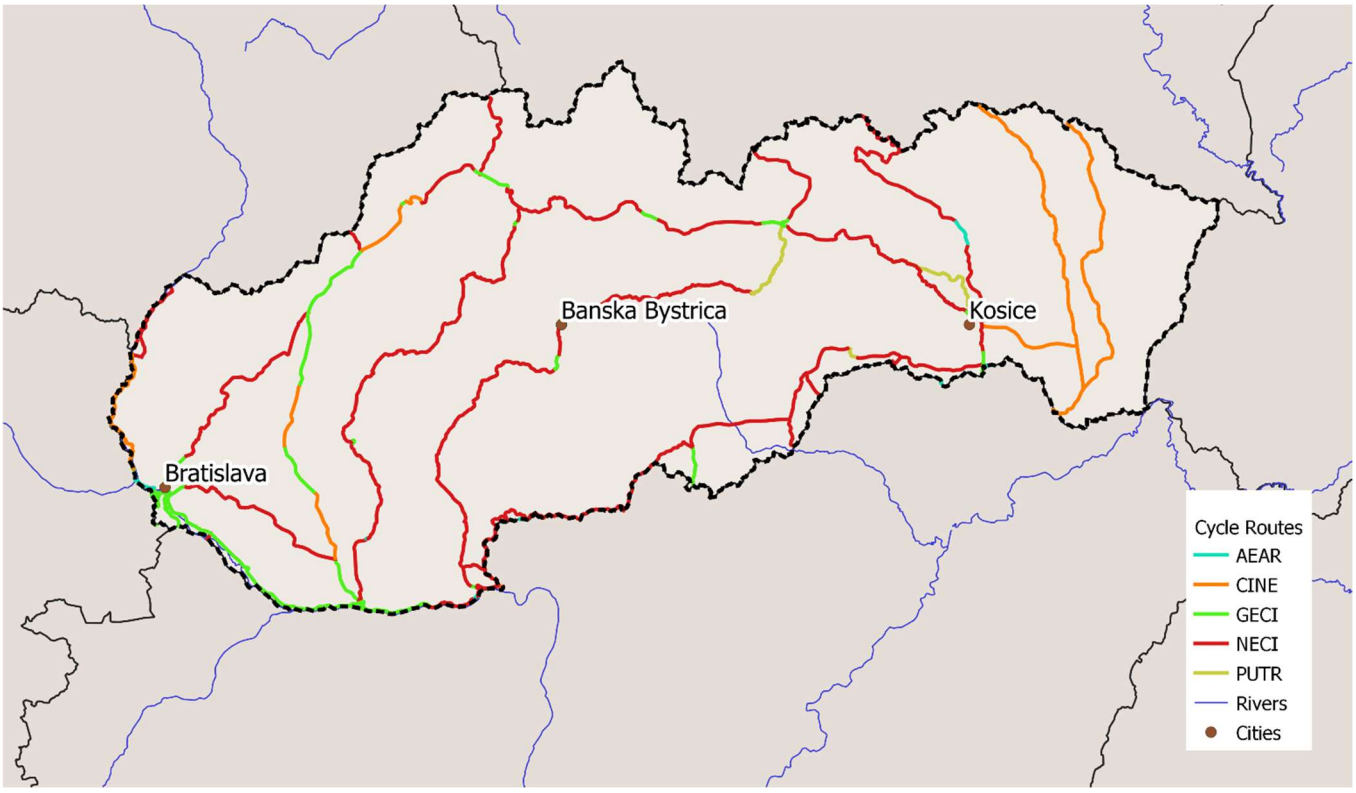
3.6.3. Slovakia

In Slovakia, the cost of NECI category is based on previous projects and also on analysis of the Slovakian National Recovery and Resilience Plan. The cost of AEAR is slightly higher than the usual one, but it represents a very small section of the Slovakian network.

The large part of the Slovakian network is yet to be built. As in Austria, some sections in the high mountains cannot be accessed by bike, hence the long PUTR sections.

SK	Length (m)	Cost/unit (€)	Unit	Width	Sum
NECI	1 474 582	143	m²	3,5	738 028 291 €
CINE	450 184	50	m	1	22 509 200 €
AEAR	26 282	30	m	1	788 460 €
GECI	389 083	1,5	m	1	583 625 €
PUTR	92 032				
SUM	**2 432 163**				**761 909 576 €**

6. Table Investment necessities in the Slovakian part of the DanuVelo network



8. Figure Overview of the Slovakian part of the DanuVelo network

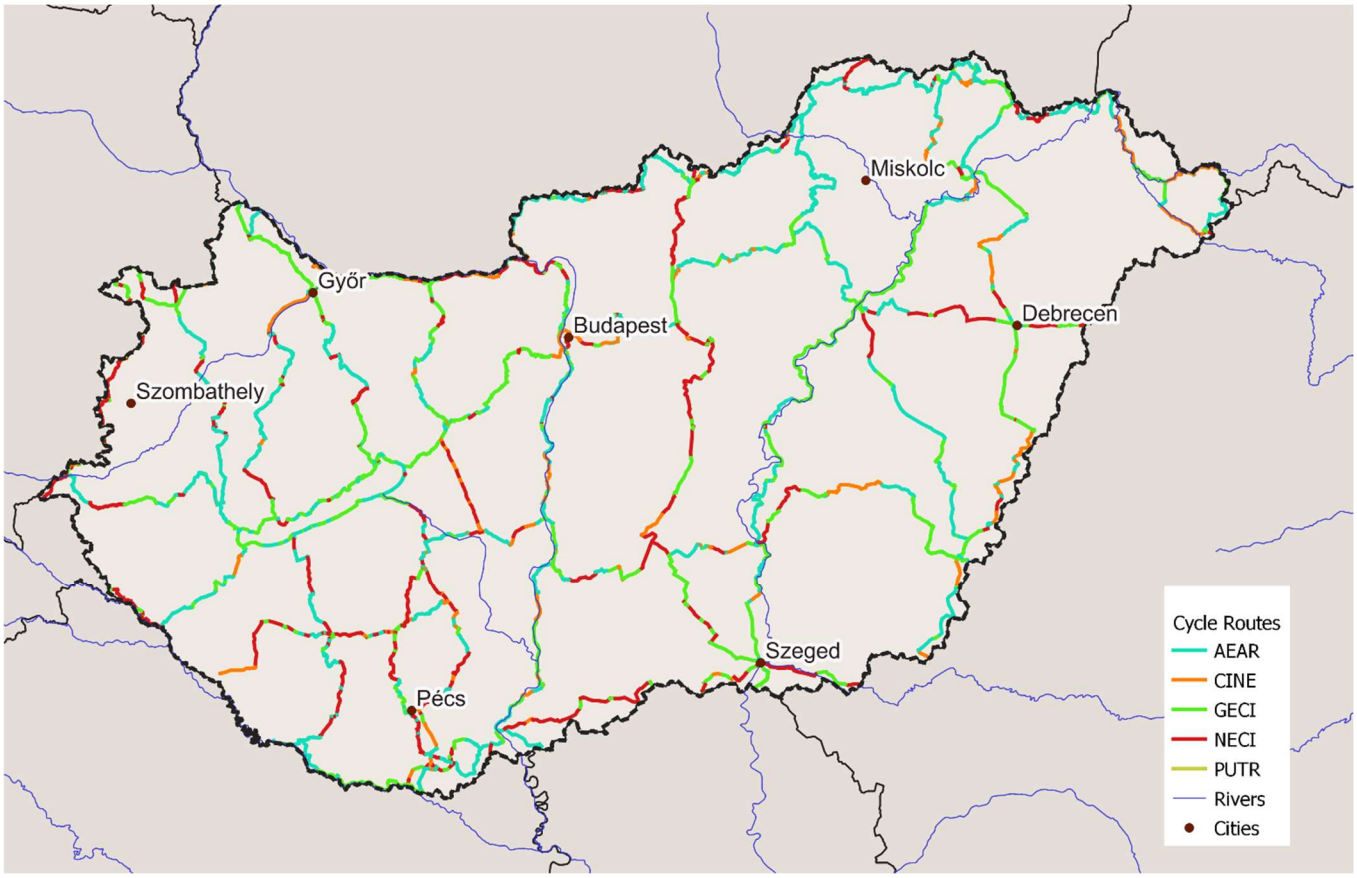
3.6.4. Hungary

Hungary has a higher value of CINE than the common one since in Hungary this category usually means a new asphalt surface and not just compacting gravel as in many other countries, as in Hungary there's not a culture for building compacted gravel roads for cyclists.

The Hungarian network is based on the National Spatial Plan that contains all cycling routes to be built. A selection of those routes were included in DanuVelo, end extended to the border when it was necessary. This is the densest network of the countries in the region

HU	Length (m)	Cost/unit (€)	Unit	Width	Sum
NECI	1 157 537	192	m²	3,5	777 864 864 €
CINE	601 192	282	m	1	169 536 144 €
AEAR	1 888 752	8	m	1	15 110 016 €
GECI	1 606 676	1	m	1	1 606 676 €
PUTR	404				
SUM	**5 254 561**				**964 117 700 €**

7. Table Investment necessities in the Hungarian part of the DanuVelo network



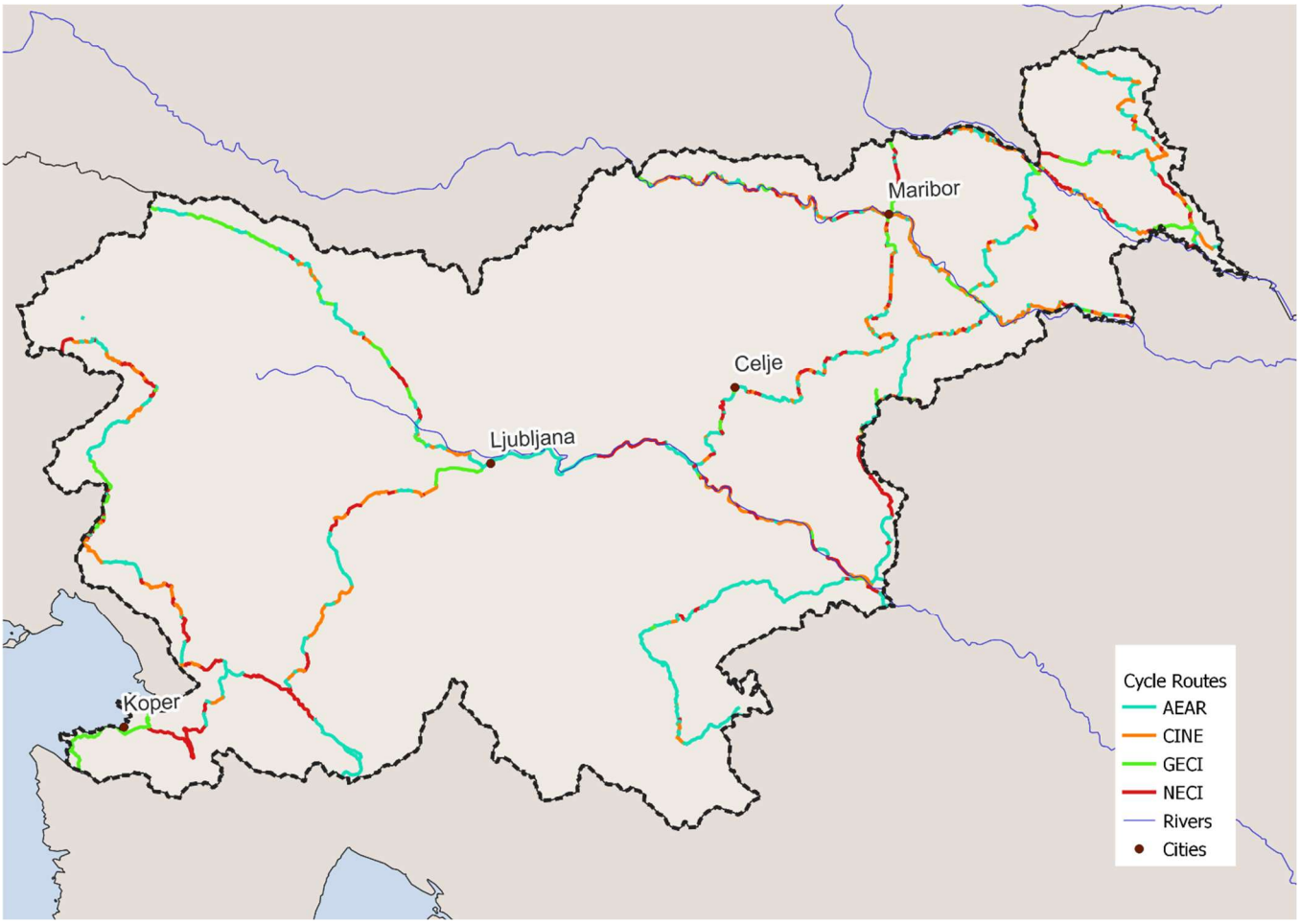
9. Figure Overview of the Hungarian part of the DanuVelo network

3.6.5. Slovenia

Cost estimation for all countries is based on the Slovenian calculation. They included only their core network into DanuVelo, but in addition in their NCRN they have regional and local cycling route levels as well.

SLO	Length (m)	Cost/unit (€)	Unit	Width	Sum
NECI	294 480	188	m²	3,5	193 767 840 €
CINE	299 994	50	m	1	14 999 700 €
AEAR	542 432	10	m	1	5 424 320 €
GECI	188 627	1	m	1	188 627 €
PUTR	-				
SUM	**1 325 533**				**214 380 487 €**

8. Table Investment necessities in the Slovneian part of the DanuVelo network



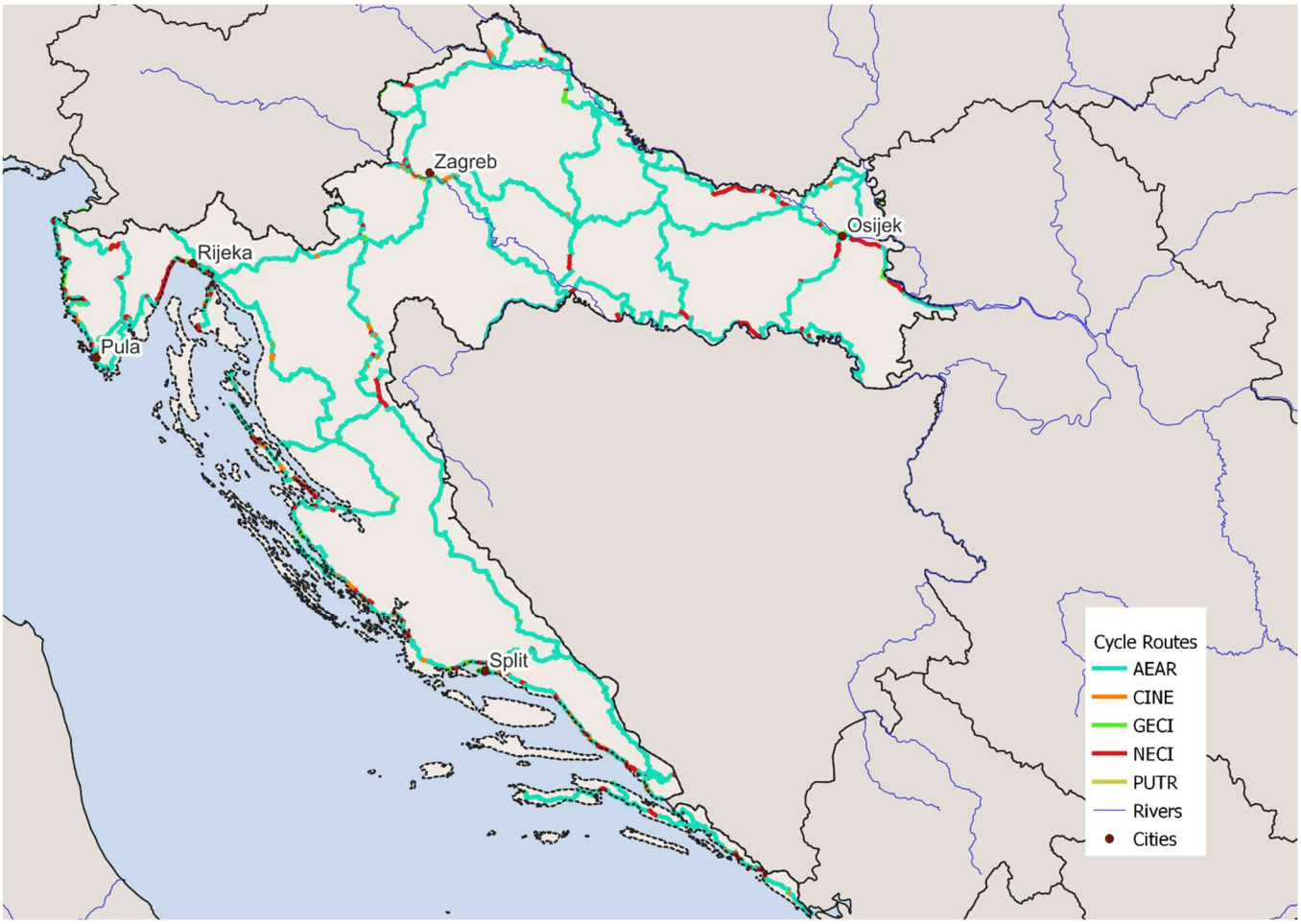
10. Figure Overview of the Slovenian part of the DanuVelo network

3.6.6. Croatia

Croatia has a high proportion of AEAR, because they utilize roads with low traffic that could be assigned for cycling traffic as well.

HR	Length (m)	Cost/unit (€)	Unit	Width	Sum
NECI	402 026	150	m²	3,5	211 063 650 €
CINE	122 861	50	m	1	6 143 050 €
AEAR	3 651 054	10	m	1	36 510 540 €
GECI	101 715	1	m	1	101 715 €
PUTR	137 768				
SUM	**4 415 424**				**253 818 955 €**

9. Table Investment necessities in the Croatian part of the DanuVelo network



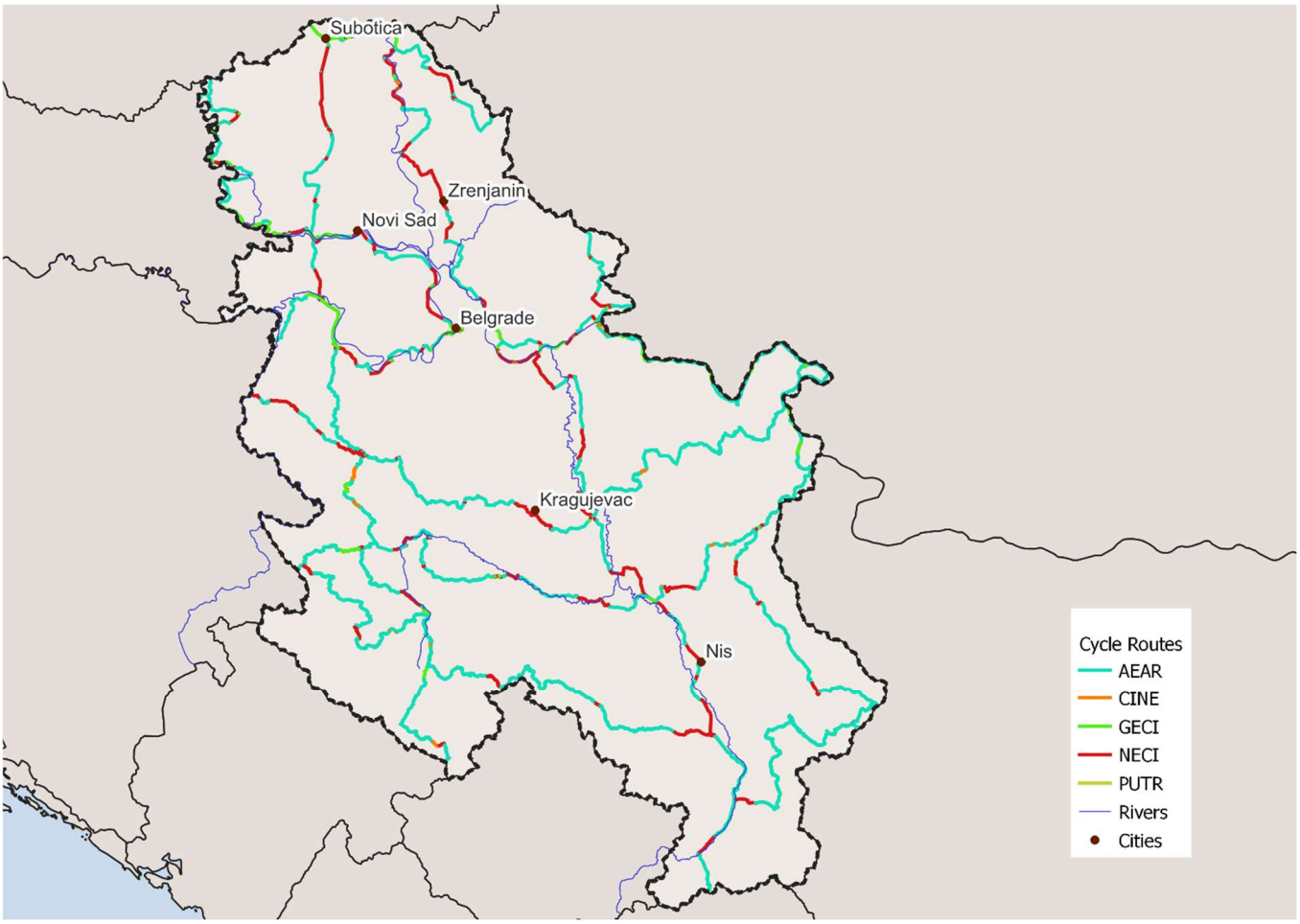
11. Figure Overview of the Croatian part of the DanuVelo network

3.6.7. Serbia

In Serbia there is a more detailed cost estimation than these for categories for their NCRN. The cost estimation below sums up that estimation. This is the first cycling plan in Serbia, and just like the Croatian plan, they also have high portion of AEAR in their DanuVelo network.

SRB	Length (m)	Cost/unit (€)	Unit	Width	Sum
NECI	840 263	63	m²	3,5	185 277 992 €
CINE	57 009	100	m	1	5 700 900 €
AEAR	2 906 561	10	m	1	29 065 610 €
GECI	411 274	1	m	1	411 274 €
PUTR	-				
SUM	**4 215 107**				**220 455 776 €**

10. Table Investment necessities in the Serbian part of the DanuVelo network



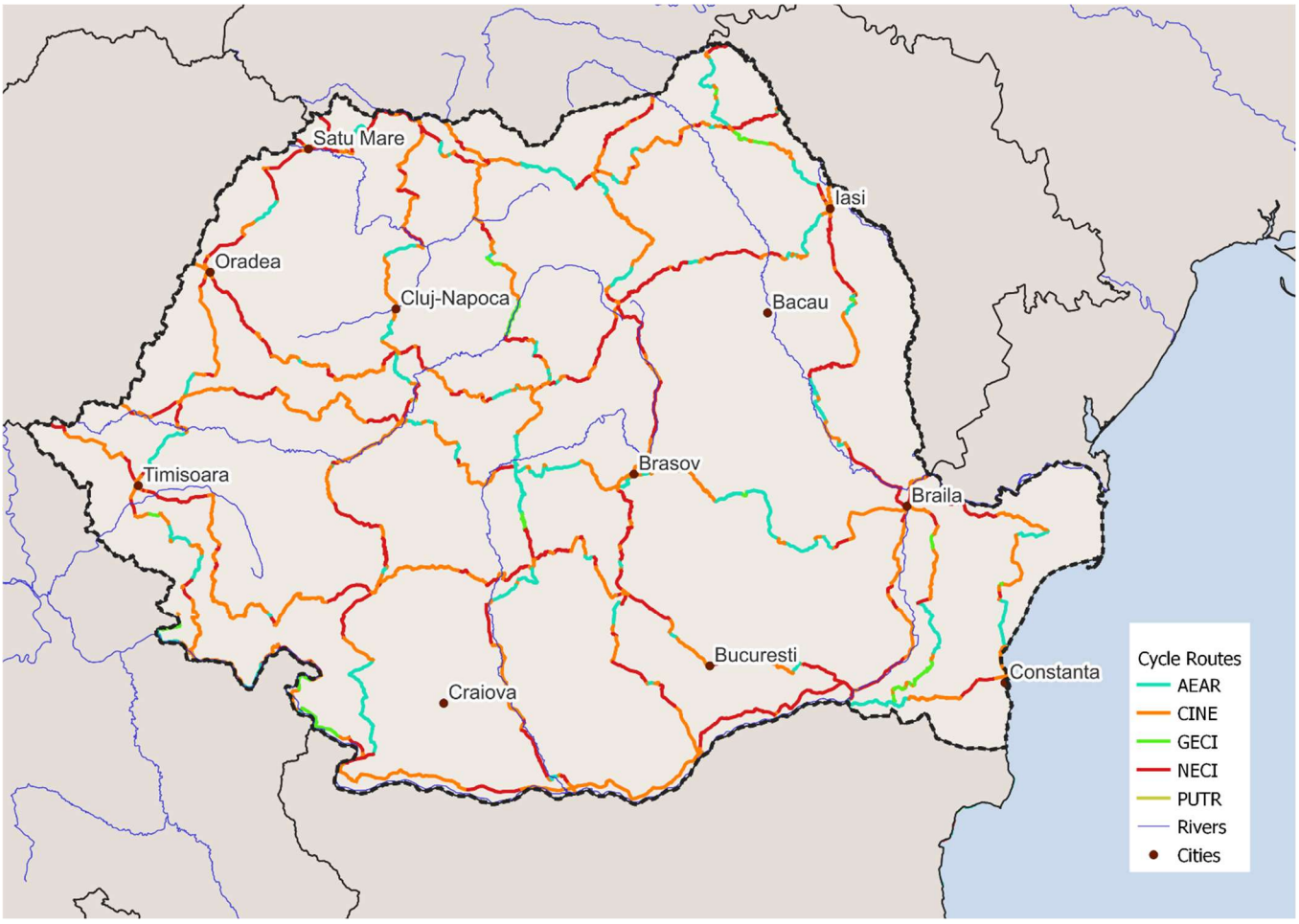
12. Figure Overview of the Serbian part of the DanuVelo network

3.6.8. Romania

The values for Romania are coming from recently executed projects, and considering the price increases in recent years. This first cycling network of Romania is the result of wide regional cooperation. Due to the large portion of NECI and CINE and the size of the country the investment necessity is high, 37% of the entire DanuVelo investment necessity.

RO	Length (m)	Cost/unit (€)	Unit	Width	Sum
NECI	2 701 096	188	m²	3,5	1 777 321 295 €
CINE	3 842 140	43,5	m	1	167 133 078 €
AEAR	1 495 884	10	m	1	14 958 838 €
GECI	295 535	1	m	1	295 535 €
PUTR	-				
SUM	**8 334 655**				**1 959 708 746 €**

11. Table Investment necessities in the Romanian part of the DanuVelo network



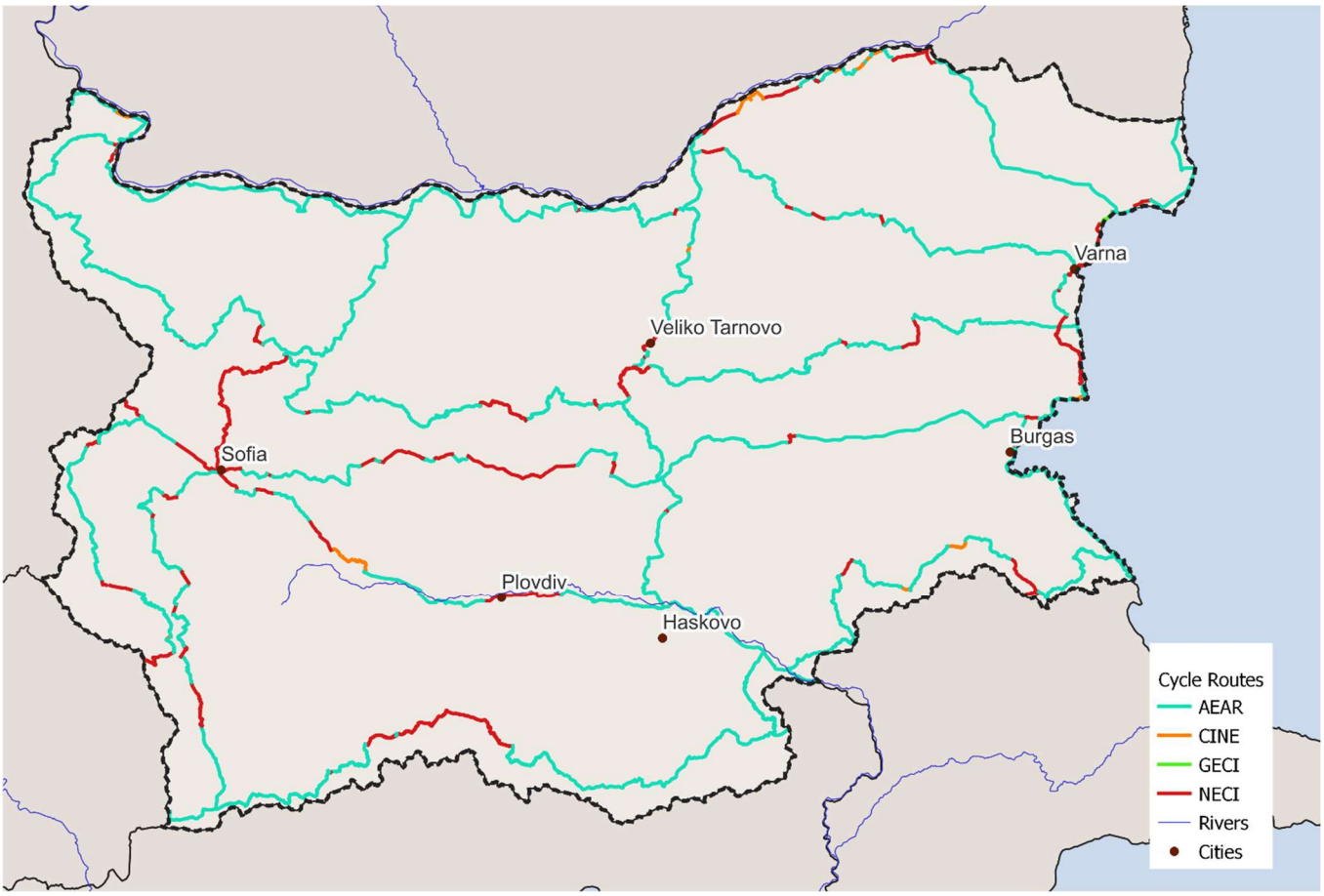
13. Figure Overview of the Romanian part of the DanuVelo network

3.6.9. Bulgaria

For Bulgaria the cost of NECI has been decreased from the commonly used value to reflect lower construction cost in the country. For Bulgaria this is also the first cycling route network plan, with very limited length of good infrastructure being present. They have selected a large number of low-traffic roads to their network.

BG	Length (m)	Cost/unit (€)	Unit	Width	Sum
NECI	862 054	128	m²	3,5	386 200 192 €
CINE	99 991	50	m	1	4 999 550 €
AEAR	3 687 167	10	m	1	36 871 670 €
GECI	8 620	1	m	1	8 620 €
PUTR	-				
SUM	**4 657 832**				**428 080 032 €**

12. Table Investment necessities in the Bulgarian part of the DanuVelo network



14. Figure Overview of the Bulgarian part of the DanuVelo network

The following table sums up the investment necessity per country:

Country	Investment necessities
Austria	150 173 106 €
Czechia	247 806 061 €
Slovakia	761 909 576 €
Hungary	964 117 700 €
Slovenia	214 380 487 €
Croatia	253 818 955 €
Serbia	220 455 776 €
Romania	1 959 708 746 €
Bulgaria	428 080 032 €
SUM	**5 200 450 438 €**

13. Table Investment necessities in the DanuVelo network per country.

4. The investment necessities of EuroVelo 6

The EuroVelo6 (EV6) route is part of the EuroVelo cycling route network, connecting the Atlantic and the Baltic Sea, beginning near Nantes in France, and ending in Constanta, Romania. This route is one of the most popular in Europe, and it connects many of the countries in the Danube region participating in the Danube Cycling Plans project. Despite the popularity and the great potential of the route, several sections lack proper cycling infrastructure. We provide an estimation of the investment necessities of EV6 and visualize the quality of the sections on maps below. The categories applied are the same as the ones defined in Section 3.

The EV6 runs through Austria, Slovakia, Hungary, Croatia, Serbia, Romania and Bulgaria along the river Danube. The combined length of the sections is 4112 km, and the investment needed to build good infrastructure along the entire route is 438 million € according to the estimation of the participating partners.

Countries	Length (m)	Necessary investment
Austria	653 723	9 614 727 €
Slovakia	174 053	10 727 405 €
Hungary	507 663	66 624 989 €
Croatia	150 916	19 938 430 €
Serbia	679 268	37 898 997 €
Romania	1 357 808	258 531 192 €
Bulgaria	588 893	35 030 750 €
SUM	**4 112 324**	**438 366 490 €**

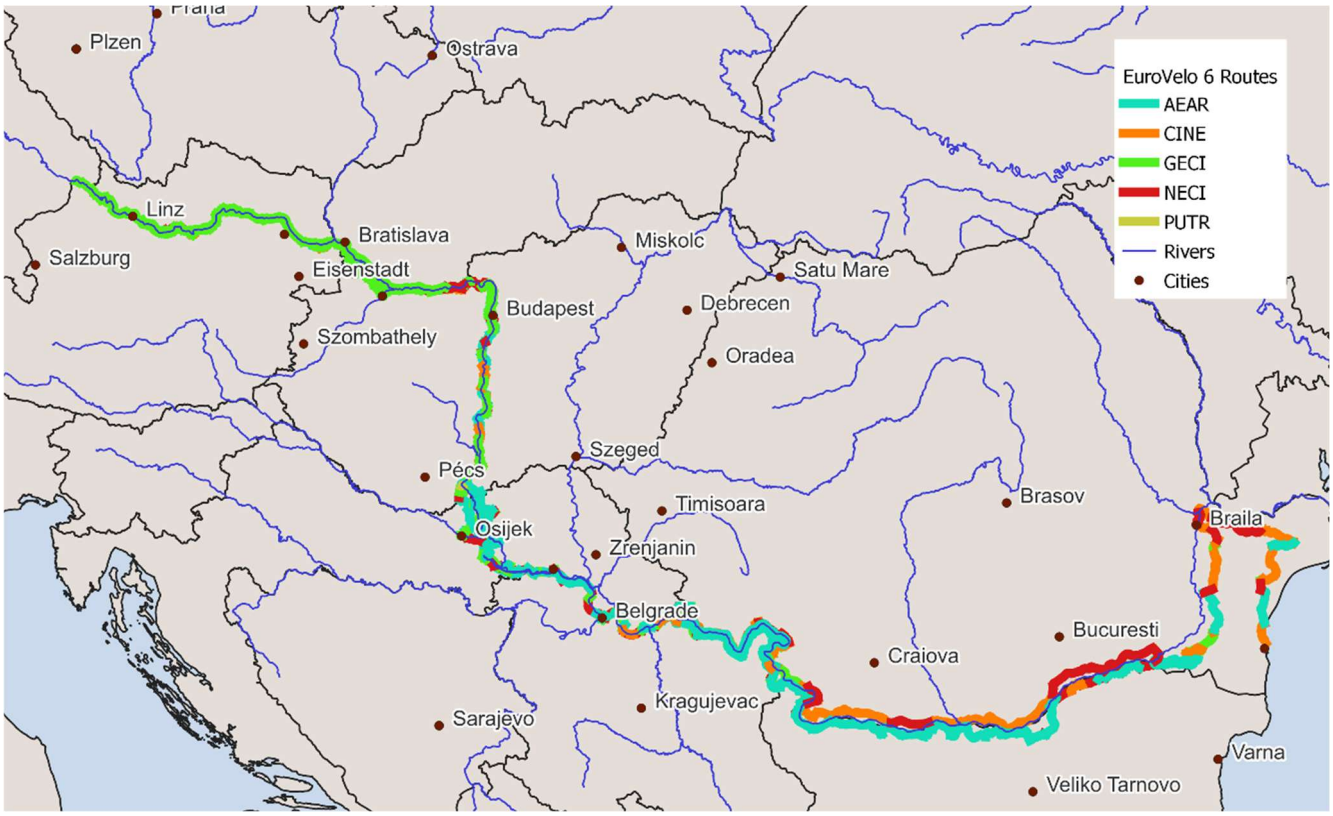
14. Table Length and investment necessity of the EuroVelo 6 cycle route in the Danube region

In the table below, we detail the different classes of infrastructure present in the respective countries along the EV6 route.

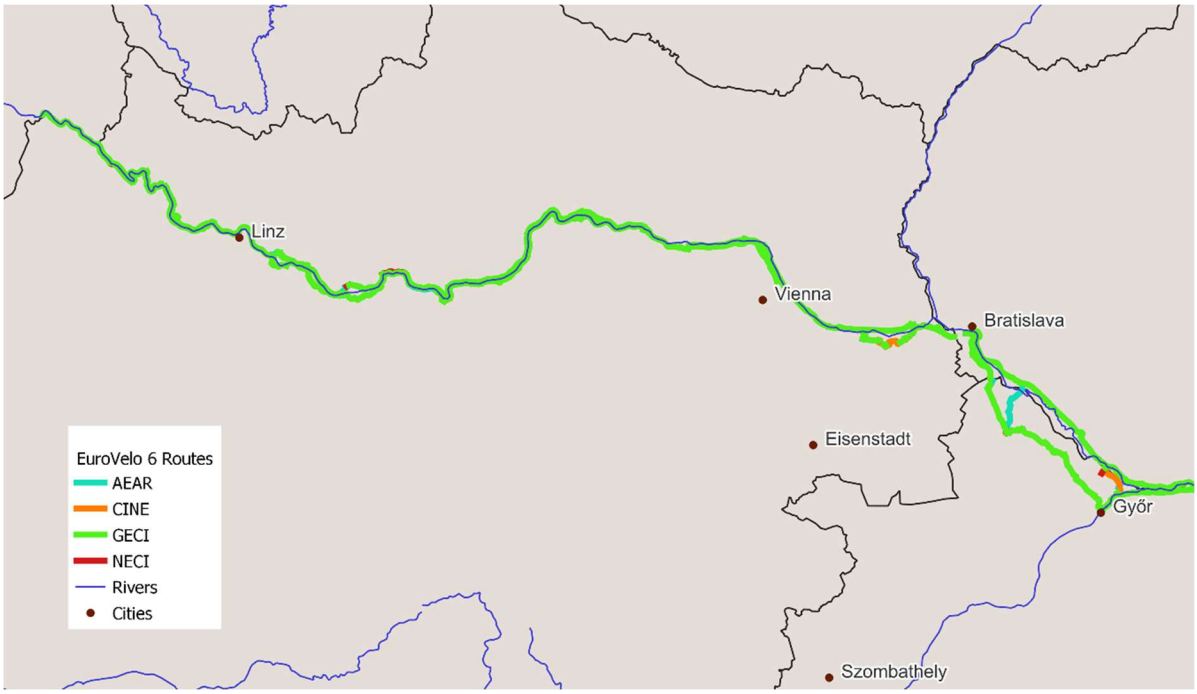
Country	Category	Length	Cost/unit (€)	Unit	Width	Sum
Austria	NECI	10 653	188	m²	3,5	7 009 674 €
Austria	CINE	12 125	150	m	1	1 818 750 €
Austria	AEAR	17 262	10	m	1	172 620 €
Austria	GECI	613 683	1	m	1	613 683 €
Slovakia	NECI	20 861	143	m²	3,5	10 440 931 €
Slovakia	AEAR	1 989	30	m	1	59 670 €
Slovakia	GECI	151 203	1,5	m	1	226 805 €
Hungary	NECI	64 168	192	m²	3,5	43 120 896 €
Hungary	CINE	77 930	282	m	1	21 976 260 €
Hungary	AEAR	166 096	8	m	1	1 328 768 €
Hungary	GECI	199 065	1	m	1	199 065 €
Hungary	PUTR	404	0	0	0	- €
Croatia	NECI	27 562	150	m²	3,5	14 470 050 €
Croatia	AEAR	105 871	50	m	1	5 293 550 €
Croatia	GECI	17 483	10	m	1	174 830 €
Serbia	NECI	150 512	63	m²	3,5	33 187 896 €
Serbia	CINE	10 584	100	m	1	1 058 400 €
Serbia	AEAR	348 281	10	m	1	3 482 810 €
Serbia	GECI	169 891	1	m	1	169 891 €
Romania	NECI	346 678	188	m²	3,5	228 114 124 €
Romania	CINE	644 366	43,5	m	1	28 029 921 €
Romania	AEAR	224 487	10	m	1	2 244 870 €
Romania	GECI	142 277	1	m	1	142 277 €
Bulgaria	NECI	62 630	128	m²	3,5	28 058 240 €
Bulgaria	CINE	42 747	50	m	1	2 137 350 €
Bulgaria	AEAR	483 516	10	m	1	4 835 160 €
Total sum		**4 112 324**				**438 366 490 €**

15. Table Detailed length of categories and investment necessity of the EuroVelo 6 cycle route in the Danube region

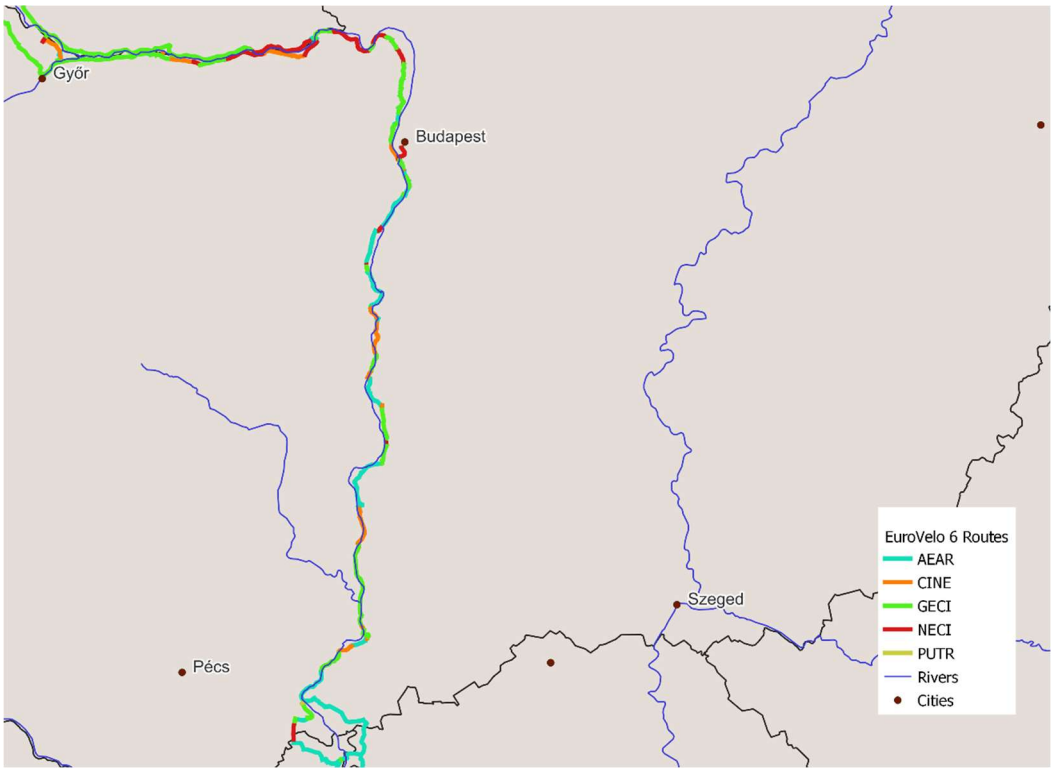
The map below shows that the overview of EV6, presenting the quality of the sections along the route, and below parts of the sections are presented on more detailed maps.



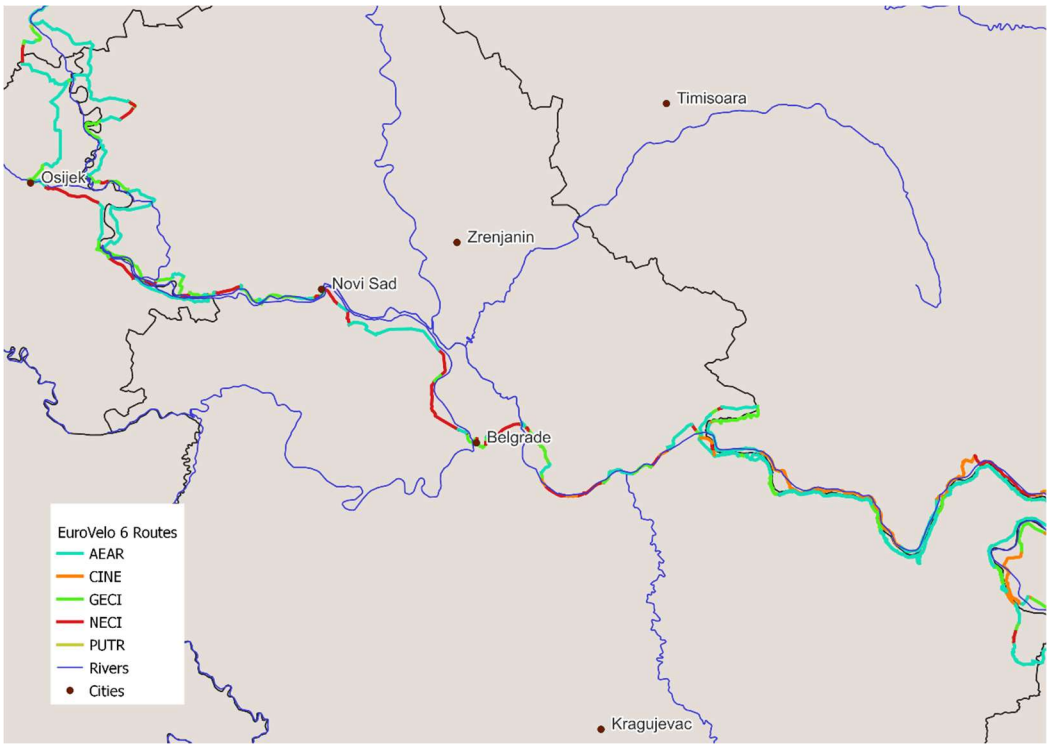
15. Figure Overview of the EuroVelo 6 route in the Danube region



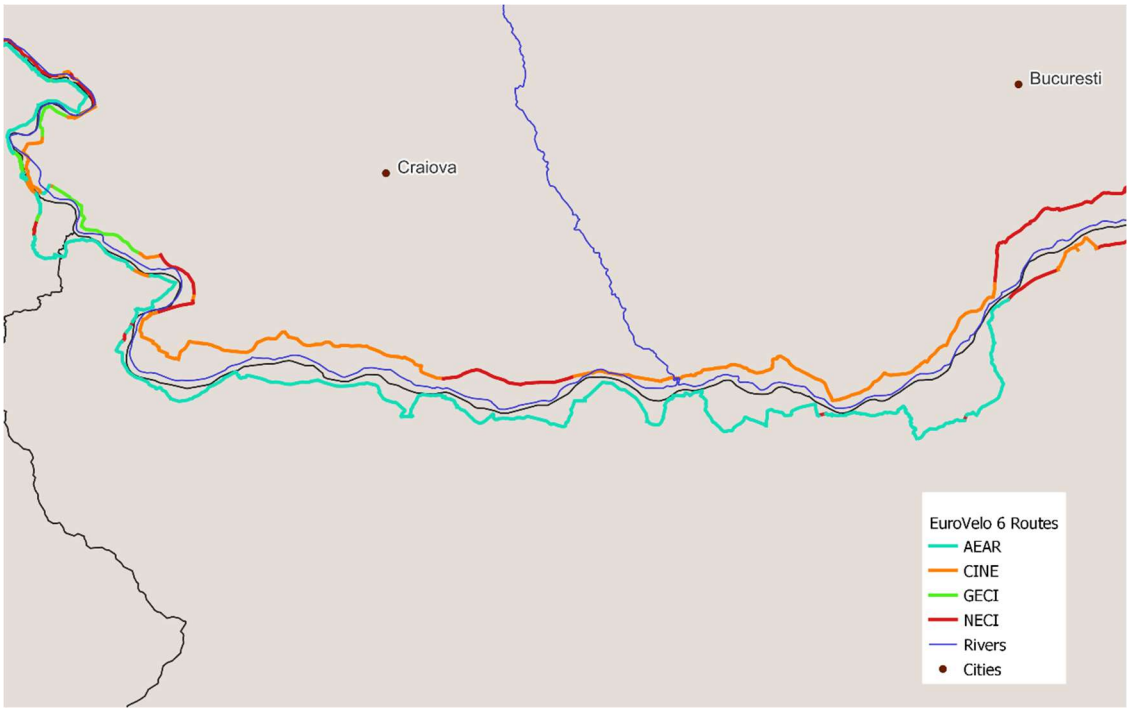
16. Figure Austrian and Slovakian section of EV6



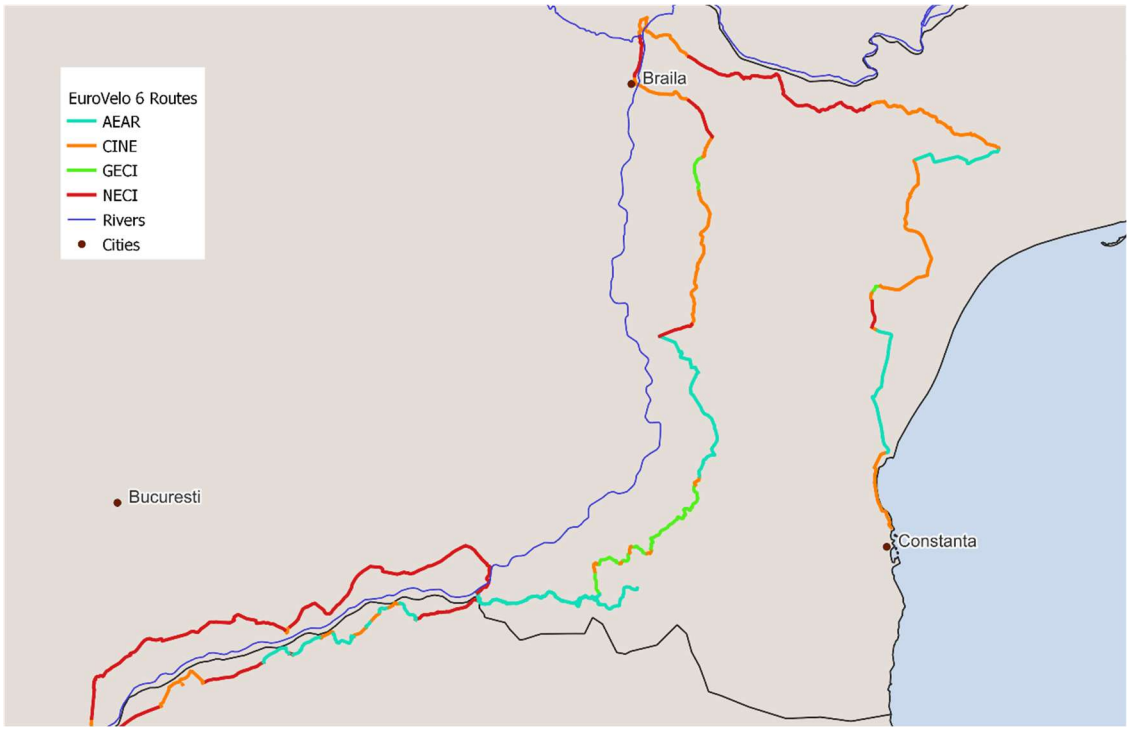
17. Figure Hungarian Section of EV6



18. Figure Serbian and Croatian section of EV6



19. Figure Bulgarian and Romanian section of EV6



20. Figure Romanian Section of EV6

In Section 5 we showcase our proposed cost-benefit analysis method (detailed in Sectin 3.1) on a section of EV6 that is currently underdeveloped, from the Slovakian town of Sturovo to the Hungarian settlement Szob.

5. Application of updated CBA methodology for the Šturovo - Szob EV6 section

5.1. GENERAL METHODOLOGY

As the DCP methodology[1] affects exclusively the economic analysis including its benefit side, only the economic analysis is presented in the cost-benefit analysis; the usual supplementary parts of the examination – financial analysis and sustainability, sensitivity analysis, risk analysis – are not included.

In terms of methodology, the calculation developed in EuroVelo 6 Feasibility Study[2] (EV6 FS) has been modified for the section we selected based on the most current EU and Hungarian CBA guidelines.

The latest EU CBA guide is the Vademecum [3], which defines the economic discount rate at 3% by default if no other value is given based on the national CBA guide, and the residual value of the individual elements of the project during the period examined (30 year) is based on its remaining service life at the end of the year. This was implemented in the latest Hungarian guide in general [4], however, in the case of transport projects the former transport CBA guide[5] is still in effect, while the new Hungarian transport CBA guide is currently under preparation.

In addition, the cycling CBA methodology of the EV6 FS has a high significance as well, as the cycling chapters in the general and traffic CBA guidelines are rather poor.

The economic CBA was evidently also developed using an incremental approach (compares with-the-project scenario with a counterfactual baseline scenario without-the-project) with a new 3% default social discount rate established for the for the 2021-2027 program period and constant prices at 2022 level.

First the methodology and unit values used by the EV6 FS were updated based on the current CBA guidelines, then the assessment of the new section was carried out, and finally the economic CBA had been implemented in the base (using CBA guidelines) and DCP updated versions.

---

[1] Danube Cycle Plans: Updating the CBA methodology to include the economic benefits of cycling, PPP2 HU: KTI Institute for Transport Sciences, D.T2.3.2: Extended CBA Methodology for Transport Infrastructure Projects, Version 1.2

[2] Hegyen-völgyön Konzorcium (Speciálterv Kft. Trenecon Kft., TURA-Terv Kft.) (2014). EuroVelo 6 (Rajka-Budapest, Budapest déli agglomeráció), KÖZOP-5.5.0-09-11-2012-0004 Hivatásforgalmi, hálózatba illeszthető kerékpárutak fejlesztésének előkészítése, Kerékpáros útvonal fejlesztését megalapozó megvalósíthatósági tanulmány, http://mf.index.hu/pol/2013-117_EUROVELO6_MT_MULEIRAS.pdf

[3] Economic Appraisal Vademecum 2021-2027 - General Principles and Sector Applications (Vademecum 2021-2027) https://ec.europa.eu/regional_policy/en/information/publications/guides/2021/economic-appraisal-vademecum-2021-2027-general-principles-and-sector-applications

[4] Trenecon Kft. (2022). Útmutató a projektek közgazdasági és pénzügyi értékeléséhez 2021-2027

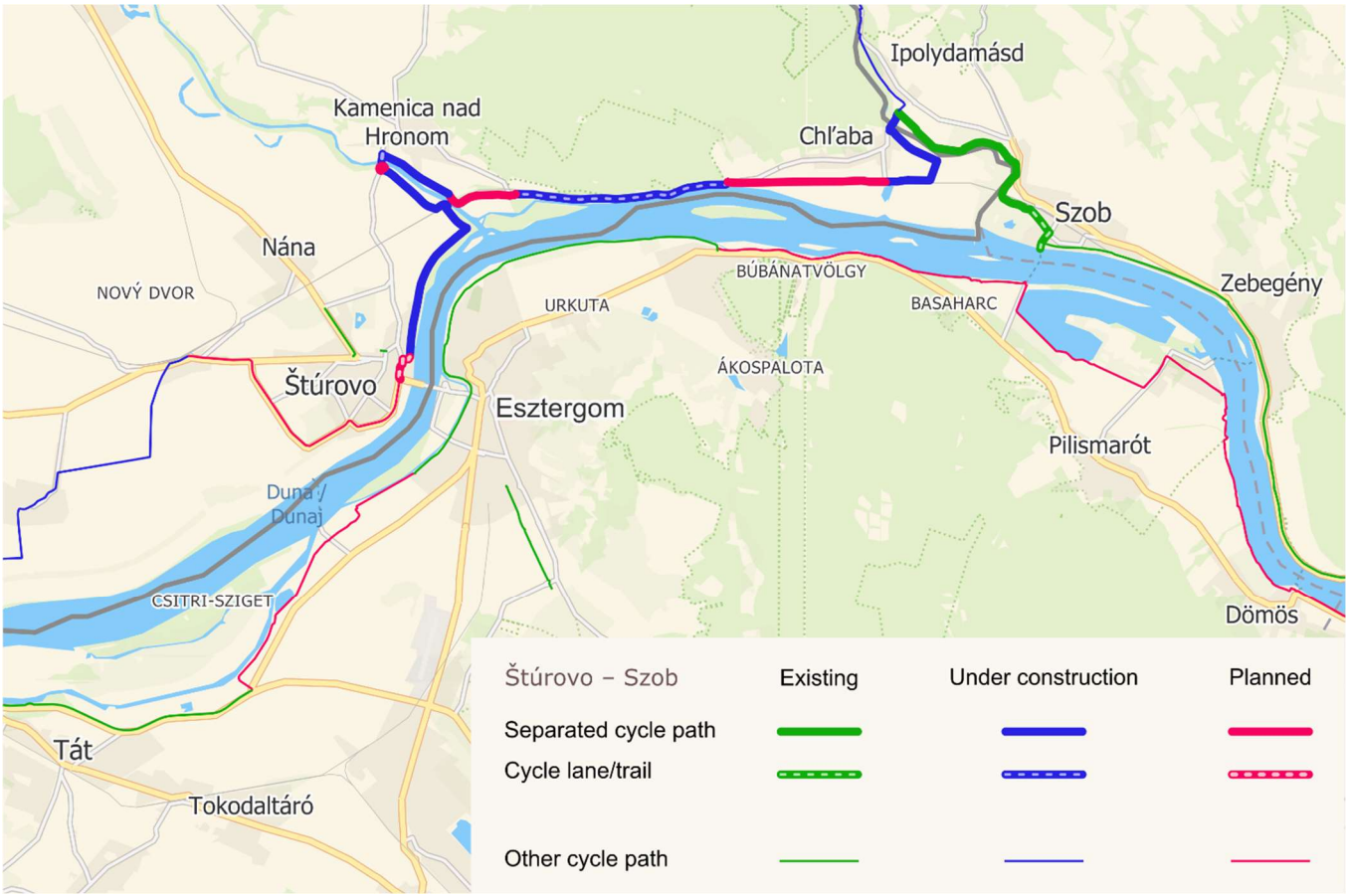
[5] Trenecon Kft. (2018): Módszertani útmutató egyes közlekedési projektek költség-haszon elemzéséhez, Trenecon Kft., https://www.palyazat.gov.hu/download.php?objectId=1084055

Calculations were made using Hungarian Forint (HUF) currency, and then converted into EUR using 420 HUF/EUR exchange rate.

5.2. THE EV6 CYCLE ROAD PROJECT

A section was selected for the analysis which, as a cross-border section, is part of the EuroVelo 6 bicycle corridor and the infrastructure has not yet been developed, but progress is expected in the near future. Our choice fell on the Štúrovo (Slovakia) - Szob (Hungary) section, which is 20 km long. Currently, this is the only section that is not part of the bicycle corridor on the left bank of the Danube at the border of the two countries, but the reason of it is the lack of infrastructure, after its construction this section is certainly expected to become part of EuroVelo 6 corridor.

The following map shows the route of the new bicycle path between Štúrovo and Szob:



21. Figure *Štúrovo – Szob cycle path*

During the exercise the projects which have been recently completed or under construction were involved in the studied section and three phases were identified.

In the first phase, the cycle path between Ipolydamásd and Szob was realized, which was completed in June 2021.

In the second phase, the construction of the Ipeľ/Ipoly border bridge between Chľaba and Ipolydamásd, which also includes a separated cycle path on its southern side, is identified as ongoing, and it may be completed at the beginning of 2023. In the meantime, the construction of the cycle path is also in progress at Štúrovo on embankments of the Danube, on both sides along the Hron, as well as at Chľaba on the north side of the railway next to the Danube and finally along the Ipeľ/Ipoly. The works began in the fall of 2022 and are expected to be completed by March 2023. Routes are marked (with cycle trail or advisory cycle lane) on the intermediate road sections.

In the third phase, which we have projected, the construction of the bicycle path next to the Štúrovo – Szob railway is taking place near Chľaba, thus the bicycle path under construction in phase 2 near the mouth of Ipeľ/Ipoly will actually become a operational part of the EV6, as well as other minor gaps are also finalized. According to current predictions, the third phase can be completed by the beginning of 2026.

At the end of the project, with the exception of the 3.4 km road section next to the Burda Mountains and smaller inland sections, the distance of nearly 20 km section can be covered with a separated cycle path, while on the mentioned narrow public roads cyclists can use a cycle trail or an advisory cycle lane on the public roads together with cars with traffic mitigation and a reduced speed limit.

5.3. ECONOMIC COSTS

5.3.1. Investment, maintenance and operation costs

The investment, maintenance and operation unit cost data of the EV6 FS were updated with the Hungarian construction industry inflation (2014-2022 index: 202.3%).

The total investment costs of the sections to be completed at the beginning of 2021/2023/2026 were simplified and assigned to the end of the previous years, with the fact that in the case of the sections completed in 2021, the related benefits were not taken into account until 2022, since the impact of the absence of an the Ipeľ / Ipoly bridge.

The residual value was calculated in a simplified manner based on the timespan of the 20-year renewal period.

5.4. ECONOMIC BENEFITS

5.4.1. Travel time

The determination and indexing of the unit travel time values were determined based on the transport CBA guide (Trenecon, 2018), which, however, only gives the same unit time value as the one for the buses in case of transportation purpose. The tourist unit time value was matched to the unit time value of other trips by passenger cars, which was modified and multiplied by 1.4 times this based on the DCP CBA (2022). In the case of a separated cycle path, the greater value of bicycle travel time than that of a passenger car is justified by the increase in perceived safety. (For the sake of simplicity, we considered the final state of the section as a separated cycle path throughout.) In another approach, the perceived safety is equivalent to 30% of the increased travel time value, which is roughly the same as the additional travel time value of cycling.

The 2017 unit time values taken from the CBA guide were updated with inflation and GDP growth, and based on Vademecum's guidance, GDP growth was adjusted with an elasticity of 0.8 in the case of business trips, and 0.7 in other cases.

With regard to traffic data, the starting traffic for transport purposes (2022) was determined to be twice the traffic measured in the Danube Bend in 2014 (EV6 FS, 2014) (an average of 10 cyclists/day at any point of the section), and the tourist traffic is approximately the same considering that this is an area with less frequent traffic, which is compensated by the dynamic increase in traffic over time (400 cyclists/day).

The annual multiplier related to the traffic reference daily traffic (190 days/year) also comes from the EV6 FS, while the related daily distance is the length of the examined section (19.9 km). This study considers the FS's calculation, in which it calculates the average daily distance (5.9 or in the case of tourist cyclists: 50 km/person/day as a unit value) when calculating the total traffic, to be wrong, as it only gives the total performance made by cyclists appearing at one point of the network and not the performance of the entire section.

The annual multiplier (70 days/year) related to the tourist reference daily traffic (average summer weekend traffic) was determined based on the data available online from the bicycle traffic counters of the VeloClass[6] national road network. At the time of the EV6 FS, such data were not yet available, 38 days/year were determined based on the (annual) daily peak of bicycle traffic of Balaton ferries.

The total travel time was determined based on the length of the examined section and the average speed value (traffic: 15 km/h, tourist: 20 km/h) used by the EV6 FS. The travel time saving was determined at 5% for the whole project section.

[6] VeloClass https://veloclass.kozut.hu

As a starting point, cyclists had two options to go along this section before this project and the new Ipeľ / Ipoly road bridge:

1. The distance is 17 km through the sidewalk of the Ipeľ / Ipoly rail bridge (on the north side) and on the Slovakian side, using mainly unpaved roads.
2. In the direction of the nearest road bridge of Ipeľ / Ipoly between Salka (Ipolyszalka) and Letkés, the entire Štúrovo – Szob section is 24.7 km (along public roads).

As an alternative for the route described above, the 19.9 km long asphalted cycle path will be a new option, which at the end of the project will 'only' have a cycle trail of about 4 km, while the other sections will boast a separated cycle path, and for about 1.5 km it is foreseen to run on a common track of public roads with little traffic. Better journey times can be obtained with the project due to more route choices, the paving of the unpaved roads and the designation of the cycle trail or advisory cycle lanes.

In the case of new users – in the absence of a base travel time – the travel time saving was determined at half the value of the existing users based on the CBA guidelines.

In two sections – 3 km long in front of Burda Mountains and on the Hron Bridge – road traffic slows down significantly, but this is due to the traffic generated by the new Ipeľ / Ipoly road bridge. Here, regardless of the construction of the cycling infrastructure, speed limits (60 and 50 km/h) must be introduced in the extremely narrow intersections, where until now this was not necessary because of the low traffic.

5.4.2. Accidents

The relative injury units of roads for 2017 were adopted from the CBA guide (Trenecon, 2018), with the difference that only local roads were taken into account (while other types of the roads are not affected in the project), so the unit values became somewhat higher than the national average.

The 2017 unit accident costs of the CBA guide (Trenecon, 2018) have been updated with an increase in inflation and 0.8 elasticity-corrected GDP (2017-2022 overall index: 148.34%).

The CBA guide (2018) suggests 30% lower accident risk in the case of the construction of a separated cycle path, and a 5% improvement in the case of cycle lanes outside the settlements - unfortunately, the latter is counterweighted by the significantly increased road traffic). Taking into account all of these factors it is a 5% improvement from the beginning of phase 2 of the investment and a 10% improvement from the completion of the entire investment compared to the risk of accident before the project.

5.4.3. Environmental effects and climate change

The unit value of 0,083 € per vkm calculated for 2020 of the EV6 FS was updated (also with inflation and 0.8 elasticity-corrected GDP increase); the amount in 2022 is 0,108 € per vkm.

However, according to FS, only new passengers for transport purposes were taken into account, since there is no change in the case of existing passengers, neither in the case of those arriving for tourism purposes, who are coming over from elsewhere.

5.4.4. Vehicle operating costs

Based on the simplified calculation, the benefits calculated by the EV6 FS were proportional to the section length involved in the study, and the unit values were updated (inflation x GDP growth x 1.0 elasticity).

5.4.5. Health effects

The European Commission's CBA guidelines (2014, 2021) and the transport external cost guide[7] did not mention the beneficial physiological effects of cycling.

However, the EV6 FS has already determined such a value at the 2020 price of 0,019 €/km, referring to the Vancouver TransLink Public Bike System Feasibility Study [8], which is based on an even earlier study[9] that established the positive health effect of cycling of 0.1 CAD/km. From 2015, the EV6 FS consortium member Trenecon already included this reference as 0.1 USD per km (at 2008 prices) in the transport CBA guide they authored.

The current Hungarian transport CBA guide (Trenecon, 2018) also determines the health benefits of cycling at 0.1 USD per km (2008 prices); this was updated (USD inflation x US GDP growth x 0.8 elasticity with current exchange rate) to approx. 0,155 € per km in 2022.

Calculated with the amount of 0,155 € per km (2020) according to the EV6 FS, the health impact would be 343 thousand €, and based on the updated amount (0,155 € per km, 2022 prices) of the Hungarian CBA guide (Trenecon, 2018) the net present value (2022) of the impact is 2 557 million €. Although we appreciate this progressive handling of cycling by the Hungarian transport CBA guide, since neither the EU nor the regional CBA guidelines (such as the Slovak one) contain such an item, there is not any unit cost of health effects of cycling determined in the present base CBA version.

Using the HEAT[10] methodology and online interface[11], the DCP CBA method (KTI, 2022) suggests an average 9.7% reduction in mortality in the 20-64 age group, which can be achieved by 100 minutes of cycling per week, that equals to (with an average cycling speed of 15 km/h) a performance of 25 km per week (1300 km per year). Compared to the base scenario, the change is the mileage of new users. We assume that all this performance is regular (and not just occasional) in this section, so it contributes to the health effects. We also assume that approx.

---

[7] van Essen, H. et al. (2020). Handbook on the external costs of transport Version 2019 – 1.1, European Commission, Luxembourg, 2020 https://op.europa.eu/en/publication-detail/-/publication/9781f65f-8448-11ea-bf12-01aa75ed71a1/language-en

[8] Quay Communications Inc. (2008). TransLink Public Bike System Feasibility Study. https://docplayer.net/59852320-Translink-public-bike-system-feasibility-study.html

[9] Litman, T. (2004). Quantifying the Benefits of Nonmotorized Transportation for Achieving Mobility Management Objectives, Victoria Transport Policy Institute, Victoria, Canada

[10] WHO (2017). Health economic assessment tool (HEAT) for walking and for cycling: Methods and user guide on physical activity, air pollution, injuries and carbon impact assessments https://www.who.int/publications/i/item/health-economic-assessment-tool-(heat)-for-walking-and-for-cycling

11 Health economic assessment tool (HEAT) v5.0 https://www.heatwalkingcycling.org

83% of the new users may belong to the age group between 20 and 64. The mortality of this age group in Hungary is 434 people/100,000 people/year, i.e. 0.434%/year. 9.7% of this, i.e. 0.0421% of the value of statistical life (VSL), is the annual health benefit of cycling for every 1300 km of performance related to this section. In the case of Hungary, the HEAT methodology (WHO, 2017) sets the value of VSL at 979 thousand € (in 2017 prices). Based on the amount of 576 thousand € established for the same year by the CBA guide (Trenecon, 2018), we set the starting value at 855 thousand € for the year 2022. This value increases by 80% every year at the expected GDP growth rate (in 2051: 1 368 thousand €). In thirty years, the cycle path will bring a total of 5.53 VSL health benefits (0.23 VSL/year from 2031), which adds up to 6 462 thousand € over 30 years, and it represents a benefit of 3 781 thousand € at 2022 present value. That amount is slightly more than the present value of the discounted value of the initial investment cost or the total cost side.

5.4.6. Tourism effects

In contrary to the previous ones, the more recent CBA guidelines do not allow the consideration of broader economic effects, since the positive effect on a narrower economic segment draws demand away from other areas.

5.4.7. Other effects

Additional effects were not taken into account or quantified during the calculation. It is important to mention that the DCP CBA (KTI, 2022) would take into account additional benefits based on the freed public space owing to the change of mode and the reduction of car parking, but all of this applies primarily to cycling for transportation purposes and in urban environments. Due to the low traffic activity, including the lack of performance within the settlement, as well as the rural character of the region, this effect is negligible, and the tourism which determines the economic indicators of the examined section also includes significant road and parking activities (vehicle transport, accompanying staff of tourist cyclists).

5.5. THE RESULT OF THE ECONOMIC COST-BENEFIT ANALYSIS, ECONOMIC PERFORMANCE

As a result, the net present value of the overall costs and benefits is the following.

Economic costs and benefits (EUR)	CBA Base	DCP CBA
Investment	3 462 369 €	3 462 369 €
Operation	194 829 €	194 829 €
Maintenance	78 021 €	78 021 €
Replacement costs	642 657 €	642 657 €
Residual value (-)	827 029 €	827 029 €
Costs	**3 550 848 €**	**3 550 848 €**
Travel time	567 526 €	749 412 €
Accidents	57 552 €	57 552 €
Environmental effects	161 364 €	161 364 €
Vehicle operating costs	383 514 €	383 514 €
Health effects	- €	3 781 398 €
Benefits	1 169 957 €	1 169 957 €
Benefit-cost difference (economic net present value)	- 2 380 893 €	1 582 390 €

16. Table Net present value of economic costs and benefits of the base CBA version and the DCP updated methodology (EUR)

As a result, the economic indicators of the project in the two versions are as follows.

Economic indicators		**CBA Base**	**DCP CBA**
Benefit-cost ratio	BCR	0,33	1,45
Economic net present value (EUR)	EPV	-2 380 893 €	1 582 390 €
Economic rate of return	ERR	-1,58%	5,37%

17. Table Economic indicators of the project in the base and DCP updated CBA methodology

It is profoundly demonstrated how important the quantification of the positive effects and benefits of cycling is in terms of the project's social utility indicators. We propose these benefits (especially health benefits and perceived safety as an additional value of travel time) to be included in the CBA guide of the European Commission.

6. Recommendations

This Danube Cycling Infrastructure Investment Plan is a summary of distinct activities related to infrastructure development in the Danube Cycle Plans project, namely (1) the definition of common infrastructure standards particularly for countries where these are not yet included in policy, regulation and planning practices; (2) the joint training of experts in route inspection and action planning to have at least one certified person per country in this field, (3) a presentation of the update of current cost-benefit analysis guidelines to cover cycling-specific benefits, (4) the definition of the Danube Cycle Route Network (DanuVelo) including EuroVelo routes and key elements of the national networks with long-distance and/or regional significance, as well as cross-border connections, (5) an estimation of the investment necessities of the DanuVelo network and especially EuroVelo sections in the Danube region to make them attractive to cycling, (6) the application of the extended CBA guidelines on a cross-border EuroVelo 6 section. From these complex outcomes, several recommendations have been listed in their respective reports. Here, concluding remarks and general recommendations of the Investment Plan are provided.

To make more people cycling in the Danube region (or elsewhere), investing into cycling infrastructure is one of the key factors: people need good quality, well signalized and well maintained, safe and secure cycling infrastructure, adequate for use by a wide range of groups (incl. children, elderly, etc., depending on the geographical context and type of route) and connected to other mobility services or options. Therefore the first and foremost recommendation to decision-makers is to **invest into cycling and particularly into cycling infrastructure.**

How to extend and improve current routes was traditionally addressed by countries individually and, more recently, by the use of European funds, as well. Although the Danube macroregion integrates countries of many similarities, they form a colourful mix of geographical and sociocultural contexts, and they apply different approaches in the strategic planning of mobility and transport. Their individual approaches have led to diverse solutions in terms of planning concepts, route standards, maintenance and signalization practices, traffic rules, etc. related to cycling infrastructure, thus their current status in cycling infrastructure development is varied. The next recommendation addresses this variety: decision-makers on European, national, regional and local level are invited to **promote cycling** in the spirit of the major European documents, particularly the Pan-European Master Plan for Cycling Promotion adopted by 46 ministers at the 5th High Level Conference of the Transport, Health and Environment Pan-European Programme (THE PEP) in Vienna 2021 and the Danube Cycling Strategy (by the Danube Cycle Plans project), taking into account the mixture of contexts and necessities of the concerned countries and to **find the right principles and proper instruments to carry out a balanced development of cycling infrastructure** throughout the Danube macroregion.

This variety has been presented in this document: experts of the nine countries not only defined their plans for a national cycle route network and the outcomes of their negotiations to link major national routes to neighbouring countries' routes through cross-border connections, but also defined the investment necessities for their entire network. Results indicate that the above mentioned diversity in planning principles is fairly reflected by the current and desired networks, i.e. the density and type of routes that are recommended to be developed require different construction or adaptation projects and, consequently, suppose different financial means and budget. Decision-makers on both European and national level are recommended to **promote the realization of the proposed DanuVelo cycle route network**, primarily by **dedicating money from all potential funds (direct funding in the framework of multiannual programmes, loans, etc.) to finance cycling infrastructure investment projects**. On

the other hand, governments on national, regional or local level shall **access funds on international level** to generate budgets for their infrastructure projects, including CEF, Recovery and Resilience Plans and other potential funds. Application for such funds may require investors to meet strict conditions set by international financial institutions.

Countries are expected to **set up national funding schemes** to support regional and local authorities in their endeavour to promote cycling by infrastructure construction or improvement. This shall be based on a complex approach and inclusion of all relevant stakeholders, taking into account all international financial sources (RRP, CEF, Interreg, EIB, etc.), some of them translated into national operational programmes addressing cycling related projects directly or indirectly.

The **elaboration of national cycling investment plans** may ensure that the implementation of cycling strategies are related to thoroughly considered steps, schedules, budgets, financing schemes and programme or project monitoring systems in the frame of a well-structured, transparent and trustful presentation of how development projects will be realized in a country. On the basis of the present Danube Cycling Infrastructure Investment Plan, ministries (in the field of transport, tourism or other, responsible for cycling) are recommended to draft these plans in accordance with European and national policies, preferably applying a collaborative approach.

When calculating budgets and planning projects, it is also recommended to **apply the updated Cost-Benefit Analysis methods**. Although in the 2021–2027 programming period CBA is not the only way to calculate the feasibility of plans, its complex approach makes it a proper tool to understand financial metrics of a project. As part of the Danube Cycle Plans project, an extension to this methodology has been elaborated, considering at least a part of the wide range of the benefits of cycling. As seen above, the health related benefits are alone significant enough and may change decisions about a plan, therefore it is crucial to include them in future estimations. It is expected that decision-makers on both European and national level acknowledge this useful amendment to the traditional CBA techniques and lobby for or take steps towards its application in European and national guidelines.

Other achievements in the Danube Cycle Plans project, such as the creation of a common set of infrastructure standards or the training of EuroVelo route inspectors are indirect but essential elements of proper infrastructure development in the macroregion. If countries make good use of these assets and tools, and **harmonize efforts beyond the timeframe of the project** (e.g. maintain an international working group of ministerial representatives for future cooperation within THE PEP), the Danube region may become an example of cycling promotion, a good place to cycle for local people and an attractive destination for tourists.

Indeed, this plan could not cover everything related to cycling investments in the Danube region. For instance, local (urban) networks have not been addressed, as these are constructed and maintained by local governments (beyond the scope of ministries working together in the Danube Cycle Plans project). However, the development of cycle routes between urban areas are crucial for their traffic and may pave the way for developments in cities and towns. Tourism and its specific infrastructure also falls out of the scope of this plan but it is worth mentioning that tourism related developments are intrinsic elements of cycling promotion and therefore needs thorough consideration, e.g. in another plan or project.