

## **Green infrastructure in Central, Eastern, and South-Eastern Europe:**

### **Is there a universal solution to environmental and spatial challenges?**

## **PROGRAM AND BOOK OF ABSTRACTS**

Network conference of Spa-ce.net  
Ljubljana (Slovenia), September 27–29, 2015

Green infrastructure in Central, Eastern, and South-Eastern Europe:  
Is there a universal solution to environmental and spatial challenges?  
Network conference of Spa-ce.net  
September 27–29, 2015  
Ljubljana (Slovenia)

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# Welcome

Dear participants,

Green infrastructure, also referred to as “green systems,” is an important spatial component of urban areas. The traditional focus on parks and their function as open spaces and recreational areas for urban populations has now broadened to encompass a wide variety of concepts and roles. Today, green infrastructure is viewed as a solution to the challenges facing urban areas, such as traffic overload, air pollution, noise, social exclusion, and the negative impacts of climate change. Over the past few years, policymakers and many other stakeholders have come to recognize the vital role green infrastructure plays, not just in improving the quality of life, but also in safeguarding public health.

Countries in Central, Eastern, and South-Eastern Europe have developed diverse concepts of green infrastructure, as well as approaches and strategies for planning and developing green systems at the local and regional levels. The aim of the 2015 Spa ce.net conference is to present, compare, and discuss these approaches and strategies, to learn from them and to find common points and shared guidelines for the future development and management of green infrastructure, in sustainable cities and regions. Any conclusions can enhance decision-making at various levels from project design and spatial planning to policymaking. The theme of the conference closely reflects the aim of the initiative “European Green Capital,” a title which Ljubljana – the host city of the Spa-ce.net conference – will hold in 2016.

Ljubljana adopted a sustainable development vision for 2025 to further improve the environment and quality of life. In light of this vision, a package of sustainability documents has been adopted, e.g., a new sustainability mobile plan (SMP). It contains 20 projects, of which four – the banks of the river Sava, urban gardens, urban parks / open spaces, and four landscape parks – are directly related to green infrastructure. Moreover, the following topics are dealt with: climate change, green urban areas incorporating sustainable land, nature and biodiversity. The successful implementation of the plan is highly dependent on efficient planning and examples of best practices.

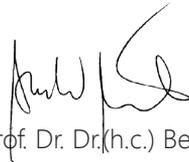
Therefore, the 2015 spa-ce.net conference is an important contribution both to practice and research in Slovenia and the wider region. Abstracts collected in this book encompass three major topics: governance, climate change and health. (1) Under the governance topic, strategic approaches regarding the integration of green infrastructure into spatial planning are presented.

(2) Within the framework of the climate change topic, green infrastructure is discussed as a mitigating measure and presents innovative solutions such as green walls or approaches to estimate the value of trees in the urban landscape. (3) The third section focuses on the research results that investigate the role of green areas for public health. All in all, experiences from nine Central, Eastern and South-Eastern European countries are discussed. These form a sound basis for a fruitful cooperation between the concerned stakeholders and the participants of the conference.

To conclude, the joint organizing team of the University of Ljubljana and IOER is delighted to welcome you to Ljubljana and invites you to enjoy this year's spa-ce.net conference.



Prof. Dr. Davorin Gazvoda (Dean)



Prof. Dr. Dr.(h.c.) Bernhard Müller (Director)



Assist. Prof. Dr. Naja Marot



Dr. Andreas Ortner

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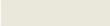
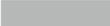
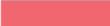
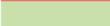
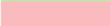
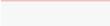
Leibniz Institute of Ecological Urban  
and Regional Development (IOER),  
Germany

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# Program overview

Time	September 27th Sunday	September 28th Monday	September 29th Tuesday	
9:00	Arrival	Opening of the conference - Session A1	Session A4	
9:30				
10:00				
10:30		Coffee break	Coffee break	
11:00		Session B	Session A5	
11:30				
12:00				
12:30		Lunch	Lunch	
13:00				
13:30		Session A2	Session C1	Official meeting of the spa-ce.net network
14:00				
14:30				
15:00		Coffee break		
15:30		Session A3	Session C2	
16:00				
16:30				
17:00				
17:30				
18:00		Sightseeing in Ljubljana city centre	Departure	
18:30				
19:00				
19:30				
20:00	Welcome drink at As Aperitivo	Conference dinner at Gostilna na gradu		
20:30				
21:00				
21:30				

	Social programme
	Official spa-ce.net meeting
	Governance
	Climate change
	Health
	Coffe breaks&lunches

## Detailed program

### SUNDAY, SEPTEMBER 27<sup>th</sup>, 2015

Arrival of the participants and **Welcome Reception**, As Aperitivo in the center of Ljubljana, 7:00 pm

### MONDAY, SEPTEMBER 28<sup>th</sup>, 2015

#### Opening of the conference

**A1** 9:00 am – 10:30 am, room D1  
Chair: Naja Marot

Welcome by the Dean of the Biotechnical Faculty, Prof. Dr. Davorin Gazvoda  
Welcome by the Director of IOER Prof. Dr. Dr.(h.c.) Bernhard Müller

- Short introduction to Slovenian strategic spatial planning – Blanka Bartol
- The importance of a comprehensive planning approach to green infrastructure – Ina Šuklje Erjavec
- Planning green infrastructure as a source of urban and regional resilience – Paulina Schiappacasse, Bernhard Müller

*Coffee break, 10:30 am – 11:00 am, lobby in front of D1*

#### Green infrastructure and health

**B** 11:00 am – 12:30 pm, room D1  
Chair: Artem Korzhenevych

- Spatial factors as opportunity or risk for the quality of life of urban inhabitants – Katarina Ana Lestan, Ivan Eržen, Mojca Golobič
- Green infrastructure as an important factor in human wellness conditions for inhabitants of urban areas – Marek Degórski
- Social behavior as a basis for the design and development of green infrastructure – Barbara Goličnik Marušić
- Green networks of pedestrian-bicycle paths in Novi Sad – Ksenija Hiel, Jelena Čukanović, Aleksandar Kurjakov, Ana Gačić, Emina Mladenović, Mirjana Sekulić

*Lunch break, 12:30 pm – 1:30 pm, lobby in front of D1*

## Green infrastructure and policy

**A2** 1:30 pm – 3:00 pm, room D1  
Chair: Robert Knippschild

- The historical background of green infrastructure, its establishment as a concept, and its implementation in the German landscape planning system – Igor Fernando Marques de Almeida, Liubov Shirotova, Catalina Vieira Mejia
- Green infrastructure in Serbia: Towards efficient policies in the fields of environment and planning – Ana Perić
- The impact of local transportation systems on green infrastructure – Policy versus reality. The case of Poznan, Poland – Jędrzej Gadziński
- Improving quality of life by planning the coastline of Novi Sad – Dijana Brkljač, Jovan Đerić, Aleksandra Milinković, Ksenija Hiel
- Green infrastructure: Governance, planning, provision – Milena Tasheva-Petrova

## Climate change – Policy aspects

**C1** 1:30 pm – 3:00 pm, room Ž2 (first floor in the connecting building)  
Chair: Bernhard Müller

- Implementation of green infrastructure principles in Croatian coastal towns as a tool for minimizing climate change problems – Ines Hrdalo
- Urban green spaces – Demands, opportunities, and planning approaches for urban climate adaptation – Stefanie Rößler, Juliane Mathey
- The role of green infrastructure in settlements and cities – Tjaša Griessler Bulc, Iztok Ameršek, Mateja Dovjak
- Renewable energy as “green infrastructure” – Slogan, interest, or integrated policy? – Viktor Varjú

*Coffee break, 3:00 pm – 3:30 pm, lobby in front of D1*

## Green infrastructure: Urban agriculture and conservation

**A3** 3:30 pm – 5:00 pm, room D1  
Chair: Milena Tasheva-Petrova

- Overview of allotment garden development and spatial policies in Latvia’s cities and towns – Kristine Abolina
- Allotment gardens and “Wochenendhaus” zones: Green infrastructure versus affordable housing – Maja Lorbek, Milena Martinsen
- Urban-rural exchange in aging and shrinking communities of Japan, and its transferability to Bulgarian planning practices – Maya Miteva
- Multifunctional green systems for landscape improvement – Igor Kyselka

## Climate change and water

C2

3:30 pm – 5:00 pm, room Ž2 (first floor in the connecting building)

Chair: Viktor Varjú

- **Can urban trees reduce the impact of climate change on storm runoff?** – Katarina Zabret, Mojca Šraj
- **Future possibilities of green walls in a medium-sized Hungarian town – A case study of Kecskemét** – András Donát Kovács, Edit Hojk
- **Analytical tools for determining the effects of location and size of urban green spaces and water bodies on the microclimate and quality of life** – Iris Lehmann, Clemens Deilmann
- **Green infrastructure for sustainable water management case study: Flood reservoir Podutik** – Tjaša Griessler Bulc, Darja Istenič, Matej Uršič, Aleksandra Krivograd Klemenčič

**Walk around Ljubljana**, starts 6:00 pm in front of the City Hotel

**Conference dinner at Gostilna na Gradu**, from 7:30 pm on

**TUESDAY, SEPTEMBER 29<sup>th</sup>, 2015**

### **Green infrastructure, sustainability, and cities**

**A4** 9:00 am – 10:30 am, room D1  
Chair: Maros Finka

- **Green infrastructure and urban resilience planning in Central Europe: A solution for environmental and spatial challenges in the inner-city areas of Ljubljana, Slovenia** – Nataša Pichler-Milanovič, Mojca Foški
- **Green areas, sustainability, and improved quality of life in Novi Sad, Serbia** – Ana Lakić, Ksenija Hiel, Emina Mladenović, Jelena Čukanović, Aleksandar Kurjakov
- **Green infrastructure in the city of Belgrade** – Dejan Filipović, Velimir Šećerov
- **Public open space and urban development in ten Slovenian cities** – Petra Vertelj Nared, Alma Zavodnik Lamovšek

*Coffee break, 10:30 am – 11:00 am, lobby in front of D1*

### **Green infrastructure: Perception and participation**

**A5** 11:00 am – 12:30 pm, room D1  
Chair: Mojca Golobič

- **Green infrastructure in the urban process: Opportunities for a new planning culture** – Elena Dimitrova
- **Participatory governance of urban green spaces** – Rozalija Cvejić
- **Urban green infrastructure as a common good** – Maros Finka, Lubomir Jamecny, Vladimir Ondrejicka, Matej Jasso
- **Urban green infrastructure – Planning matters, and collaborative management can help** – Maja Simoneti

*Lunch break, 12:30 pm – 1:30 pm, lobby in front of D1*

### **Spa-ce.net network meeting**

1:30 pm – 2:30 pm, room D1

## How to reach the welcome reception location



Location: **As Aperitivo**, Čopova ulica 5, 1000 Ljubljana

Time: Sunday, September 27<sup>th</sup>, at 7:00 pm

The restaurant is located in the city center near the "Three Bridges." It is accessible from two directions: from Slovenska Street near the Pošta bus stop and from Wolfova Street, enter through the narrow passage called Knafjjev prehod. The restaurant is not reachable from Čopova Street. If you enter from Slovenska Street, the restaurant will be on your left; from Wolfova Street, the restaurant will be on the right side.

Welcome reception will be held in the open area of the restaurant, after you enter on the right side of the bar. Drinks will be accompanied by a light menu.

## How to reach the conference venue

### ● By public transportation

The public bus system provider is called “Ljubljanski potniški promet,” or LPP, for short. The buses are colored white (with green and yellow markings). Bus numbers 14, 14b, and 18 all stop in the city center and will take you to the Biotechnical Faculty.

Buses all pass bus stations Konzorcij, Ajdovščina and Bavarski dvor. When going to the facility, the route of bus 14 is Vrhovce, the route of bus 14b is Bokalce, and the route of bus 18 is the Center Stožice. The exit station is called Jamnikarjeva (14 or 14b; a green restaurant on the left, the fruit vendor at the station). The exit station for bus number 18 is called Večna pot.

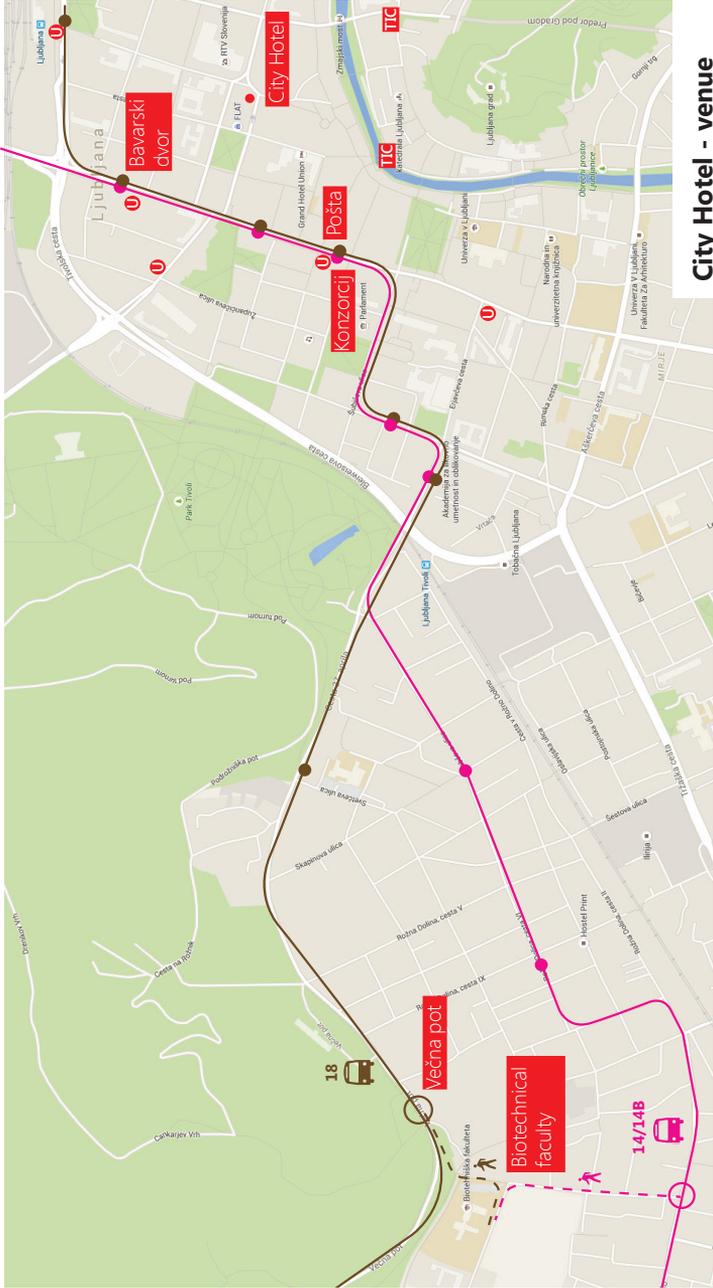
On the way back to the town, buses 14/14b are marked Savlje and bus 18 Bavarski dvor.

**Before boarding the bus, you must purchase an Urbana public transport card. Paying with cash on the bus IS NOT possible.**

The Urbana card is available from LPP ticket offices (Bavarski dvor), tourist information centers and most of the city’s newsstands and post offices. Additional funds can be added to the Urbana card at all the above-mentioned sales outlets and from every green Urbanomat ticket machines. These machines located across the city and can usually be found right at bus stops. The ticket machines accept cash, credit, and debit cards.

The price of the transport card is 2 € and a single journey fare is 1.2€. The card allows for up to a 90-minute journey, regardless of the number of buses needed to reach the destination. However, each time when you (re-)enter the bus in these 90 minutes, you need to register at the terminal. If your Urbana card is from a Tourist Information Center and you keep the receipt, you can return the card to the place of purchase at the end of your stay and claim a 2€ refund.





**City Hotel - venue**

-  41 min
-  24 min
-  12 min

-  Urbanomat
-  TIC Tourist information centre

## ● By car

The address of the Biotechnical Faculty is Jamnikarjeva 101, 1000 Ljubljana.

You can reach the faculty only from the Cesta na Brdo (NOT from Vecna pot).

**From the highway:** The nearest highway exit is Ljubljana-Brdo. After the exit, go straight (if coming from the South, turn right), through the first traffic light and, at the big intersection, turn left. Continue straight towards the centrum and immediately after the second traffic light, turn left (on the right there is a Mercator shop) into a small street. At the end of this street, turn left and you will arrive at the facility.

**From the center:** follow Tivolska Street and then turn right into Tržaška Street towards the Koper/motorway. At the fifth traffic light, there will be colorful houses on the left. Turn right (you will see a high school building in front), towards the rail. Cross the rails and, at the traffic light, turn left. Drive straight and, before the next traffic light (there is a Mercator shop on the left), turn right into the side street. At the end of this street, turn left and you will arrive at the facility.

# Public transportation map



**SCHEMA LINIJ  
MESTNI JAVNI LINIJSKI PREVOZ IN INTEGRIRANE  
POTNIŠKE LINIJE**  
LPP MAP OF BUS ROUTES  
CITY PUBLIC TRANSPORT AND INTEGRATED LINES

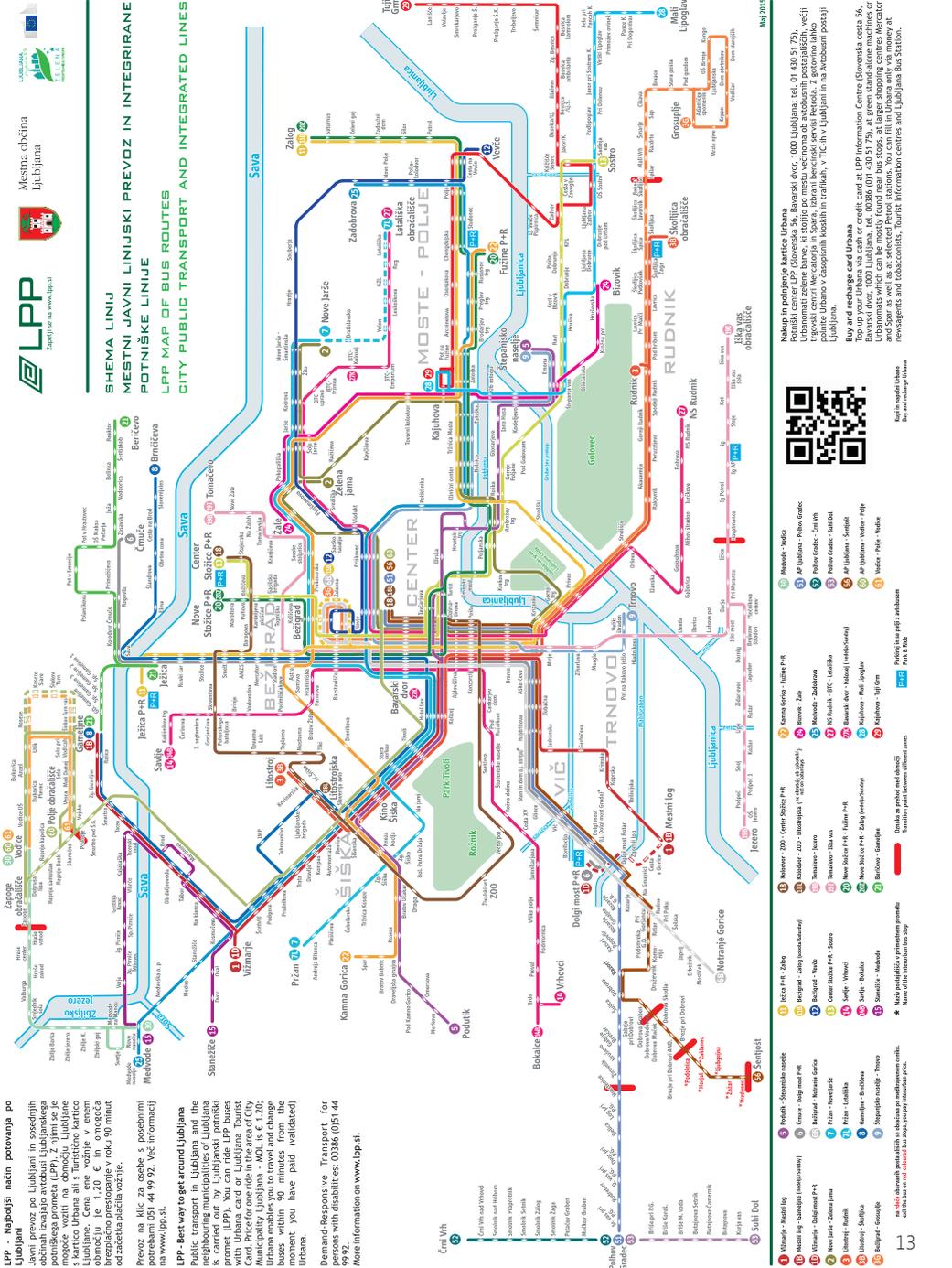
**LPP - Najboljši način potovanja po Ljubljani**  
Ljubljana je prvi evropski mestni prevoz po Ljubljani in sosednjih občinah, tretjajo avtocesti Ljubljanskega potniškega prometa (LPP). Z njimi se je mogoče voziti na celotni Ljubljani in okolici. Cena ena vožnje v enen smeri je 1,20 € in omogoča obsežno preostanek / roku 90 minut od zadnjega plačila vožnje.

Prevoz na klic za osebe s posebnimi potrebami 051 44 99 92. Več informacij na [www.lpp.si](http://www.lpp.si).

**LPP - Best way to get around Ljubljana**  
Ljubljana is the first European city public transport in Ljubljana and surrounding municipalities. It is carried out by Ljubljanski potniški promet (LPP). You can ride LPP buses throughout Ljubljana and its surroundings. One-way fare is 1.20 € and allows for an extensive remaining / within 90 minutes of the last payment of the fare.

Prevoz na klic za osebe s posebnimi potrebami 051 44 99 92. Več informacij na [www.lpp.si](http://www.lpp.si).

**Domovna Respublika - Transport for persons with disabilities: 00386 (0)91 44 99 92.**  
More information on [www.lpp.si](http://www.lpp.si).



**Nakup in poljenje karte Urbana**  
Pomilni center LPP (Slovenska 56, Bavarški dvor, 1000 Ljubljana, tel. 01 430 51 75),  
trgovski center Mercatorjevi in Sparu, Izbrani bencinski servisi Petrola, 4. potovno središče  
Urbana v trgovskih prostorih in avtomatih  
Boj and Mercatorjevi and Sparu  
Urbana can be bought and recharged at LPP information centres (Slovenska cesta 56, Bavarški dvor, 1000 Ljubljana, tel. 00386 (0)1 430 51 75), at green stand-alone machines or  
Urbana can be bought and recharged at selected petrol stations, selected shopping centres and  
Urbana can be bought and recharged at selected petrol stations, selected shopping centres and  
newsagents and tobacconists. Tourist information centres and Ljubljana Bus Station.

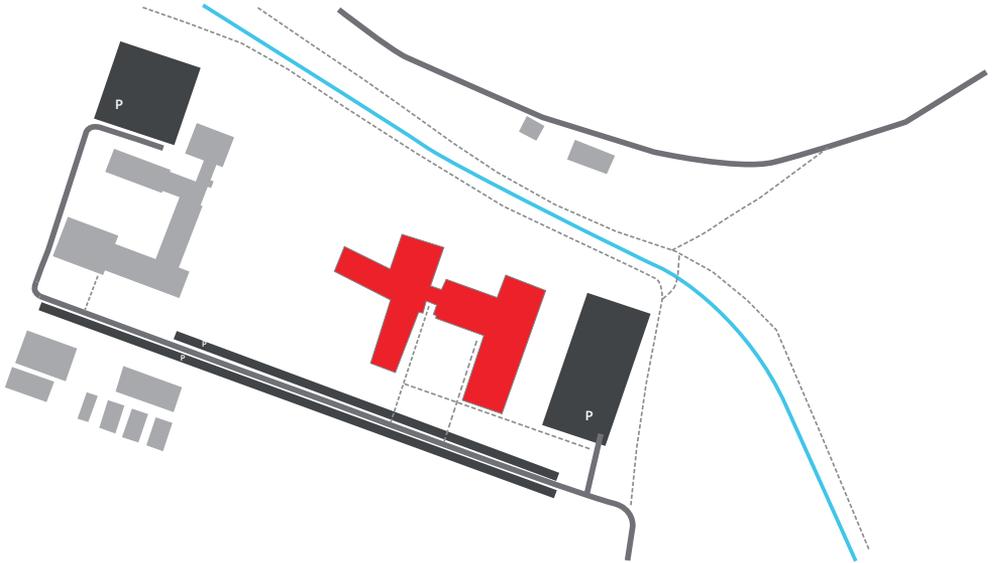
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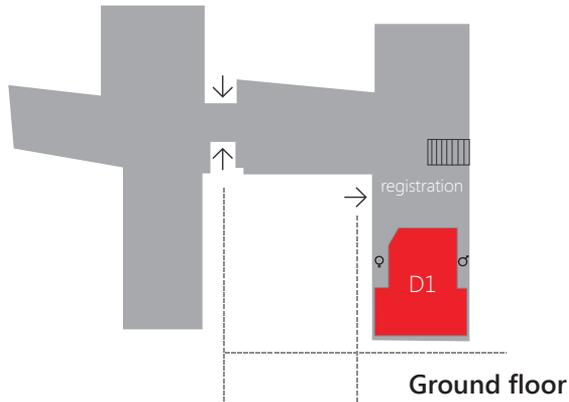
## Registration, buildings, and floor plans for the venue

The main part of the conference will be held at the **Department of Food Science and Nutrition (new building)**. Lecture Hall D1, where the majority of the sessions will take place, is on the right side of the entrance.

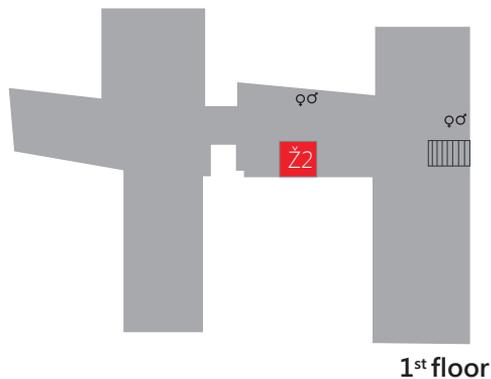
Registration will be open in the lobby outside of the lecture hall on Monday, September 28<sup>th</sup> and Tuesday, September 29<sup>th</sup>, starting at 8:30 am.

Additionally, registration will be also possible in the City Hotel on Sunday, September 27<sup>th</sup>, from 4:00 pm to 6:30 pm.





On Monday, September 28<sup>th</sup>, parallel sessions C1 and C2 will be held at the building connecting the new and the old building on the first floor (see map). You take the steps up into the first floor then follow straight “the darker corridor”. When the corridor divides into two parts, take the left one. Lecture Hall Ž2 is on the left side of the passage.



On both days, coffee breaks and lunch will be served in the lobby of the new building outside Lecture Hall D1.

## Exhibition "Na terenu" ("The Fieldwork")

Selected student projects of the Department of Landscape Architecture, Biotechnical Faculty, 2012–2014

During the conference, the exhibition "Na terenu" will be located in the lobby, outside of the D1 Lecture Hall. The participants of the conference are invited to view the exhibition.

Exhibition »Na terenu« (in English, "Pursuing the field work"), shows a selection of student projects presented by the Department of Landscape Architecture of the Biotechnical Faculty, University of Ljubljana, during the 8<sup>th</sup> International Landscape Biennale, entitled A Landscape for You in Barcelona in September 2014. The Biennale has been a traditional event for 15 years but, in 2014, the competition was widened from Europe to a global platform. The main aim of the event is to exhibit the major works of landscape architecture of the last five years and to present the Rosa Barba prize to the best project.

In addition the professional projects, landscape architecture schools are traditionally invited to present their work at the **International Exposition of University Projects in the Schools of Architecture and Landscape**. The Department of Landscape Architecture presented ten student works that convinced the jury of their quality and innovation. In the competition of more than 100 schools from all around the world, the Department was among other acclaimed schools, such as Leibniz University of Hannover, Harvard University, The Oslo School of Architecture and Design, and the University of Toronto. It was selected as one of the top 13 best schools. The presentations encompass projects from studios on landscape design, environmental and urban planning, and visual communication (presentation techniques).

Mentors: Doc. Dr. Tatjana Capuder Vidmar // Prof. Dr. Davorin Gazvoda // Prof. Dr. Mojca Golobič // doc. mag. Mateja Kregar Tršar // Prof. Dr. Ana Kučan // Doc. Darja Matjašec // As. Nejc Florjanc // As. Dr. Nadja Penko Seidl



Aljaž Babič, Tadeja Pavšič, Domen Rus

## Walking tour

The walking tour will start on Monday, September 27<sup>th</sup>, at 6:00 pm outside the City Hotel. It will take you around the city center: recent green infrastructure and other projects of urban development will be presented. The short walk will finish at the dinner venue on the Castle Hill at 7:30 pm.



## How to reach the conference dinner restaurant

**Gostilna na Gradu**, Grajska planota 1,  
1000 Ljubljana

Time: **Monday, September 27<sup>th</sup>, 7:30pm**

The restaurant Gostilna na Gradu is located on the Castle Hill, which is accessible from multiple directions. The most comfortable route is a ride on the funicular railway. The bottom station is located at the Krek Square (Krekov trg). The price for the return ticket is 4€ and a single ride is 2.2€.

Alternatively, at the Vodnikov trg, find the small street called Študentovska pot (on the other side of the market). The castle is a pleasant ten minute walk at the end of Študentovska pot. Another route to the castle is from Gornji trg through the street called Ulica na Gradu Street (Street to the Castle).

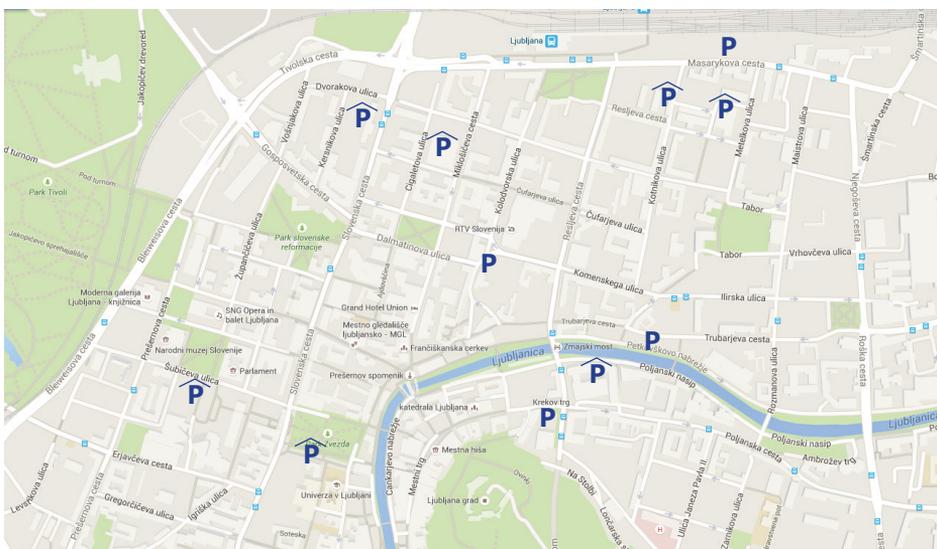


# Parking

## ● Centre of Ljubljana

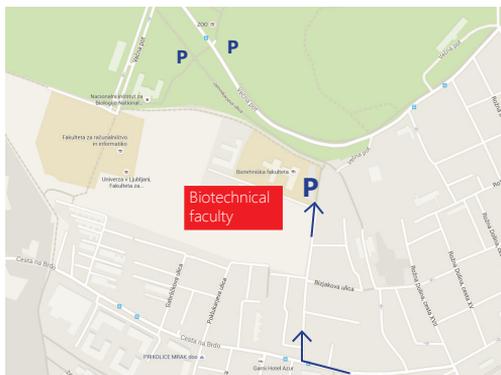
Ljubljana has a fee-based street parking system. The parking fee covers from 7:00 am until 5:00 pm; in the core areas of the city, a parking pass will be valid until 8:00 pm. After 8:00 pm and at night, parking is free. The allowed duration of parking varies from one to four hours, depending on the parking zone. In addition to street parking, parking garages and lots are available.

The City Hotel offers an underground garage with parking spots for 18€ per day. Booking in advance is advised.



## ● Biotechnical faculty

Biotechnical Faculty offers free parking with a secure entrance. Any conference participants who want to use this parking option should let us in advance.



## Free Wi-Fi and other useful information

- **Free WIFI**

Biotechnical Faculty offers both Eduroam network and its own Wi-Fi network, BF Guest. In the latter case, the password for access changes every week. Therefore, the password will be available at the registration desk during the event.

In the city center, Ljubljana offers the WiFree Ljubljana network to the residents and visitors. It allows up to 60 minutes of free internet access, daily.

- **Important addresses**

**Venue: Biotechnical Faculty** – Jamnikarjeva 101, 1000 Ljubljana

**City Hotel:** Dalmatinova 15, 1000 Ljubljana

**Welcome Reception: As Aperitivo** – Čopova ulica 5a, 1000 Ljubljana

**Conference Dinner: Gostilna na Gradu** – Grajska planota 1, 1000 Ljubljana

- **Emergencies**

**112** – General emergency number

**113** – Police





## Topic 1:

# A GOVERNANCE

- A1 – Opening of the conference
- A2 – Green infrastructure and policy
- A3 – Green infrastructure: Urban agriculture and conservation
- A4 – Green infrastructure: Sustainability and cities
- A5 – Green infrastructure: Perception and participation



## **The importance of a comprehensive planning approach to green infrastructure**

**Ina Šuklje Erjavec**

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Although the idea of a “Green Infrastructure” is originally associated with improving the functioning of ecosystems, protecting the state of biodiversity, and renovating and integrating natural areas, it is also more spatially defined as “a network of natural and semi-natural areas, features and green spaces.” In our paper, we focus on the spatial and planning aspects of “Green Infrastructure” and attempt to interlink the approaches. The starting point for discussion is recognition that the state of the environment, as well as the provision with ecosystem services, is directly related to spatial aspects and characteristics of the area. Therefore, for green and other open spaces with certain natural characteristics, this relationship is crucial.

In the paper, we point out that it is important to understand that, due to the basic spatial characteristics deriving from natural features and processes, green spaces are the basic component of “green infrastructure,” regardless of their origin (natural or created) and regardless of land use, ownership, and manifestation. In the paper, we argue that urban green spaces exist in a great variety of shapes, structures, and types and can assume different characteristics, from nature reserves, areas for landscape conservation, agricultural land and woodlands and forests, to more “green space land use” areas such as parks, gardens, squares, sport and recreation areas, children’s play areas, cemeteries, and family and allotment gardens. All affect the environmental qualities, climate, and living conditions of urban and suburban areas, and all enable aspects of ecosystem services. Furthermore, we point out that the roles and benefits of urban green spaces are extensive and multifunctional. By constituting the spatiality of green infrastructure, green spaces also introduce its planning dimension. The paper demonstrates that for the purposes of “providing ecological, economic and social benefits through natural solutions,” as the aim of green infrastructure is defined by the European Commission (COM, 2013, 249 final), it is important to understand and discuss the topic within the wider urban and landscape planning context.

In the paper, we present planning methodologies for comprehensive development and managements of green and open spaces that are already used by spatial planning and design professions. Referring to practical experiences from green system projects in Slovenia, as well as results and experiences from the international Green Keys project, we explain why a strategic, comprehensive, and long-term planning approach to urban green space development is needed. The processes for developing green space strategy or green systems as a planning approach is explained in detail with reference to different examples and good practices. In the conclusion of our paper, we discuss the interrelation between the concept of green infrastructure and comprehensive green space planning.

## **Planning green infrastructure as a source of urban and regional resilience**

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Green infrastructure programs and strategies are considered as planning opportunities to promote sustainable and resilient urban development. However, the discourse on green infrastructure policy and its effectiveness has pointed out the limited success of practical implementation. As green infrastructure has no planning status by itself, it must be embedded into comprehensive urban and regional planning approaches in order to have an impact on sustainable and resilient urban development. At the same time, spatial planning may provide a platform for green infrastructure's institutionalization.

With this background in mind, the article discusses, first, the principles for planning resilient cities. Second, we analyze how green infrastructure programs can boost these principles by contributing to building urban resilience. Third, we discuss the weaknesses of institutionalizing green infrastructure initiatives. Finally, conclusions are drawn regarding the future role of spatial planning in the process of institutionalizing green infrastructure strategies.

## **The historical background of green infrastructure, its establishment as a concept, and its implementation in the German landscape planning system**

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Open green space planning emerged as an answer to the many effects of the rapid urbanization caused by the Industrial Revolution. These effects have led to unfavorable living conditions for the lowest social classes and to a significant reduction of green spaces and their connectivity. The first attempts to introduce green spaces in urban areas were more concerned with design than with functionality (e.g., promenades, boulevards, etc.). The starting point of this historical analysis is the work of Frederick Law Olmsted, seen by many as the pioneer of explicitly functional green networks. Functionality means here the aim of providing ecosystem services through the creation, restoration, and improvement of green spaces. Olmsted introduced the parkways concept in the US as an attempt to integrate nature into the city, claiming the need for interconnected parks systems. Similar concepts that highlighted the need for interconnected urban green spaces were developed in Europe at the same time, all of them reacting to the social and economic consequences of industrialization. The garden city concept, for example, aimed to buffer urban development through the creation of green belts in separate urban cores of countryside areas, in order to ameliorate living conditions in Britain. The greenways concept, a more contemporary approach to open green space planning, is perhaps the closest predecessor of Green Infrastructure (GI). Greenways are mainly seen as trail-oriented structures, with an emphasis on their economic and recreational values. They are also recognized as structures to conserve the ecological resources of an area. These concepts have much in common with the contemporary Green Infrastructure approach. Nevertheless, GI is different in that it presents a greater complexity of principles and a wider range of strategic applications. Additionally, it addresses not just linear spaces, but also larger areas that provide ecosystem services (ES). After describing the historical background of the emergence of Green Infrastructure predecessors, the paper investigates the distinctive features of GI, compared to landscape planning in Germany. The main criteria chosen for the analysis were the principles attributed to GI and the provision of ES. It is possible to recognize many similarities between landscape planning in Germany and GI. Such principles as multi-functionality, multi-scale, connectivity, and accessibility are found in the context of both planning instruments. The main differences between GI and German landscape planning have been found in the evaluation of ES. Although landscape planning delivers extended landscape functions, which can be interpreted as a provision of ES, not all ES are covered. The research results suggest that the GI is not well-known in German planning practice. However, the integration of GI can improve the traditional landscape planning system, due to its strong socio-economic focus and

its close connection with ecosystem services, providing a wider range of benefits for human well-being and health. The GI concept can also enhance communication among different groups of stakeholders. Furthermore, it makes the decision-making process more transparent and brings better understanding and acceptance of the concept to politicians, practitioners, and the general public.

## **Green infrastructure in Serbia: Towards efficient policies in the fields of environment and planning**

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Green infrastructure (i.e., green systems) serves the interests of both people and nature. More precisely, green infrastructure affects the spatial structure of natural zones. It also addresses the environmental features of urban patterns. In a world of great land consumption, green systems can be a cost-effective alternative to intensive land use. Green systems also create new jobs and provide social cohesion, and green infrastructure practices yield economic, social, and environmental benefits. Keeping in mind that sustainable development addresses the subject of green systems, we observe that policies and actions to improve green infrastructure are linked to a wide variety of fields, such as climate change, disaster risk management, biodiversity, forestry, water, agriculture, health, transportation and energy, sustainable urban development, etc. However, the most effective way to strengthen green infrastructure is through spatial planning. Hence, the main goal of the paper is to present an overview of contemporary planning policies with regard to green systems development. This is done at two levels. First, the paper provides insight into the existing framework of regional policies and programs promoting green infrastructure development. One key strategy recommendation for policymakers in the field of regional green infrastructure and urban development is more effective implementation of planning regulations in the green systems domain. The second analytical step elucidates the circumstances in the Republic of Serbia, in terms of making and implementing green infrastructure principles in planning practice. This practice should take into account all barriers to the green infrastructure development in Serbia as a post-socialist country: mixed land ownership, slow administrative procedures, low public acceptance, different points of view and priorities, limited opportunities to change spatial plans, lack of knowledge and expertise, etc.

The research is focused on the analysis of both institutional and regulative framework of the green infrastructure policies. More precisely, the relevant bodies, on national and local levels, as well as their main documents (i.e., spatial plans, strategies, laws, studies, and projects) will be explored in order to answer the following questions: Is the topic of green infrastructure integrated into policy sectors? What are the links between various disciplines related to the issue of green systems? Is there collaboration among multiple

departments and sectors when providing the green infrastructure policies? Can we identify potential policy interactions? The paper's major contribution, therefore, is to elucidate how to: 1) promote and support the development of green infrastructure through the coordination among national agencies; and 2) integrate the green infrastructure concept in existing planning policies, including general principles to be considered or concrete priorities and measures to be taken.

### **The impact of local transportation systems on green infrastructure – Policy versus reality. The case of Poznan, Poland**

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Construction of a green infrastructure network is often most difficult in urban centers of growth. This is due to greater concentrations of inhabitants, intensive land-use, and high density of different infrastructural elements. Therefore, authorities of large cities must ask the following questions: 1) What are the most significant threats to green infrastructure in urban areas? and 2) How can green corridors be organized in these areas, while ensuring all the basic needs of local communities? In this context, one of the most important problems is the relationship between green infrastructure and local transportation systems. The main objective of the presented study is to assess the level of negative impacts of the transportation sector (especially road transportation) on the green infrastructure and to show currently proposed solutions to this problem. Second, I compare the presented policy on green infrastructure with actual changes and trends in transportation systems. Thereby, finally, I present an assessment of plans for transport development and some predictions regarding future impact.

The research was carried out in the Poznan agglomeration, where many valuable natural areas serve as essential elements of the local green infrastructure. In the first part of the research, the negative impact of transportation is presented with the use of kernel density analysis (conducted with the GIS program). Then, the most important assumptions of local policies on this subject are identified and discussed in light of plans for road infrastructure development.

Finally, we evaluate and propose predicted negative effects. The analyses show that a key problem is the fragmentation of valuable natural areas and the route of the high traffic intensity roads through and near these areas, which causes conflict. The most negative transportation influence occurs in the agglomeration center, where the quality of the environment is already low. At the same time, existing land use and transportation strategies propose solutions neutralizing these negative impacts. Examples of such actions may include a reduction of traffic intensity by better use and an increase in the availability of public transportation, the implementation of fees and limited parking zones, an increase in the fluidity of traffic, and restriction of residential

development near roads with high traffic intensity. Nevertheless, current trends and especially new transportation investments serve to negate official strategies and intensify the negative impacts on green infrastructure. In large Polish urban centers, the most popular recent investments have included creating new road connections to ensure high capacity and fast connections between the center and the outskirts. As a result, the process of suburbanization is an increasing problem and a source of urban sprawl in the Poznan agglomeration. Negative consequences include the increased use of vehicles and the growing volume of congestion. The pressure on green infrastructure is still increasing, and expected future investments include the construction of city ring roads, which will separate several green infrastructure corridors and could cause significant deterioration of the natural environment quality. In effect, perspectives for the future do not look very optimistic.

### **Improving quality of life by planning the coastline of Novi Sad**

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In the fabric of urban development, a coast is a border between the natural elements and building structures of the city. Therefore, it is extremely important to connect the settlement with the water surface along which it develops. Due to the beneficial effects of water on microclimate and environmental conditions, places next to the water tend to attract residents. The pull of these areas increases with the number and diversity of elements that are systematically implemented. Linear urban element is marked as a high quality place when it provides various functional contents: spaces of different character and purpose, with many urban elements that enrich it and increase its functionality. In this way, elements such as landscaping, street furniture, and greenery in the zones of the city by the water form specialized-purpose structures for all types of users. Novi Sad's coastline should be designed both for the residents of the city and for all visitors and tourists who come to it. Intersected along the river along one axis and the channel in the transverse direction, the resort has very long, straight stretches of coast, a part of which is undeveloped, representing extraordinary potential for development. Many aspects need to be improved in the coastal area, thereby enhancing the positive ecological, sociological, and economic effects on the overall physical and mental health of the population. The strategy for development of green spaces of the City of Novi Sad (2015–2030) identifies coastal areas as a very important link in the chain of connecting green space, with an emphasis on the linearity and character of these areas. The urbanized part of the city's coast forms a system of three continuous segments, which from south to north form a planned linear move composed of built and natural elements that promote the health of citizens, recreation,

quality microclimate, positive psychological impact of the environment, and high-quality socialization in the regulated areas. This paper will analyze to what extent certain parts of the space meet the needs of the majority of users and in what manner the space should be further transformed to improve the conditions of use. We will study currently undeveloped areas that must be made more comprehensive, functional, and socially and aesthetically valuable. The length of the coast, the surface of green space along the banks, and distribution in relation to the urban elements will be researched, as will the Danube flood areas, protective and hydro-technical facilities, and green spaces along the coast. Comparing these analyses and dispositions of the existing contents of the quay will shed light on the need for future facilities along the coastline. These considerations are intended to give further direction to planning the city coast as one of the key elements of green infrastructure.

**Green infrastructure: Governance, planning, provision****Milena Tasheva-Petrova****University of Architecture, Civil Engineering and Geodesy****tasheva\_far@uacg.bg**

Green infrastructure addresses various development issues at different territorial levels, such as the impact of urban sprawl, urban-rural connections, landscape fragmentation, connectivity, and the retrofitting of urban green spaces.

Different policy documents and planning tools promote green infrastructure development and support activities that add value to green systems, while some green infrastructure benefits support policy objectives. While producing these synergetic effects, different scales and scopes of green infrastructure planning and provision also face contradictions, either between the desired green infrastructure benefit and the existing policy objective, or between the newly formulated policy objective and the green infrastructure benefit (EEA Technical Report, 2011).

The paper traces the main aspects of green infrastructure integration and how it is embedded into the existing Bulgarian planning system. The analysis of the institutional framework is focused on the following issues: 1) green infrastructure and the strategic, tactical, and operational planning, 2) provision and maintenance of green infrastructure, and 3) provision of multifunctional benefits. Governance issues are outlined and discussed in terms of the main ecosystem services types: supporting, provisioning, regulating, and cultural.

Possible interactions between the implementation of particular instruments of EU/ national policy objectives and green infrastructure benefits, as well as key potential synergies and conflicts that might arise, are outlined.

The paper also discusses the potential mechanisms at the corresponding planning levels that can better integrate green infrastructure into other policies.

## **Overview of allotment garden development and spatial policies in Latvia's cities and towns**

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Allotment gardens in many cities and towns are experiencing revitalization, including a diversification of functions. This is due to greater awareness regarding broader sustainability issues among planners and users and the economic reality faced by a significant segment of population. To this end, allotment gardens must be given a place or allocation in spatial development plans. In Latvia, urban greenspace is under intense development pressure. The paper will present the results of an inventory of space/place designation in urban development plans in Latvian cities and towns for the upcoming 7–10 year period. The paper will highlight the existing planning trends in case study cities and will indicate the driving forces that contribute to a shrinkage or growth in allotment garden greenspace and contribute to the subsequent impact on urban sustainability.

## **Allotment gardens and “Wochenendhaus” zones: Green infrastructure versus affordable housing**

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This paper describes the characteristics and future policy challenges for allotment gardens (“Kleingärten”) and for areas with leisure homes (“Wochenendhausgebiete”) in densely populated and growing cities. These historic urban forms were traditionally part of green belts in European cities. At the end of the 19th century, the removal of city walls and introduction of mass transportation in European cities provided the opportunity to expand cities into green suburban areas. Colonies of small houses with garden plots and allotment gardens developed during this era, representing a new type of settlement where green infrastructure (gardens) and housing provisions were closely intertwined. The gardens in these settlements were based on the notion of a subsistence economy. Kitchen gardens enabled the settlers to grow food and maintain animal husbandry. In the aftermath of World War I and World War II, settler communities and allotment gardens gained additional importance, as they provided a quick solution to housing and food shortages. In the Federal Republic of Germany, housing estates, consisting of small houses with gardens, continued to be built well into the mid-1970s. In the German Democratic Republic, allotment gardens with summer cabins, as well as dachas (weekend homes), were an important source of self-provision for food and leisure space. Buildings in these garden lots were originally very modest in terms of floor area consumption. Moreover, technical infrastructure in this type of urban

morphology is fairly simple, and the degree of sealed surface is low in comparison to traditional suburban single-family homes. Despite municipal land ownership, garden plots are mainly passed on within families.

Though not accessible to everyone, these centrally located, garden-based urban fragments contribute significantly to living conditions in dense cities through provision of ecosystem services such as improvement of microclimatic conditions and biodiversity, as well as an amenity for leisure and social cohesion. Later, as suburbanization processes accelerated and the cities expanded even further into the surrounding landscape, these particular urban morphologies became a part of the inner city fabric. In several expanding cities, allotment gardens and “Wochenendhausgebiete” are located very close to popular inner-city districts. In growing cities with housing shortage and rising land prices, however, the sites of allotment gardens and dachas are becoming increasingly attractive, particularly for multi-story housing. The renewed interest in core cities leads to both increasing housing demand as well as the need for green amenities in dense areas. However, eviction protection for dachas in Germany will end in October 2015. In Vienna, since 1992, original allotment gardens with summer cabins were split into two categories: traditional “Kleingarten”-settlements with seasonal use and a new zoning category for year-round living. Based on critical analyses of changes in policies and planning regulations in Austria and Germany, we will describe challenges arising from conflicting policy goals. Preservation of this kind of urban green infrastructures is in conflict with the need for more affordable housing. Equally important, the requirement to provide just access to green amenities for new generations of urban dwellers remains yet unsolved.

## **Urban-rural exchange in aging and shrinking communities of Japan, and its transferability to Bulgarian planning practices**

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Current demographic processes in Bulgaria are characterized by a diminishing and aging population. As young, educated people emigrate to places with better chances for career, the result is shrinking populations in small-, medium-, and large-sized cities. As a consequence, questions about local community conditions and about the opportunities for remaining residents are emerging. In many of these towns, unemployment and poverty levels are high, leading to a low quality of life. Yet shrinkage could be also regarded as an opportunity to create greener, more productive, and more sustainable settlements through planning and implementation of urban and peri-urban agriculture.

In 1948, Bulgaria was an agricultural country with a predominantly rural population. By the 1980s, as a result of industrialization, many people had moved to the cities. Yet the traditions of growing food and consumption of quality products were still remembered by the new citizens who continued to maintain relationships with their places of origin. Maintaining these agricultural traditions is also typical in Japanese cities, where agricultural land is part of the urban structure and residents have close interactions and relation with farmers.

It is not uncommon for Japanese citizens to see farmers in the city or meeting farmers in rural areas (Yokohari, 2006). The paper presents a Ph.D. study (undertaken with the support of a one-year European grant by AUSMIP+ program) on the urban-rural interaction in aging and shrinking urban communities in Japan, more specifically, on urban agriculture practices (allotment gardens) in the contact zones of aging settlements.

Shrinking and aging population processes lead to land use changes and to an increasing number of vacant lots and abandoned farming land. In response to the increasing number of old farmers and their heirs, who are unable or unwilling to continue family business, Japanese public policy has introduced urban and peri-urban agriculture activities within the green system, thus promoting health food consumption and education. This revival of food-growing traditions as part of a modern lifestyle serves to shift urban and rural functions and provide for the exchange of people, land, and activities. Now, in Japan, effective rural-urban interaction has replaced conventional agricultural activities with the development of allotment gardens on the periphery and in the city.

The case study method was chosen and Kashiwa village in the Chiba prefecture was identified as an appropriate case study for exploring urban agricultural planning

approaches in Japan. This case study shows how planning has maintained the urban green system and strengthened aging communities by stimulating urban agricultural activities and social cohesion. Furthermore, as citizens maintain and cultivate abandoned land, their needs for jobs, a sense of meaning, and healthy lifestyles are met. This study, which investigates the development of urban agriculture in shrinking cities in Japan, provides a chance for reflection on the influence of local cultural traditions in coping with contemporary urban challenges and for recommendations on the needed legislation and planning framework to enable future action for developing urban agriculture in shrinking Bulgarian towns.

### **Multifunctional green systems for landscape improvement**

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Czech and Slovak legislation has, since the late 1980s, enshrined the duty of creating so-called territorial systems of ecological stability (ÚSES) as a tool for active nature conservation. It is an interconnection of natural and partly altered (near-natural) ecosystems that maintain the natural balance and natural gene pool of the biogeographical region. There are local, regional, and supra-regional systems of ecological stability, which consist of printed circuit elements (biocenters) and line elements (corridors). These elements have methodically set minimum functional spatial parameters. This system of ecological stability is applied to migrations of organisms (plant seed dispersal and the active movement of animals) and used to improve the character of the landscape by reducing fragmentation and increasing aesthetic value. The design of this green network preferably includes elements of the existing environment and strives to be multifunctional. Elements of the system may serve as protection against erosion, roads, or waterways alleys. The article also deals with the specifics of the formation of green systems in urban areas, as well as their coordination and consultation in the context of the acquisition of local master plans and land consolidation projects at local and regional levels. These observations are documented with examples based on the author's experiences.

## **Green infrastructure and urban resilience planning in Central Europe: A solution for environmental and spatial challenges in the inner-city areas of Ljubljana, Slovenia**

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The paper considers the emerging concept of green infrastructure within urban resilience planning as a response to multiple challenges facing European cities. An understanding of social-ecological and urban resilience enables effective management of interventions to allow urban areas to adapt to disturbances, embracing the potential for transformation. Resilience is identified as a combination of politically challenging questions to disrupt equilibrium assumptions and human ability to control the environment. Urban resilience can provide a common perspective on the multidisciplinary actions of municipalities, highlighting the impact of planning on urban eco-systems and the development of green infrastructure as a response to environmental and spatial challenges in European cities. The paper aims to identify some of these activities in Ljubljana, the capital city of Slovenia, as a result of a research study in the inner-city Tabor neighborhood, which was developed within the EU FP7 TURAS project (2011–2016). A broad range of strategies and activities (both top-down and bottom-up) already exists regarding green infrastructure and urban resilience at the local level. This diverse urban neighborhood has been identified as a “bridging” area, where urban planning is considered as a tool for implementation of green infrastructure concept, as a sustainable instrument for implementation of urban revitalization policies in Ljubljana. The research reveals that the concept of green infrastructure and urban resilience is not systematically integrated into strategic planning and city governance, due to institutional and social barriers.

The other aim of the research is to address innovative aspects of collaborative planning and community participation in the revitalization of Tabor, with a focus on activities that sustain viability and improve the quality of life for local residents and visitors. The focus was on diverse planning activities within the bounds of the limited availability of public and private resources. New planning schemes draw together environmental, social, and economic actions that are spatially applied in particular urban contexts. The focus on the inner-city area allows us to correlate physical assets (such as scale and distribution of urban institutions, services, amenities, and different revitalization projects) with networks of social capital. A timeline for the revitalization of Tabor shows the spatial, temporal, and organizational evolution of urban resilience planning and various attitudes to sustainability through key interventions. These observations allow us to identify the capacity, knowledge, and networks among people and places, and their attitudes towards the development of green infrastructure over time. These activities are also closely related to the “Ljubljana – Green Capital of Europe 2016” initiative, which promotes the development of green infrastructure in the city municipality of Ljubljana and the Ljubljana urban region.

**Green areas, sustainability, and improved quality of life in Novi Sad, Serbia**

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In addressing the problem of climate change, green areas are gaining importance as they improve environmental quality and represent areas that will be more intensively used. It is necessary to create a healthy environment for living and working, taking into consideration healthy urban planning and design, transportation, climate sustainability, and quality of life. Green areas contribute to the preservation of health by providing space for recreational activities, children's play and safe assembly of the urban population.

This paper will provide guidance for the improvement of urban green spaces in the city of Novi Sad in order to upgrade the quality of life of residents. To ensure a better quality of life, it is necessary to underscore the role that green spaces play in promoting health and well-being. Educating users about green space offers a different approach to understanding the public's relationship with public greenery. It is also necessary to respond to climate change through the use and maintenance of appropriate plant material. To promote sustainability, public green spaces must maintain biodiversity, reduce CO<sub>2</sub> emissions, reduce the use of pesticides, and use water rationally and time-appropriately.

To satisfy the needs of all users, green spaces should be accessible to all categories of people, including children, elderly citizens, and people with disabilities. Serbia and Novi Sad have not yet reached sufficient awareness of the importance of this issue. In order to change this situation, it is necessary to apply examples of good practices in accessible spatial planning, and to implement legislative acts that provide accessible landscaping. Improving the availability and coverage of public green spaces relies on finding the spatial potential for larger or smaller park areas in zones where vegetation coverage does not exist, in the case of other categories of greenery.

Involving local communities in the design and management of green spaces is essential. Community participation can be active on several levels, from planning and establishing to monitoring and maintaining green areas. This is important in realizing the potential of green spaces of the city for safer and cleaner green areas. The involvement of the local population is also form of participation in decision-making, where citizens have the opportunity to decide on the priorities of the local community in cooperation with municipal authorities.

The main objectives in achieving a better life in urban areas are: 1) the preservation and improvement of the population's health; 2) increasing socialization of the population; 3) increasing knowledge and lifelong learning about plant and animal life and its importance to the natural environment; 4) increasing the economic status of the city and citizens; and 5) increasing the availability, accessibility, and safety of green areas.

### **Green infrastructure in the city of Belgrade**

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In the paper, the authors will present their experience in planning of green infrastructure in the city of Belgrade in the last ten years. The project, called Green Regulation, was carried out in conjunction with the Master Plan of Belgrade in 2004 and was the first attempt to move the focus of green fields and green infrastructure planning to the forefront of strategic planning issues. Several examples from practice in Serbia will illustrate the level of its influence in planning methodology and Belgrade's current challenges in spatial and urban planning.

## **Public open space and urban development in ten Slovenian cities**

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This paper presents the results of the author's doctoral thesis research, with a focus on ten small Slovenian cities. This paper focuses on the relation between physical characteristics of public open space, people's satisfaction with the open space, and the existing or planned land use in urban development and spatial plans.

The role of open public space for urban development of small towns is discussed. Well-maintained public open space greatly contributes to urban development and the quality of life in the city. The emphasis is on the importance of open public space for walkability, enforcement of local identity, and contribution to spatial and social meanings. The diversity of spatial arrangements opens up the possibility of multiple uses for open public spaces. The more diverse the arrangements, functions, and activities of the open public space, the greater are the opportunities for a variety of uses and activities in the city. Therefore, the role of open public space in a balanced urban development is to support the improvements in the quality of life, to enable social contacts, and to maintain or re-establish cultural diversity and local identity.

Some of the research findings include which physical characteristics of open public spaces people are the most satisfied with, and which physical characteristics are most often used in correlation with local characteristics and cities' maintenance. These results point to the importance that the city urban structure has on walkability and thus on traffic flows in small cities. The results are of great importance for future planning of open public space and for urban development in small towns. Spatial planning (land use, placement, and activities) can affect the uses and walkability of the Slovenian cities.

## **Green infrastructure in the urban process: Opportunities for a new planning culture**

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Efficiently working green infrastructure is acknowledged as an important factor that contributes to the sustainability of urban systems because of its complex role in the city. Yet the sociocultural dimensions of its contribution to the urban process seem to be less studied and discussed than the ecological ones. Public greenery proved to be a vulnerable element of Bulgarian settlements during the last 20 years in Bulgaria. Generally, two types of urban situations could be identified in the late 1990s: (a) public green areas in places of considerable investment pressure for privatization and build-up; and (b) public green areas, characterized by withdrawal of activities and lack of capacity for maintenance in shrinking settlements. In the first case, even if the function of the public greenery was not entirely changed, processes of ecosystem fragmentation became visible alongside the diminishing quantity and quality of the areas. In the second case, empty and potentially unsafe public green areas emerged with no public capacity for maintenance. Both cases resulted in decreasing quality of life in the settlements.

This paper traces the variety of informal and formal social action stimulated by these tendencies. Because of the initial slow reaction of public authorities and the shortcomings of the active legislation and regulations, the civil sector was the first to self-organize to protest against the lack of effective public policy protecting the urban green system. The mobilization of citizens' organizations for practical action contributed to a growing public awareness about the potential of civil action to influence public policy. In residential quarters of the settlements, the self-organization of local groups for the defense and maintenance of public greenery had two main results: developing a new attitude of respect and care for nature and mobilizing social energy for joint positive action. A sequence of small practical educational projects (so-called "edible gardens") was initiated by an NGO (ZAEDNO Foundation – Communication for Support and Development) in kindergartens and later in schools across the country. Reported results were indicative of the scope of the multidimensional cultural impact and mobilized social energy for integrating nature into the city. The author claims that conceptualizing the cultural dimensions of processes related to the urban green system would provide local policy-making with a broader understanding of the efficiency of spatial planning approaches and would enable it to more efficiently address issues of social cohesion and urban resilience. The proposed approach is illustrated by a recently developed diploma project within the B.Sc. program of Urbanism at the UACG in Sofia.

## **Participatory governance of urban green spaces**

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The research focuses on participatory governance of urban green spaces. Such arrangements are hardly ever the result of official participation processes unfolding under formal planning policies. Although labelled as participatory, many times the official process is too structured and too official to reach its original goal – to truly involve society in the planning and governance of urban green spaces. Such official participation processes are often implemented through low-participatory, costly project interventions. Newly established green spaces partly fit the needs of society, but mostly provide very limited services. For these reasons, participatory governance of urban green spaces tend to occur on the street and out of sight of officials. Practical cases of such governance are poorly explored, which is unfortunate, because these processes offer the potential to change government tools that are currently unfit to deliver socially useful urban green spaces.

In the research, we studied an arrangement that goes beyond the classical, authority-dominated ideal, with a special focus on socially-inclusive decision-making. To identify whether and for whom the arrangements have been successful, and in which particular contexts, the research had the following objectives: (1) to identify and conceptualize innovative participatory governance arrangement, (2) to investigate how successful it is in terms of encouraging socially inclusive behavior, and (3) to derive guidelines on effective participatory governance arrangements for UGI planning and management in different contexts and for different purposes. The study used a case-study methodological approach. Data was collected through interviews and through document analysis.

## **Urban green infrastructure as a common good**

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With the development of civil society and the increased exposure of our cities to the effects of global changes, people's perception of their own responsibilities for their quality of life, as well as the perception of the contexts of their own existence, has changed. This change may represent a drive for new understanding of their belonging to certain communities and new understanding of their relationship to the shared values important for their life – urban spaces like streets, public squares, and urban green infrastructure. As evidence of the growing awareness of non-economic values confronts economic interests in the decision-making, communities and governments have attempted to balance economic and non-economic values in planning and decision-making.

The effectiveness of urban green infrastructure management, linked to urban public and semi-public spaces, depends on the degree of community involvement (Poklembova, 2013, Maco 2015). Green infrastructure in public spaces and semi-public spaces are regarded in the theory of commons as common-pool resources. They therefore face similar problems of resource degradation, overuse, free-riders, or conflicts between actors. Their management process and planning reflect the way in which social dilemmas are confronted with real or seeming contradictions between individual and collective interests. There is an awareness of the interrelation between, on the one hand, the quality and quantity of ecosystem services (provided by urban green infrastructure in public and semi-public spaces) and, on the other hand, quality of life in the cities and their neighborhoods. However, this awareness is not properly reflected in the investors' decision-making processes (whether the investors are private developers or the public body). It seems that the particular instruments, though responding to the challenges of different degrees of self-organizational powers, are not efficient enough, and principal changes are needed in the governance modes and institutional arrangements that create frameworks for the collective action that is fundamental to urban green infrastructure.

The theory of common-pool resources developed by Ostrom (1990) offers the conceptual framework for innovative governance of urban green infrastructure in public and semi-public spaces, offering several ideas and set of design principles for their efficient governance. The main objective of the paper is to demonstrate the potential of this conceptual framework to improve the governance of urban green infrastructure and to develop its efficient and sustainable management strategies given existing

complexity, multiple actors, and multiple levels in decision-making.

This paper is a contribution to the Cost Action IS 1309 INNOGOV, the national grant scheme Vega 2/0038/14, and project SPECTRA+ No. 26240120002 “Center of Excellence for the Development of Settlement Infrastructure of Knowledge Economy,” supported by the Research & Development Operational Program and funded by the ERDF.

## **Urban green infrastructure – Planning matters, and collaborative management can help<sup>1</sup>**

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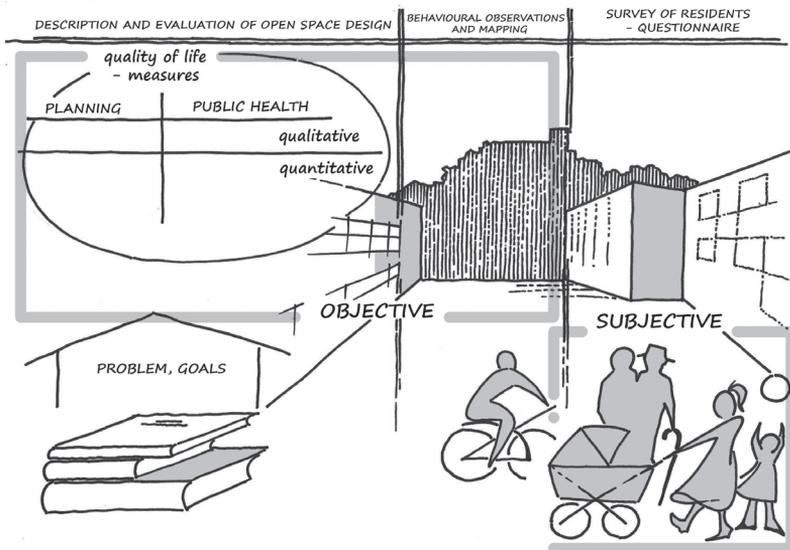
The planning of urban green space has become increasingly important in recent years. The reasons for that are (1) the growing number of functions that green space is supposed to fulfil in the future of our cities and (2) the increasing public expectations for urban green space quality and accessibility. The evidence proves that, when it comes to green space, the benefits of planning cannot easily be replaced. Therefore, to satisfy the needs and functions, accessibility and connectivity, sustainability and liveability, and the health of the human environment and citizens, planning of green area must become more ambitious. From the perspective of Ljubljana and Slovenia, where planning as such is still often perceived as an obstacle for the development and where planning of public space is many times hindered by the issues of ownership and burdens of management, this new need for planning is an interesting challenge.

This paper discusses the findings of recent studies about planning practice and emerging urban practices and uses them to propose a new model of green space governance that would lean on collaborative management of public green space, thereby opening up new perspectives for a more ambitious planning. Based on gathered data, this paper demonstrates how quality and function of green space are related to planning and future green space development. On the other hand, green infrastructure and growing number of interests behind it will serve to discuss new approaches to management. A study about the practice of public green space planning in the neighborhood areas has proved that recently the costs of public management are a serious obstacle for the planning ambitions of public authorities. The responsibilities that follow the declaration of public space (the need to buy the land and to maintain it) have recently overshadowed the development, enlargement, and improvement of green space areas. On the other hand, various studies about urban gardening practices in the city prove citizens' impressive self-organizing capacity, as well as the high level of citizen resistance to alienated spatial planning and ordinances. Decades of vital, non-formal gardening practices and interesting new community gardens bursting around the city are proof that gardening can be a flexible temporary land use and a fruitful base for community-building and new urban activities. With respect to both sets of conclusions, a collaborative model of management could likely

be effective in managing public green space in neighborhood areas. This model could also help to release the burden of public expenses and thereby empower authorities to plan green infrastructure more ambitiously.

<sup>1</sup>The case of “Urban gardening in Ljubljana” was studied in the context of green infrastructure and resilient urban planning in the TURAS project; WP3: Urban/Industrial Regeneration, Land Use Planning and Creative Design. TURAS –





## Topic 2:

# B HEALTH

B – Green infrastructure and health



## **Spatial factors as opportunity or risk for the quality of life of urban inhabitants**

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The living environment has an impact on human health and well-being. Health-related lifestyles of individuals are a result of the individual's choices, but the implementation of these decisions also depends on the opportunities offered in the physical and social environment. The research literature provides ample evidence that physical activity has an impact on human health and well-being. The "urban densification" paradigm, prevailing in urban planning policies since the beginning of the millennium, has resulted in poorly equipped open and green space in collective housing environments. The presentation addresses the relationship between the quality of open space and health-related lifestyles in post-transition urban residential areas in Ljubljana, Slovenia. Compared to the older neighborhoods, the new ones are single-use residential areas, with small open spaces and poor landscape design. The objective of this study was to investigate the linkages between the outdoor space and the lifestyle adopted by the inhabitants. The research aimed to provide answers to such questions as: What is the residential area urban design like? What do people actually do in residential open spaces? How do the residents perceive their living environment? The study revealed that the relatively positive perception of the quality of their living environment is mainly related to the residents' high economic status, high level of completed education, and lower average age. User groups with such characteristics can compensate for poor outdoor space by using infrastructure elsewhere. On the other hand, the quality of life in new residential areas is inadequate for other users, such as children and the elderly. The immediate environment of contemporary collective housing does not stimulate spending time outdoors, walking to services, or playing and socializing; nor does it provide conditions for healthy childhoods and active aging in the long term. The results revealed that a lack of outdoor programs correlates with a poor variety of outdoor activities, limited to transition type, less time spent outdoors, and lower satisfaction with their home environment. People living in such environments are less likely to develop a healthy lifestyle. This is especially relevant for children and the elderly, who are considered vulnerable groups in terms of active use of open space due to their dependence on proximity to their homes.

## **Green infrastructure as an important factor in human wellness conditions for inhabitants of urban areas**

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Green infrastructure is considered a benefit for both regional and urban development and growth. Hence, green infrastructure can play an important role in human wellness conditions, particularly in areas characterized by a high influence of anthropopressure. An aging population, an expanding range of urban heat islands in urban areas, the fragmentation of green areas, and the reduction of biologically active areas are all challenges for spatial planning and urban management. In addition, urban sprawl, which blocks ecological and aerating corridors, worsens the essential living situations of residents. The presentation will show the development of green infrastructure in Warsaw and predict the green development of the city for the next 50 years. Additionally, demographic and health hazards situation are discussed.

## **Social behavior as a basis for the design and development of green infrastructure**

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This paper addresses urban open spaces and their use(r)s. It is concerned with spatial relationships between usage and the physical structure of parks and squares in city centers, and addresses the social dimensions of green infrastructures in cities and towns. Based on methods of behavior mapping, the study reveals dynamic patterns of actual occupancies of places, used to produce responsive and inclusive design. The paper discusses the actual uses mapped in places, using repeated observation on different days, times, and weather conditions as applied to parks and squares in two European cities (Ljubljana, Slovenia; Edinburgh, UK). It shows that occupancy patterns have some spatial logic and that in development, planning, and design, it is essential to pay more attention to the spatiality of uses, the compatibility of uses, and the comprehensive usage-spatial relationships when aiming for well used, people-friendly places.

The paper refers to the practical conduciveness and responsiveness of places to human use; examines how different kinds of spatial structure facilitate use by different publics in different ways; and discusses whether such knowledge and awareness is taken into account and respected in design processes and their results as such. Moreover, GIS-supported behavior maps consist of layers of information, including type of activity, duration of an activity, age group of the person involved in the activity, and gender of

the person. On this basis, we are able to comment on passive or active engagement and allow speculation on the recreational habits and lifestyles associated with different locations. Further, the paper sees mapping and map-making related to physical aspects of places and imaging, two subjects with which planners and designers are usually quite familiar. Therefore, the paper speculates that a body of knowledge represented in such way may help designers and decision-makers effectively address design, evaluation development, and re-development of places. The value of the research recognizes the social dimensions of places and can therefore

- Help designers be confident that layouts proposed for intended uses will, in practice, serve those uses well and be likely to be used as predicted;
- Help planning and decision-making authorities to reveal restorative environments via peoples' attachment to open spaces and their recreational habits, and to interpret people's (healthier) lifestyles;
- Help planning and decision-making authorities to recognize a variety of peoples' needs, habits, and expectations in open spaces, via information addressing various user groups, age groups, or gender-referenced characteristics of place users.

## **Green networks of pedestrian-bicycle paths in Novi Sad**

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Green spaces in urban areas play a key role in ensuring the health, well-being, and biodiversity of their citizens. Different categories of green spaces in cities should be connected in a network, and green space should be accessible to all categories of users including children, seniors, and people with disabilities. There should also be increased awareness about the importance of daily use of different categories of green spaces. Several recent studies of green spaces in Novi Sad point to deficiencies in official planning documents, which could provide a systematic planning and improvement of green spaces in the city.

Numerous studies indicate that the active or passive use of city green areas allows citizens to improve their health. In Novi Sad, the uneven distribution of different categories of green space, as well as their functional equipment, can be partially replaced by an adequate network of walking and cycling paths. So that citizens enjoy pleasant movement from one space to another, these linear spaces must be adequately covered with greenery. Furthermore, green linear spaces in any town foster biodiversity and prevent the fragmentation of habitats.

Along existing pedestrian-bicycle paths in Novi Sad, there are different spaces that enable citizens to engage in various physical activities, from sitting in the micro-green spaces to walking to actively playing recreational and professional sports. These linear green pedestrian-bicycle paths should be developed into a unified network within the city and connect it with the Danube bicycle route through Serbia, Eurovelo 6. This unique network of green paths will allow citizens to walk and ride bikes, roller-skate, etc., which will not only improve the health of the urban population, but also decrease the impact on the pollution due to the reduction of car traffic. With their various facilities, attractive space, accessibility, and interconnectedness, these routes will increase the number of users, attract more tourists, and boost the city's economic development in such industries as catering, hotels, trade, services, and others.

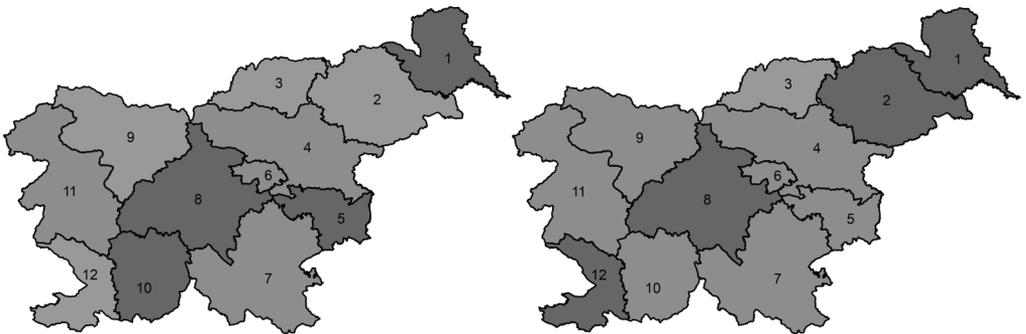
The wish is for Novi Sad to become a sustainable "green city" with high-quality, multifunctional, and attractive green spaces connected in a network. This paper will analyze the existing network of walking and cycling paths and their green routes. On the basis of an official document, "Strategy for Development of Green Spaces of the

City of Novi Sad, 2015–2030” and the action plans envisaged by the Strategy, our analysis will create the basis for a proposal for a new network of walking and cycling paths. These paths will connect all existing categories of green spaces in the city and will connect the city's network of paths with the Danube bicycle route Eurovelo 6 and other suburban and rural roads.





Andraž Hudoklin



Exposure to flooding and drought in Slovenian regions

### Topic 3:

## C CLIMATE CHANGE

- C1 – Climate change – Policy aspects
- C2 – Climate change and water



## **Implementation of green infrastructure principles in Croatian coastal towns as a tool for minimizing climate change problems**

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Croatia has been facing an increase of development pressures on its coastal areas, a trend that it shares with many other European countries. This process leads to environmental degradation due to a lack of appropriate strategies and policies in promoting well-planned and managed urban areas. In the process of global climate change, coastal cities are becoming heat islands because of the lack of systemically planned green areas. Key elements of urban sustainability, in spatial context, are based on a balanced relationship between built and open urban spaces, on the one hand, and on the other hand the connectivity of urban open spaces among themselves and with surrounding landscapes at the regional scale. These are key principles of green systems and urban green infrastructure. Therefore, this paper discusses the problems that occur when built environments become degradation factors and when most indicators for urban sustainability are questionable. When fragmentation of open green spaces dominates urban planning, it can be helpful to apply the principles of green infrastructure. This investigation targeted different Croatian, coastal Mediterranean towns (Dubrovnik, Split, Zadar, Šibenik, Rijeka, Pula). Results of the conducted study show that it is possible to overcome problems stemming from non-planned or partially planned urban development. The paper also emphasizes the importance of preserving ecologically valuable green areas within the urban fabric, as well as its connection to the regional green infrastructure. These areas are not only important for habitat biodiversity, but are also elements of the urban tissue that contribute to the urban microclimate and can be important elements in reducing the problems of climate change. Green infrastructure can be a solution to many environmental problems, and this study addresses problems of soil erosion and floods as well. These problems have arisen where the urban footprint is predominantly grey and green absorptive urban surfaces are disappearing. In such situations, the urban green infrastructure is useful for urban regeneration, from regional and local-urbanistic scales (restoration of riparian landscapes) to a project scale (sustainable urban drainage systems, bio retentions, rain gardens, etc.). At the same time, green elements within the urban area must be functional as social places, so the green system / urban green infrastructure must be seen as a model for a sustainable "socio-ecological network" that can help minimize climate change problems.

## **Urban green spaces – Demands, opportunities, and planning approaches for urban climate adaptation**

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Green infrastructure, in terms of the manifold elements of urban vegetation, green spaces, and urban ecosystems, provides diverse benefits and services to tackle the challenges of climate change. Such benefits include, for example, the regulation of the micro- and bio-climate to deal with heat waves and to support storm water and flood management, making green infrastructure a crucial element in adapting cities and urban regions to climate change. Urban green spaces therefore have direct influences on the quality of life and the health of an urban population.

What do we know about the climatic benefits of urban green infrastructure, and how can we address these benefits in planning practice? Based on (1) findings on the microclimatic benefits of different elements and types of urban vegetation and green spaces, the contribution will discuss (2) strategies and concrete approaches to green space planning and development, so as to use the potential of green infrastructure for climate adaptation.

Due to a wide variety of green infrastructure in urban areas, the climatic effects differ, which must be considered in planning. To analyze and describe the climatic effects of different types of urban vegetation, a comprehensive analysis of vegetation structures based on urban biotope types will be presented. In order to identify the climatic effects of different urban green space types, urban climate modeling was undertaken on the levels of city, urban district, and type of urban vegetation structure. Based on scenarios for different urban neighborhoods according to the effects of land use changes, this paper discusses green space development, building activities on microclimate, and their potential and limits regarding climate adaptation.

Against the backdrop of a regional program for climate change adaptation (for the model region Dresden, Germany), approaches and experiences will be discussed to implement green infrastructure on different scales. Demand for a "climate-active" green infrastructure must be considered at several planning scales, ranging from the urban-regional perspective to design of a single urban green space. Overall, to implement green infrastructure as a guiding principle of urban development, it is crucial that spatial strategies be used to address the prominent role of urban green and open spaces. Concrete approaches to multifunctional green spaces, brownfield development, and aspects of design and maintenance of urban green spaces will be presented. In addition to the planning aspects, issues of implementation, funding, and future perspectives will be discussed.

## **The role of green infrastructure in settlements and cities**

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Growing urbanization and increasing resource consumption, combined with climate extremes (droughts, extreme heat, and extreme rain events and floods), calls for the resilient planning of our settlements and cities. This requires a certain level of decentralization of the urban infrastructure, leading to the application of green infrastructure, innovative green technologies, or a combination of technologies for integrated management of water, food, and energy (the Nexus approach). Increased industrialization and urbanization in recent years have dramatically affected the number of urban buildings, with major effects on the climate of urban spaces, energy consumption in the building sector, and water consumption and pollution. On the other hand, nature has developed intense self-regulating, self-cleaning, and buffering capacities. In the context of improving well-being in settlements and cities while coping with climate change, the application of technologies that mimic healthy natural ecosystems has become vital.

The paper is focused on two case studies of green infrastructure; green roofs, and treatment wetlands (TW) from the perspective of decreasing heat island intensity and reducing waste water pollution. A systematic literature review and field measures showed that the introduction of green roofs in future settlements and cities may result in decreased heat island intensity. The results prove that a temperature decrease depends on climatic characteristics, the amount of vegetation, and urban geometry. TW, which are the “kidneys of the landscape” due to their functions in the hydrologic and biogeochemical cycles, provide side benefits in terms of public use, wildlife habitats, and aesthetic value. In the last 25 years, about 120 TW have been constructed in Slovenia. The monitoring results of 20 single-stage, vertical-flow TW (constructed in Slovenia from 2013 to 2015) showed that they can efficiently reduce water pollution by taking into account operational and legislation requirements. Average outlet concentration was 40.9 mg/l O<sub>2</sub> and 8.85 mg/l O<sub>2</sub> for COD and BOD<sub>5</sub>, respectively.

Both case studies of green infrastructure can be seen as multifunctional infrastructures that can mitigate several negative effects of urbanization, climate change, and other urban activities.

**Renewables energy as “green infrastructure” – Slogan, interest, or integrated policy?****Viktor Varjú****MTA KRTK Regionális Kutatások Intézete/Institute for Regional Studies (HAS)****varju@rkk.hu**

The “EU2030” goal includes the increase of a renewable energy share to at least of 27% of the EU’s energy consumption. Renewables, especially photovoltaic energy investments, have become increasingly popular in the last few years. Renewable energy is appearing more and more frequently as a priority area, not only in the capital city but in other cities as well. In order to achieve renewable goals, governments have begun to support green electricity, causing a boom in installed capacity in some central European countries. However, this increase can have negative effects: the overuse of subsidies and the cut states cannot maintain this high level of support. The research question of this paper is: how can changes in renewable energy regulation city planning strategies? What are the main factors determining cities’ level of investment in renewables? Drawing on policy documents, development strategies, interviews and questionnaires, the author concludes by arguing that the key motivations of investing renewables differs from state to state, city to city. These motivations are influenced by central governments but mainly depend upon local stakeholders (most often motivated by economic interests and the use of sustainability as a slogan, not a reason).

## Can urban trees reduce the impact of climate change on storm runoff?

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The process of urbanization has led to significant changes in surface cover, which has influenced the hydrological properties of an area. The infiltration of precipitation into the soil is reduced, and therefore both surface water runoff and the speed at which water travels have increased drastically. Storm water in cities is usually drained through the sewers and drainage canals. In the last few decades, the impact of climate change on precipitation trends has been observed. Studies have shown that the amount of rainfall is increasing and that heavy rainfall events are becoming more frequent. These changes result in greater amounts of runoff that have to be drained. Therefore, among other consequences of climate change, it is also more challenging and more expensive to maintain storm water management. As part of green infrastructure, urban trees, in addition to having many other positive effects on the urban environment, are increasingly recognized for regulating storm water amount and therefore also reducing storm water management costs. Trees can reduce runoff due to rainfall interception. This phenomenon occurs when rainfall falls to a ground that is covered with vegetation, which divides precipitation on intercepted rainfall (retained in the canopy) and through-fall (reaches the ground by dripping, falling through the canopy openings or flowing down the stem). Part of the rainfall, which is retained on leaves and branches, evaporates over time to the atmosphere so it does not reach the ground. The remaining reduced precipitation eventually reaches the ground and contributes to surface runoff.

The amount of intercepted rainfall and, consequently, the percentage of surface runoff reduction depends on various parameters such as average rainfall intensity, typical distribution of rainfall over the year for the targeted area, tree crown size, canopy storage capacity, leaf area index, diameter at breast height, and bark structure. In order to plan tree planting with a view to storm-water reduction, the planner must know the impact of the parameters on the interception amount so as to be able to select suitable tree species. Studies of these parameters' impacts are common for forests in which measurements of rainfall interception are available, but their effects in urban areas have not yet been well quantified. In order to contribute to understanding rainfall interception in urban areas, we have conducted measurements of through-fall under isolated deciduous (*Betula pendula*) and coniferous (*Pinus nigra*) trees in the city of Ljubljana, Slovenia. A comparison of two tree species shows significant differences in interception. Tree characteristics were set by measurements and used to calculate the effectiveness of each tree species in reducing costs of urban management, as in the case of a large parking lot near the research plot where the rainfall interception measurements were conducted.

## **Future possibilities of green walls in a medium sized Hungarian town – A case study of Kecskemét**

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Adaptation to climate change is probably one of the most urgent tasks for settlements, especially for larger cities. In the case of densely built cities, the challenge is to manage the negative processes of urban heat islands, which can be detected particularly during summer periods.

In our work, we focus on the possibilities of green wall applications. Green walls are important elements of green infrastructure and have a crucial role in modifying the microclimate. They can also contribute to reducing energy usage. Our aims are the following: to show the function of green walls as parts of a green infrastructure and to predict expected changes in importance before 2050, based on the example of Kecskemét. This town is a relatively large settlement in Hungary, with 114,000 inhabitants. The city is located in the climate-sensitive Carpathian basin, on the sand ridges between the Danube and Tisza rivers. From the point of view of green infrastructure, Kecskemét is certainly not among the worst settlements, thanks to its so-called "green zone," an arboretum and leisure park with a substantial water surface. However, in spite of the green zone, the microclimatic circumstances of the downtown are not entirely favorable. One reason for this is the lack of green surfaces in the streets, in the squares, and in the relatively small housing plots; such potential green surfaces could improve air quality and decrease local temperature anomalies.

Currently, there are no outdoor green walls in Kecskemét, which leaves open a great opportunity for development. However, not every building is a good candidate to be covered with plants. In this work, we do not examine private buildings, where the use of green infrastructure depends on the personal decisions of the inhabitants and owners; in contrast, urban management and local developers could be required to build green infrastructure. Therefore, in our study, we focused on public buildings with the exception of renovated, modernized structures and tourist attractions such as town halls, churches, etc. The local strategies and environmental programs emphasize the health status and the comfort of the population, topics which are strongly correlated with climate-conscious attitude and solutions. We draw attention to the importance of green infrastructure and future development opportunities, and we quantify the energy savings that result from less heating and air-conditioning in green infrastructure buildings.

## **Analytical tools for determining the effects of location and size of urban green spaces and water bodies on the microclimate and quality of life**

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Type and distribution of urban green spaces and water bodies are key factors for microclimatic quality. At the same time, accessibility to urban green is an important aspect of quality of life, especially in areas of high density in built-up areas (Arlt et al. 2005). Urban green areas that contain a mix of trees, lawns, meadows, shrubs, bushes and hedges can reduce the air temperature in the afternoons and evenings up to a distance of 200–300 m into adjacent neighborhoods, thereby reducing heat stress on hot summer days (Arlt et al. 2005, Mathey et al. 2011). Similar effects can be observed with water bodies. The air temperature is reduced by means of evaporation, similar to an oasis effect.

Each city has its own physical structure. The relevance of urban green spaces for the living conditions in the city depends on its physical structure and, especially, on the distance between the type of residential areas, whether located next to a high-density area (e.g., heavy built-up blocks from the 1880s) or next to low-density areas consisting of single-family homes.

The IOER developed a tool to detect potential heat islands and to quantify the size and number of such “risk” areas. The tool allows the user to calculate the accessibility of green areas and water bodies to the inhabitants and to quantify that accessibility in terms of affected persons.

The approach is based on a multi-criteria assessment, using a number of parameters to describe the issue. In this approach, built-up areas of high density are differentiated according to their use (residential, mixed use, commercial, industry, and social infrastructure). Green and water areas within the settlement area are calculated with a specific green index. The neighborhood of high-density areas and urban green / water bodies is calculated using Euclidean distance. Critical areas of the built-up settlements can thereby be illustrated with maps. The mean of all distances and the maximum of Euclidian distance are merged into one dimension. By means of extremum standardization (0–1), it is possible to compare cities.

By superimposing the critical areas with population density from the 2011 census, it is possible to estimate the number of inhabitants affected.

A GIS source is the ATKIS basic landscape model for the analysis of settlement areas. The approach examined seven large- to medium-sized cities for test and evaluation.

## **Green infrastructure for sustainable water management – Case study: Flood reservoir Podutik**

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Precipitation is an essential part of the global water cycle, necessary for the recharge of surface- and ground-waters. In a natural environment, there is an unimpeded connection between land, groundwater, and surface waters, while in urban areas, this connection is interrupted by impervious surfaces. The increased surface runoff might cause flooding in the cities and downstream water bodies and flushes numerous pollutants, which accumulate on urban surfaces. The city of Ljubljana (Slovenia) has dealt with flooding for many years. However, the events of recent years have made clear that additional flood protection measures are needed to achieve higher resilience to climate change. The use of green infrastructure, such as ecosystem technologies (ET) that mimic the natural environment, could offer new approaches in flood reservoirs and storm-water retention ponds management by changing them into multipurpose green urban areas. ET comprises a broad range of environmental engineering facilities, such as vegetated drainage ditches, waste stabilization ponds, detention ponds, treatment wetlands, phytoremediation, and revitalization measures, etc. ET represents an innovative approach towards nature, space, and environmental protection, based on a holistic approach.

An example of ET for storm-water management was implemented in a flood reservoir called Podutik. The existing reservoir, from 1986, has been redesigned into a multi-functional flood reservoir with enhanced ecosystem services. The reconstruction was carried out based on the framework of the 7FP Turas project. The flood reservoir receives flood water from a nearby stream, as well as surface runoff from surrounding residential surfaces. The ET was constructed within the flood reservoir, consisting of a constructed wetland and a new riverbed able to provide several environmental protection functions, namely: 1) Flood prevention, 2) Water retention for irrigation purposes of nearby green areas; 3) Water pollution mitigation from urban gardens and sewage overflows; 4) Increased self-cleaning capacity of the ecosystem; 5) Increased

biodiversity; 6) Establishment of recreation and education paths.

The hydraulic capacity of Podutik was evaluated using different hydraulic models. ET efficiency performance was estimated based on the physical, chemical, and microbiological analyses of water on regular bases from 2006 to 2014. The composition of the algae community was determined to assess the ecological status of Podutik, while the vegetation and bird populations were determined to assess biodiversity.

The efficiency performance of the ET regarding water quality parameters showed that pollutant concentrations met the outflow permitted levels. The biodiversity of the algae community in Podutik was high, and the ecological status of the system was good. A vegetation and bird inventory revealed the high biodiversity of hygrophilous and marsh plants and nesting birds. Results show that with the establishment of the ET, several ecosystems services have been provided (e.g., water retention and biodiversity).

In the context of sustainable water management, the ET has a great capacity to mitigate water level fluctuations and has strong remediation ability. It will also provide a higher level of biodiversity and higher stability of ecosystems, which can ensure higher resilience to climate change.

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