

SMART AND GREEN

The Future of Visegrad Cities



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Introduction - The project

The project “Smart and Green: The Future of Visegrad Cities” is a project funded by the Visegrad Fund. Organisations from the four Visegrad countries, Poland, Czech Republic, Slovakia and Hungary were working together with the goal to collect best practice case studies on smart city innovations with green components and to conduct interviews with several experts of the topic, resulting in this practical document mostly for decision makers, but also giving some insight for laics interested in the topic.

The four Partners from the Visegrad countries collected 16 case studies on smart city solutions, as well as conducted 18 interviews based on the same questions with national smart city experts, government representatives, landscape architects, and smart city innovators themselves. The following text summarizes these interviews.

Urban areas in Visegrad countries are rapidly changing, but still the region is falling behind in facing the growing challenges in sustainable ways. Effective international cooperation among these four countries would avoid duplication of efforts and ensure the exchange of knowledge between relevant sectors. To enhance the cooperation, CEEweb for Biodiversity from Hungary, the Association for Garden Design and Landscaping from Slovakia, the Polish Green Roof Association and the Czech Landscape Gardening Association were working together closely.

This publication deals with cities from the Visegrad countries and gives insight in cities such as Budapest (Hungary), Warsaw, Wrocław (Poland), Bratislava, Trnava, Nitra, Zvolen (Slovakia), Brno, Litoměřice, Písek, Uherské Hradiště (Czech Republic).

The four Partners conducted interviews with following experts:

Association for Garden Design and Landscaping, Slovakia:

Zuzana Hudeková, Expert at Regional Ecological Center Bratislava, Bratislava

Natália Puschmannová from City Municipality of Bratislava, Department of Architecture, Bratislava

Štefan Lančarič, from City Municipality of Nitra, Local Proxy Body for Integrated Regional Operational Programme, Nitra

Libuše Murínová from City Municipality of Zvolen, Department of Environment and Transport, Zvolen

Jarmila Garaiová from City Municipality of Trnava, Department of Spatial Development and Urban Conceptions, Trnava

Martina B. Paulíková, NGO Slatinka, Zvolen

CEEweb for Biodiversity, Hungary:

Péter Varga from Organica Water Inc, International Company Gyula Szabolcs Fekete from Road Management Co. of Municipality of Budapest

Judit Rab and Samu Szemerey from Lechner Knowledge Centre, Budapest

Zsombor Tatai from Budapest Capital Urban Planning

Ltd., Budapest

Czech Landscape Gardening Association, Czech Republic:

Marek Ščerba from the Department of Transport Telematics of the Center for Transport Research, Uherské Hradiště Jaroslav Klusák, Energy manager of the city of Litoměřice, Litoměřice

Miloslav Šatra, Head of the Department of the environment, Písek

Jana Drápalová, Mayor of the the district of Nový Lískovec, Municipality of Brno, Nový Lískovec

Polish Green Roof Association, Poland:

Marzena Bronisz, Landscape Architect from PoLandscape Company, Warsaw

Katarzyna Wróblewska, PhD from Wrocław University of Environmental and Life Sciences, Department of Horticulture, Wrocław

Marta Żaryn, Python Developer, Polish Green Roof Association, Warsaw

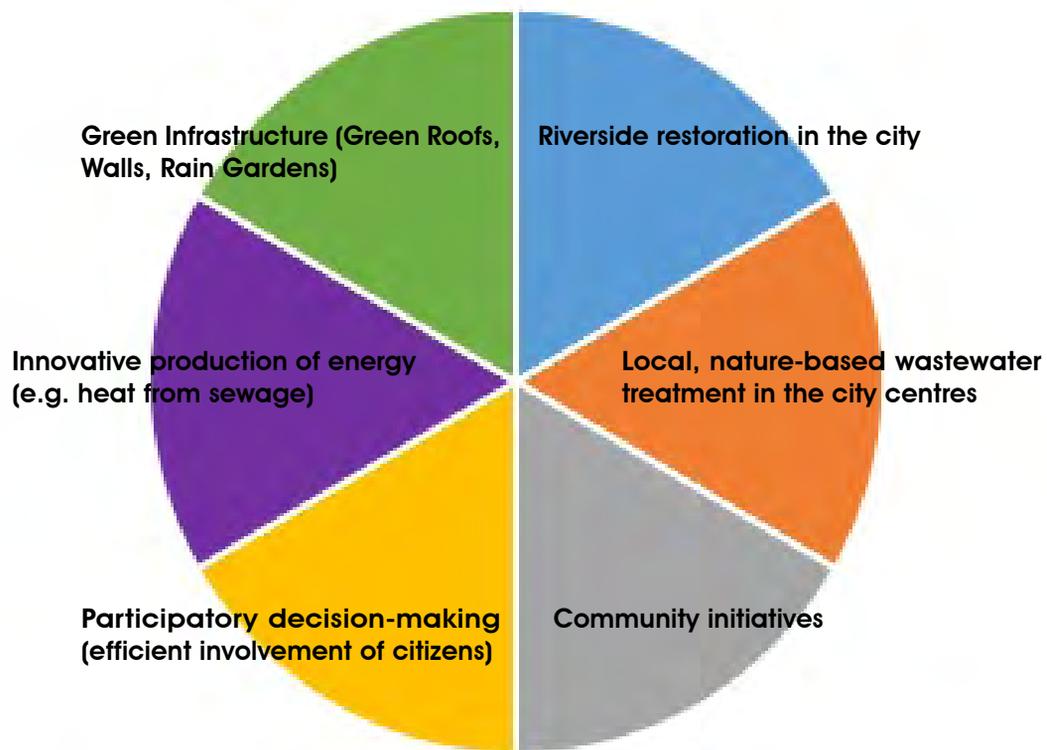
What are smart cities? Why combine smart with green?

Three quarters of EU citizens live in urban areas (1), and 54.5 per cent of the world's population lives in urban settlements, projected to further grow in the near future (2). With a growing population in the cities less and less space is available for nature, thus Smart Cities can be an aid for both people and nature.

Smart Cities use technology to meet citizens' needs and improve the efficiency of urban services. It is a concept that was developed in order to tackle modern challenges in urban settings. In search of more sustainable solutions to these challenges, an increasing number of cities are turning to solutions that are inspired by, supported by or copied from nature. Nevertheless, a smart city is not only a city that develops its information and communication technology, but combines these with green, nature-based solutions, this way turning environmental, economic and social challenges into innovation opportunities, not letting our cities turn grey.

In Hungary and in the Czech Republic 70 percent, in Poland 60,2 percent, in Slovakia 54,4 percent of the population live in cities (3, 4, 5, 6). It is quite obvious that we need more liveable and greener cities, to have a better quality of life. New solutions are in many cases even cheaper than conventional ones (7).

Components of smart cities



Smart and Green cities in a nutshell

Why should we use smart and green solutions?

- They improve our health and the overall quality of our lives;
- Create self-sufficient cities energy wise;
- Mitigate urban heat island effect;
- Improve water, soil and air quality;
- Make our cities more beautiful;
- Keep us fit by providing more opportunities for recreation;
- Increase real estate values.

What is stopping us from having smarter, greener cities?

- Mental barriers – preventing the introduction of innovative technologies in conservative surroundings
- Legislation – lack of standards and regulations, multiple layers of jurisdiction;
- Citizens/users themselves – absence of awareness about the benefits;
- Decision-makers – might be challenging to convince to make a change;
- Lack of a holistic approach – harmonization with other sectors is essential;
- Budget – sometimes there is a will, but it is difficult to find a way;
- Time – making significant progress is time-consuming.

What can we do about it?

- Communicate the advantages of smart, nature-based solutions in comparison to the strictly technical ones to all stakeholders, including the more conservative industries;
- Advocate the change of the existing regulations and dedicating more money from the budget for smart solutions;
- Include citizens in planning phases, let their voices be heard;
- Present green solutions that are cheaper than the existing ones when talking to the decision-makers;
- Establish long-term strategic partnerships;
- Gain knowledge – visit conferences, exchange ideas and experiences: the tools are already there and they might be easier to implement than you think!

Main challenges to tackle with smart city solutions

THE ASPECT OF GOVERNANCE

Our goal was to find out how experts working with smart city solutions perceive challenges from the aspect of governance. In the following section you will read about the multiple layers of jurisdiction, regulation, mental barriers, and gain insights to good practices in some cities' management efforts to implement smart innovations.

BUDAPEST

One of the most important challenges that Budapest has to tackle is the **multiple layers of jurisdiction**. The capital of Hungary is governed on the one hand by the District Municipalities and on the other by the Municipality of Budapest. Thus, the application of smart city ideas often encounters difficulties when trying to implement them in double-layered regulations. A smart city innovation is integrated, and the legal environment has to enable and foster that.

In the last centuries no decision-making environment has been established that would be suitable for the adaptation of innovations, whether in a human capacity or legally (Rab, 2017).

"In a municipality, a lot of institutions have solar-panels on their roofs. The innovation that these solar panels are networked in a system, so the electricity produced can be used in a different location, has legal barriers. Hungary's legal environment today enables big electricity producers and big companies to deliver electricity to the population." - tells Judit Rab, Head of the Municipal Services Department at Lechner Knowledge Center.

"Hungarian society is used to a sanctioning legal surrounding, and knows what they should not do. This is counterproductive, as it is almost certain that we will encounter an obstacle when establishing something new." – says Judit Rab, Head of the Municipal Services Department at Lechner Knowledge Center.

Therefore, a permitting regulation that would assign responsibilities explicitly, would be more effective. "It is important to assign the responsibilities. On small areas this has already started in Hungary, but it usually encounters big obstacles. Awareness raising for being responsible for something should be started in a young age, and later the responsibilities should be exactly defined, knowing also the other people's responsibilities"

The main disadvantage is the fragmentation of the responsibility also in Slovakia. There are 3 Ministries (Ministry of Economy of the Slovak Republic, Ministry of Transport and Construction of the Slovak Republic and Ministry of Environment of the Slovak Republic) and the Government Office of the Slovak Republic, who are dealing with Smart Cities, which leads to the solution of the specific issues, but general

conceptual state strategy is missing.

In Hungary, instead of goal oriented development, a **fund-oriented development** is present. This is why it is highly important to structure and streamline the funds in line with the commitments. (Rab, 2017).

There are also **psychological or mental barriers**. People are not aware that they have the right to decide, moreover, that they should decide. Participation is about that the population can decide and for this, citizens need to be educated (7) (Lechner Knowledge Center, Judit Rab). "Trust in institutions, in decision makers, in each other and in companies is low, which affects effectiveness and commitment." – says Judit Rab, Head of the Municipal Services Department at Lechner Knowledge Center. - "Those projects which consider that in Hungary there is another situation; something that can be implemented in Helsinki cannot be copied the same way, but only similarly, in another operational model, can be successful".

BRNO

There is a common conceptual challenge in all of the interviewed cities – what is a smart solution and what is not – which echoed in interviewees' answers even more when talking about the combination of "smart and green".

This difficulty probably stems in the fact that all of the interviewed experts have already achieved significant results in their cities, be it in the area of alternative energy, waste management or traffic control, but they are hesitant when it comes to labelling the solutions as "smart". "It seems to us, that there is a risk of the **term smart being profaned soon**, similarly as the terms sustainability or the previously popular Agenda 21. Today, once again everything is concealed under smart while it sometimes seems that it is only a marketing strategy of modern technologies' suppliers. We want the human, as the ultimate user of these measures and solutions, to not be left out (Drápalová, 2017)," says Jana Drápalová, Mayor of the district of Nový Lískovec, municipality of Brno.

PÍSEK

This The first city in the Czech Republic to embrace the "smart city" concept provides a similar account, contrasting the long-term strategy of Písek with the recent "smart" phenomenon: "Písek has employed smart measures as early as in the 90s – without it being called so – such as gas installations, traffic restrictions in the city center, harmonization of traffic lights on uphill roads, monitoring of air quality, etc. We strived to control our waste management even at the time when it was not by the law to do so (Šatra, 2017)," says Miloslav Šatra, Head of the Department of the Environment in Písek.

Since Písek has been the frontrunner in the field, in some areas it had to overcome challenges that other cities did not face: "One of the challenges is **the coherence with Czech legislation**. We started using innovative technologies in the areas of waste collection, organic waste or kitchen waste management more than 20 years ago. What we have found challenging is that innovative solutions such as sludge disposal often **lack an enabling legislative framework**. Fortunately, legislation is similar in the European Union so it is not such a lengthy process to enact appropriate laws now."

BRATISLAVA, NITRA, TRNAVA, ZVOLEN

This Natália Puschmannová (Department of Architecture, Bratislava City Municipality) and Jarmila Garaiová (landscape architect, Department of Spatial Development and Urban Conceptions, Trnava City Municipality), have both agreed that the cities are struggling with air, soil, water and noise pollution, where the main sources of pollution are transport, agricultural activity and industrial production. Pollution increases due to low environmental quality of the city and its very low ecological stability and alarming deficit of accessible forest parks, parks and areas with recreational facilities. Significant negative effects could be seen due to global climate change, particularly in the increasing number of heat days, existence of urban heat islands, prolonged periods of drought, deficiency of precipitation, increasing flooding situations, including floods from more intensive heavy rainfall." Libuše Murínova (Department of Environment and Transport, Zvolen City Municipality) predicts growing financial expenses for city municipalities due to the above mentioned situation.

Zuzana Hudeková, landscape architect, expert for the Climate Change Strategy and the key person for the maintenance plan of the green areas in Karlova Ves, perceives "establishing the common understanding of the principles of differentiated green spaces management - especially the reduction of mowing in some parts of the municipality green spaces" as the main challenge. "The challenge was to communicate the reduction of mowing to the local inhabitants."

The plans of Nitra city are ambitious: The city plans to gradually introduce intelligent public transport, which will be truly environmentally friendly. The living standards of the population should also be increased by the modernization of public lighting as well as the modernization of waste management. Smart City intention is also geared to the electrification of urban services and enabling energy security.

Katarzyna Wróblewska (PhD from Wrocław University of Environmental and Life Sciences) from Poland says, that apart from some biological factors, such as plant diseases, the greatest difficulty is to convince authorities about the necessity of the use of such solutions, thus running research in this field. Marta Żaryn (Polish Green Roof Association) adds: "A big challenge related to smart city solutions which we have to tackle is the lack of awareness and gathering funds".

GOVERNANCE

Smart city planning in Bratislava

Ideas in practice - Slovakia

Bratislava has elaborated a **Concept for the smart city development** in cooperation with experts from Vienna and Brno. There are 4 priorities of the smart city concept: the first is public participation, the second is the **quality of public and social services**, the third is **transparency** and the fourth are the long-term strategies of Bratislava. New technologies will be applied in mobility, traffic, energy, lighting, services for citizens and green management. **The energy consumption of Bratislava should be reduced by 20% by 2020.**

Within the project **“Bratislava is preparing for climate change - a pilot project for rainfall precipitation and management in urban areas”** several localities were established for retention, rainfall management and for supporting biodiversity in the urban environment.

Great example is Bratislava Municipality Karlova Ves, a very densely populated urban area, the typical city district prevailing consisting of prefabricated buildings with a large number of apartments. The low construction quality of “concrete” buildings is accompanied with relatively poor quality of the open urban spaces and the lack of green spaces. These facts led Bratislava Municipality Karlova Ves to pilot some innovative solutions. As the first municipality in Slovakia, Bratislava Karlova Ves calculated its carbon footprint. One of the possibilities to decrease the carbon footprint and in the same time to increase the biodiversity is the differentiated green spaces management, which Bratislava Karlova Ves started to implement in 2016.



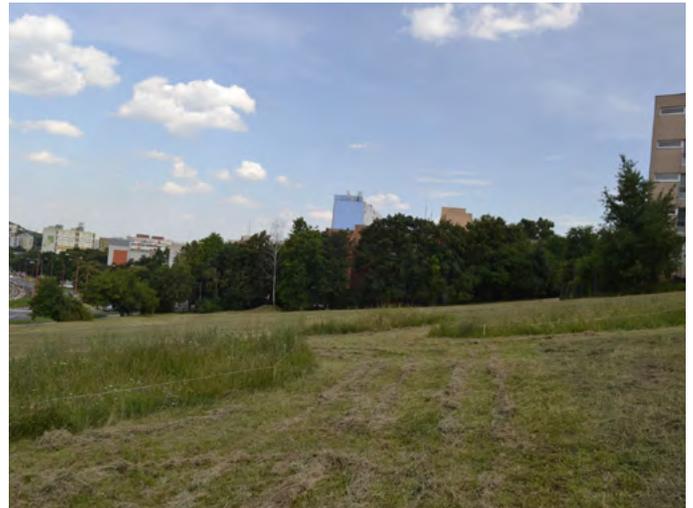
Photo: archive Zuzana Hudekova



Implementing the flower meadows into public open spaces (city parks, residential areas, at the administrative buildings) helps to increase the biodiversity in the urban environment. Bratislava, Slovakia (Photos: Maria Bihunova)



Insect hotels, information boards, mixture of flowers and changing colours all have educational character. Bratislava, Slovakia (Photos: Maria Bihunova)



Different management of the meadows in the District Karlova Ves (Bratislava), which enhance the biodiversity and support bees and insects. Slovakia (Photos: Zuzana Hudeková)



Different management of the meadows in the District Karlova Ves (Bratislava), which enhance the biodiversity and support honey bees and insects. Slovakia (Photos: Zuzana Hudeková)

ENVIRONMENT & ALTERNATIVE ENERGY

Energy management of public buildings in Brno – Nový Lískovec

Ideas in practice - Czech Republic

In 2015, the Brno City Council approved a strategic document called **Smart City Brno Concept** which proposes an analysis of the status quo, aims, vision and introduces a participative governance structure called the City Ecosystem. One of key parts of Brno's smart city strategy is a program to support energy efficient buildings. A pilot area for these types of measures is the district Nový Lískovec. The district features an extensive 20-30 years old estate of prefabricated concrete apartment buildings of 3500 units, of those around 860 are in the city's ownership. By insulating the buildings, 1 ton of CO₂ per inhabitant was saved. Since then, the city has been conducting energy management of buildings on a weekly basis to quickly determine sudden deviations from normal values and arrange for repairs, preventing unexpected energy bills. The data is publicly available for monitoring at the district's [website](#). In September 2016, the district's Mayor, Jana Drápalová, signed a memorandum of cooperation with the Technology Agency of the Czech Republic which marked the launch of a new process, bringing Nový Lískovec among frontrunner Czech smart cities. As a part of the signed memorandum, two projects will be implemented: **a pilot low-energy public building of a community center and a smart parking system.**



Prefab concrete apartment buildings in Nový Lískovec, Czech Republic, after renovation.
(Source: Open license)



Prefab concrete apartment buildings in Nový Lískovec, Czech Republic, after renovation.
(Source: Open license)

ENVIRONMENT & ALTERNATIVE ENERGY

Smart alternative energy project of the city of Písek

Ideas in practice - Czech Republic

Písek was the first Czech city to officially embrace the “smart city” concept. The smart strategy rests on three pillars: **intelligent mobility, intelligent energetics & services and integrated infrastructure and ICT**. Besides a number of smart solutions already adopted, the city has recently taken steps to mitigate inefficiencies in its water mains grid, which should annually save around 3 million liters of water, by installing pressure and sediment sensors into pipelines. On the opposite end of the spectrum, Písek also decided to improve its treatment of sewage water to reduce costs arising from sludge disposal and also to reduce potential environmental impacts of sludge dumping. Using a state-of-the-art sludge utilization plant, sludge will be incinerated in a closed cycle without any undesirable byproducts and only water vapors and small amounts of ashes remaining. Furthermore, these sanitized ashes will then be used as a component for the production of fertilizers in accordance with Czech and European laws. The sludge incineration plant will be self-sustainable in terms of energy and will even be able to power the surrounding buildings of the water purification plant. By employing this technology, the City of Písek will annually save around 1.8 mil CZK in costs related to sludge disposal and if a LIFE grant application is approved, the initial investment is expected to return in 9 to 11 years.



The oldest Czech bridge (from the 13th century) is located in the first Czech smart city. (Source: Open license.)

GOVERNANCE

Smart actions taken in Trnava

Ideas in practice - Slovakia

Trnava is one of the few cities in Slovakia that has several conceptual documents dealing with the development of the greenery and management of the greenery. Trnava city has taken target steps in improving the quality of the open green spaces and urban environment of the city as following:

1. Shielding of public spaces, paths, children playgrounds and school yards; using climbing plants and plants on constructions/vertical vegetation.
2. The city municipality has been adopting the program to cool down public open spaces for 3 years now.
3. The city has recently implemented a number of adaptation measures to climate change
4. Trnava has alternative energy sources - a 55 kWp photovoltaic power plant, supports electro mobility by construction of power stations, supports alternative forms of transport by building the cycle-ways and Bike Tower.

There have been plenty of trees planted within the city cadastral, recreational zones in the city and its surroundings have been reconstructed or established, there is a huge support for safe, sustainable and ecological movement. Trnava has a **Strategy for the climate change adaptation, Conception for the alternative plant planting, Conception for smart traffic system, Detail urban plan of the city, Guidelines for the urban, architectural, landscape competitions** and many more.

All documentations, strategies, guidelines are published on the website of the city (www.trnava.sk).



New recreational zones in Trnava, Slovakia
(Photo: Maria Bihunova)



Revitalisation of the historical parts in Trnava, Land art at pedestrian zone (temporary installation) Slovakia (Source: facebook Trnava)



Elevated (temporary) flower beds and plant on the construction are also the ways of importing the green element to streets in the city centre. Trnava. Slovakia (Photos: Maria Bihunova)

Practical challenges

Our goal was to find out how experts working with smart city solutions perceive challenges from the practical point of view. Read about extra work hours, the distrust of investors, difficulties and solutions in water management and water retention, financial resources and on the need to prove the effectiveness of smart solutions.

Mental barriers are present also on the practical level – the introduction of innovative technologies in conservative surroundings and in a slow-moving industry often encounters obstacles, and takes a lot of time. Producing completely new types of solutions and designs is always a challenge. “The entrance of our technology into new

markets has taken a little bit longer than we planned, in spite of the fact that we are still moving in a much faster pace than almost all other existing technologies in the wastewater industry today. The challenge is really getting the first reference in a new place. – tells Péter Varga, Senior Manager at Organica Water.

ENVIRONMENT & ALTERNATIVE ENERGY

Smart way of wastewater treatment in a city Organica Water

Ideas in practice - Hungary

Organica Water creates innovative smart city solutions for wastewater treatment, which is based on natural systems and has a smaller physical footprint compared to the traditional wastewater treatment plants. It is an innovative and sustainable approach to treat sewage locally, with creating a botanical garden-like environment on the spot instead of pumping the sewage through extensive pipelines under the city outside the center to large, smelly, and inefficient wastewater treatment plants. The enhanced biological solution of treating sewage is not only cost-effective, making possible water reuse for irrigation, but also brings healthier environment to the citizens living in the cities with rapidly growing population.



Organica Water's wastewater treatment plants in different cities (Source: www.organicaewater.com)

Being innovative in a governmental entity is a challenge. "Being innovative in the IT sector can be frightening. The new technology has to be easy to understand and easy to use. It has to be a pain killer. It must be something that helps the user to make their daily work easier, and if not, they are not interested. The task is to convince the users that it is easy to use, that it is more comfortable, more reliable, more efficient." – says Gyula Fekete, Senior GIS Expert at Road Management Co. of Municipality of Budapest.

From a practical point of view, it is a challenge to ensure that the smart innovation is not more expensive than its former solution. In case it is more

expensive, it needs to be even more efficient in terms of economic results (Fekete, 2017).

Zsombor Tatai, Environmental Planning Office Leader at Budapest Capital Urban Planning Ltd. tells the following about the sewer system in Budapest: "The **sewer system** in Budapest has a capacity problem, as the system cannot drain heavy rainfall. Development of the infrastructure is not possible anymore and is also a huge cost. **We need to retain the water with green infrastructure measures.** We need **rain gardens** and other **green applications** which can relieve the infrastructure, thus improving the water balance, essential for urban

vegetation. It is a typical problem that there isn't enough water in periods of drought or in another period there is too much water available. **This could be balanced with smart solutions.** We see a lot of times in public spaces that the drainage of rainwater is of utmost priority, and green areas were protected with edges (so that salty snow slush cannot flow on it). Thus it has a reason, why the water from the pavement was not directed to the green areas. Nevertheless, **we need to try to retain the water where it is possible.**"

ENVIRONMENT & ALTERNATIVE ENERGY

Rain water management in Zvolen

Ideas in practice - Slovakia

Innovative biotechnological approaches for rainwater management in Zvolen are focused in particularly on adaptation measures on climate change, enhancing the biodiversity of the environment and green areas due to sustainability principles. 32 rain gardens and 25 underground rainwater reservoirs have been constructed for irrigation needs and re-use in buildings for sanitary facilities. Open bioclimatic pools have been built in the forests and public open spaces (4 pieces) and an extensive green roof garden on the bus station. There is an active intent to establish bees in the urban environment, to maintain lawns extensively, establish flower meadows, plant fruit trees and flowering trees. All named measures are done with the aim to increase the biodiversity. In October 2017 the first natural cemetery in Slovakia was opened in Zvolen. They are based on the principles of nature-close maintenance. There is a close cooperation with the Technical University in Zvolen, and non-governmental associations Živica and Slatinka.



Roof garden above bus station, Zvolen, Slovakia (Photo: Maria Bihunova)



Rainwater management, Zvolen, Slovakia (Photo: Maria Bihunova)

Example of the landscape architectural design using the water at the public open space, in front of the Technical University, Zvolen, Slovakia (Photo: Maria Bihunova)



Water tanks in the basement of the City Municipality building, collecting the rainwater, which is afterwards used for flushing lavatories, Zvolen, Slovakia (Photo: Maria Bihunova)

UHERSKÉ HRADIŠTĚ

In Uherské Hradiště, a Moravian city with a large pilot installation of smart traffic sensors, the challenge was largely organizational. To install technologies, permissions had to be obtained from authorities, which entailed much explaining and demonstrating the tangible potential for citizens. “The challenge is still with us, we cannot say we have overcome anything. For us, the challenge is to make investments into these solutions **reasonable** and with a **proven effect for citizens**. The aim is not to install thousands of sensors, communicating units and connect them in a large internet of things which will provide wrong or redundant data. Therefore, the initial strategy and vision is essential, to **determine what we really need** and to achieve it. The usual challenge is also a ubiquitous **distrust** of investors into these new concepts and **lacking**

financial resources for municipal investments, trials and the support of innovative companies (Ščerba, 2017),” says Marek Ščerba, Head of the Department of Transport Telematics, Transport Research Centre (CDV).

LITOMĚŘICE

Distrust is a frequent obstacle to be overcome with novel solutions and is often connected with a lack of knowledge. Litoměřice, a pioneering Czech city in energy management, saw this as the major obstacle on their way. “Initially, the biggest challenge was to **communicate** and explain the city’s approach because on the municipal level the awareness of progressive solutions is not particularly high. Similarly, it was difficult to translate research findings or approaches used abroad to understandable and applicable information (Klusák, 2017),”

says Jaroslav Klusák, Energy Manager of the City of Litoměřice. “To tackle this challenge, the city as part of Healthy City and Local Agenda 21 approach started organizing an annual public event called Top 10 Problems, where **citizens vote about the current pressing issues** and evaluate the progress on the previous ones. The city organizes energy roundtables, advises people on building renovation, organizes days of sustainable mobility and energy and more,” he shares their recipe for success.

Innovation is a lengthy and often arduous process for administrations. “Oftentimes, innovation activities are done **on top of standard working hours** which puts demands on the administration workers,” says Miloslav Šatra (Head of the Department of the Environment in Písek). Nevertheless, it is these extra miles which then distinguish leaders in the field from follower cities.

ENVIRONMENT & ALTERNATIVE ENERGY

Energy management of the city of Litoměřice

Ideas in practice - Czech Republic

The city of Litoměřice is one of the smaller municipalities in the Czech Republic, however, it is a flagship Czech city in the area of energy management. It has signed the Covenant of Mayors and is so far the only Czech city which became a member of the Energy Cities association. In 2016, it received a prestigious ‘A’ rating in the Local Agenda 21, an initiative founded at the Summit in Rio, 1992, acknowledging its good governance principles. Litoměřice committed to reduce its energy consumption by 20 % in 2030 and adopted a number of measures to achieve this. Its energy management consists of several components – low-energy building renovation, photovoltaic panels, savings fund and geothermal energy. Energy performance of renovated public buildings is monitored by an own energy management system, photovoltaic panels are installed on two schools and a kindergarten, resources from the savings fund are distributed back among institutions participating on the energy savings program, and a European-scale geothermal energy project is underway. The “smart” philosophy of Litoměřice is simple: to give an example to its citizens in terms of energy management, sustainability and ecology.



Photovoltaic installation on a local elementary school. The City of Litoměřice, Czech Republic (Source: The City of Litoměřice)



Drilling site of the geothermal energy project. The City of Litoměřice, Czech Republic (Source: The City of Litoměřice)



Public discussion of the 10 biggest problems of the city. The City of Litoměřice, Czech Republic (Source: The City of Litoměřice)



FullCapacity solar bench with a Wi-Fi hotspot and charging sockets. The City of Litoměřice, Czech Republic (Source: The City of Litoměřice)

What are the drivers of the smart city solutions?

Environmental crisis and urbanization, meaning that cities are becoming more and more crowded, are the main drivers of smart and green solutions. The recognition itself, that pollution in the city and other drives causing environmental problems have to stop, and the negative effects of urbanization have to be tackled are the main driving forces. The driver of a smart city solution can often be the need to solve something quicker, easier and more efficiently than it has been done before; which is also the most important feature of a smart city innovation.

Representatives of the institutions which were interviewed under this project are

committed to environmental issues, are aware of, and are sensitive to them on a personal level as well, which is their internal driver. "My internal driver is that I see that there are less and less people involved in the process in Hungary. The Government needs to compensate this in the circumstances of a decreasing population, otherwise the country will not work." says Judit Rab, Lechner Knowledge Center.

"In case of the RODIS project (see in box), the driver was to get homogenous, fully covered information from the roads as soon as possible. The car makes measurements, and on the next day we have the information. In very short term we gain accurate

information about the changes on the roads. **Budapest was the very first city to have that detailed information.** The technology is unique and was used by Singapore as well." - Gyula Fekete, Road Management Co. of Municipality of Budapest.

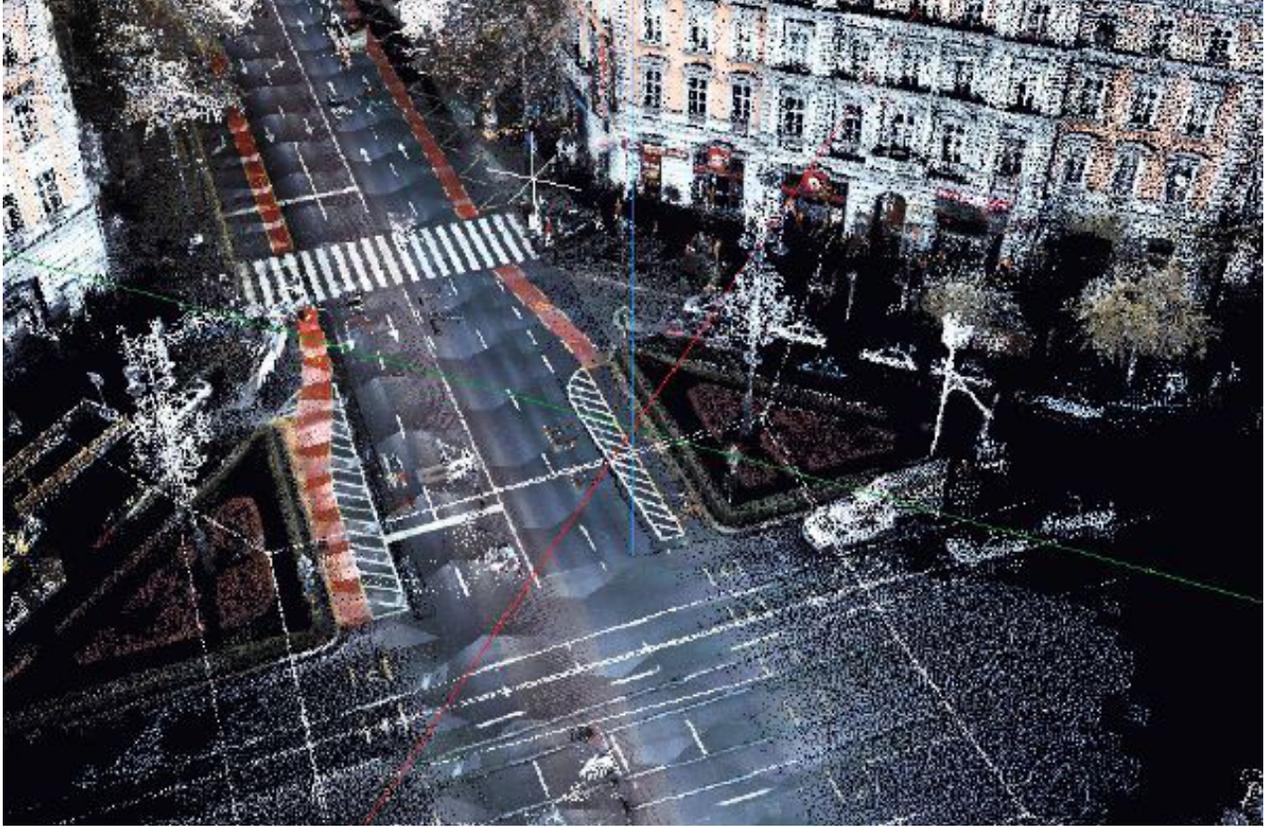
"The driver in our case is the fact that water is becoming more and more valuable and we are running out. The management of water is becoming very critical. In certain places of the world they are really experiencing shortages. To manage and reuse water is driving the development of our technology." – says Péter Varga, Senior Manager at Organica Water.

MOBILITY

THE COMPLETE 3D MAP OF BUDAPEST, RODIS (Implemented by Budapest Road Ltd.)

Ideas in practice - Hungary

Up-to-date data is needed about a city in order to operate well. The project called RODIS (Road Information System) is scanning all public roads of Budapest including signs, objects, vegetation, buildings along the road. The GIS based mapping tool works with mobile laser scanners as well as terrestrial laser scanners and is an innovative investment in Budapest, and it is unique in the world. The high resolution laser scanner records the 3D print of Budapest with up to 1,5 mm high preciseness! On a city scale, this kind of assessment was never done before. It creates a digitalized 3D map of Budapest which enables a simpler and more transparent administration for the city's administration. Work-costs and time needed for the same tasks are reduced (no need for on field measurements), thus there is more space left for developments. The innovation results in better roads, less traffic jams and nicer public spaces. It also enables - for example - to calculate the CO2 catching of a tree, as RODIS has all necessary data, meaning the canopy size, height and form of a tree.



Oktogon square in Budapest, laser scanned by RODIS (Source: Budapest Közút/Budapest Road Management)

Drivers of smart solutions are specific to their respective cities. In the city of Litoměřice, Czech Republic, the primary motivation was to decrease high municipal expenditures by reducing energy consumption in the long run. "The city decided to deal with the issue using a smart and conceptual approach by linking different areas and implementing enabling IT solutions," says Jaroslav Klusák (Energy Manager of the City of Litoměřice). It was not only IT, however, the priority lay with all topics of the Local Agenda 21, above all, **creating a healthy city.**

Smart technologies can provide the right information to make decisions, be it to citizens or to the city's administration. This was the realization with which Uherské Hradiště, Czech Republic, currently runs its traffic sensors project: "Everyone wants and has the right to be informed about the world around them. Therefore, it is necessary to seek and implement solutions which will

fulfill the needs of citizens and also the public administration which will **have better resources for its strategic decisions.** We can observe such benefits in advanced regions such as Nordic countries, the Netherlands and Great Britain. Another motive is to **gain data for further advanced research** by which we could level up with our western colleagues. The third motive was a fact that data from these technologies are measurable and allow comparison of **investment spending efficiency,**" Marek Ščerba (Head of the Department of Transport Telematics, Transport Research Centre (CDV)) enumerates.

Miloslav Šatra (Head of the Department of the Environment in Písek) of Písek, Czech Republic, adds the aspect of innovation and leadership: "It is a **constant search for innovation** because Písek strives to be the leader. We try to contribute with something new and look at inventions already in place to avoid

inventing something that has already been invented. In many aspects, Písek is **inspired abroad.**" He continues: "It is essential that someone from the municipality **leadership** adopts and promotes such measures, in Písek it is the Deputy-Mayor Knot. Fortunately, there is also **continuity** in this aspect across elected political representations," he says.

Finally, and vitally, hardly any one of these measures would have been possible had it not been for other cities going the same way. "We joined the smart city project exactly because **we have something to offer.** It is the sharing of best practices that should be the main principle of a smart city," remarks Jana Drápalová (Mayor of the district of Nový Lískovec, municipality of Brno). This underscores the key role that sharing of best practices and awareness-raising play in promoting any kind of progressive approach.

There are several drivers of smart city solutions also present in Slovakian cities. Firstly, the good cooperation with some local NGOs could be mentioned, which leads to interesting projects. An outstanding example in the field of biodiversity is for example the cooperation with the NGO Zivica (see <https://mestske-vcely.sk/>), in Bratislava, Slovakia. Another good example is the carbon footprint calculation based on the knowledge and supervision of the Czech organisation Ci12 (<http://snizujemeco2.cz/cs/o-programu>) in Bratislava.

Secondly, there is a bottom up initiative where inhabitants of the city pushed the Municipality of Prievidza, Slovakia, to renew the city park and revitalize the pond. In Zvolen, Slovakia, strong requirements of the citizens – demand for the places to relax and recreate in the natural environment led to changes and activities of the city

The third category of motivation was finding ways how to deal with climate change and look for possibilities of improving quality of life in the urban environment (Trnava, Bratislava, Zvolen).

In Nitra, Slovakia, the greenery is included in the sections: **Living Standards** and **City Mobility**, Štefan Lančarič (authorized landscape architect and Manager for IROP (Integrated Regional Operational Programme 2014 - 2020) pointed. Green solutions will be achieved through application of alternative forms of transportation, for example: Bicycle paths with side alleys and additional equipment. Trees will be planted also along class II. and III. roads. In addition, the city is investing in tree planting in urban areas and in the near future, which will help in the revitalization of the city parks, open spaces in residential areas and other green areas, which will be revitalized within the IROP call.

Libuše Murínová (Department of Environment and Transport, Zvolen City Municipality, Slovakia) has presented the concept of the “smart city” in Zvolen, which is primarily focused on the field of climate change prevention. Namely: there is support of the greenery and rainwater management. The other principles of smart cities and their synergy are not far behind. The establishment of the greenery appears to be the least demanding (financially and legally). The planting of suitable trees has been done, the preservation of natural sites in the city is supported, the nature based solutions are implemented and ecological principles of maintenance and establishment of the greenery are used.

The potential for developing smart and green innovations jointly in a city

In many Visegrad cities the potential for developing smart and green solutions is already present. In the following, you can read about how cities embrace the smart city concept in their operation, where potential target areas are transport, energy consumption reduction, rainwater management, green roofs, participation on green solutions workshops and recreational opportunities.

Good use can be made of the existing organisations and innovative ideas in Budapest, Hungary. The potential is already in the city. Nevertheless, as

mentioned before, the diverse management needs to be addressed. Working together with Budapest Horticultural Nonprofit Ltd. (Főkert Zrt) and raising its financial resources would give more opportunities to implement smart and green innovations. The RODIS project (mentioned before), as an example, is supporting the Horticultural Ltd. with a tree-inventory (Fekete, 2017).

It would be smart to have an online platform (like Budapest Dialogue) where we could read the inhabitants' opinions related to green areas/parks/public spaces. So if there is a demand for something, it can be delivered to the

decision makers as soon as possible. Developments in Budapest – as we see it a lot of times – are efficient if the community participation is strong. In Hungary, this participatory planning is still in an early phase. Implementers of course draw back from this as it is a much longer and probably also more costly, but as much as we can loose with the more effort, as much we can gain through it as the society will accept the result more. - says Zsombor Tatai, Environmental Planning Office Leader at Budapest Capital Urban Planning Ltd.

The term “smart” is inherently bound with “green”, according to Marek Ščerba (Head of the Department of Transport Telematics, Transport Research Centre (CDV)), Uherské Hradiště, Czech Republic, thanks to experts from the area of technology and environment, could start researching methods to measure impacts of traffic on the environment and lifestyle and find ways to support **transition to alternative means of transport**. “Thus, we also perceive the green element in a way that we provide data about the environment in a given street with a quantified assessment of **impacts on the health of local people** to initiate a debate about the residential parking. Emissions from cars looking for available parking without advance information constitute an environmental and health burden to the city. Thus, the potential of “smart and green” is enormous, not only in Uherské Hradiště but in every city, and Uherské Hradiště could be **an exemplary city** for middle-sized cities and many other ones. Smart and green innovations should go hand in hand – **we perceive that being smart is also green**,” Ščerba says.

Litoměřice (Czech Republic) has the environment as one of its **priority areas**, following topics defined in the Local Agenda 21. The Agenda serves as a quality benchmark balancing a number of topics, including the environment. “Smart solutions include green solutions, it is a part of a conceptual approach in creating a **healthy city**. Also, there is **high demand for the topic** of environment with the public,” the Energy Manager Klusák says. “For Litoměřice, “smart” is not only technology, but above all **the quality of life**. After all, resolving challenges in social services, free time or culture using technology is questionable.

“Smart” in the sense defined by the EU is a cluster of energy, transport and IT, but there is definitely **potential for effective solutions when other areas are included** (e.g. the environment). Photovoltaic panels, energy cooperatives or citizens’ shares in city’s energy companies are some examples of such an extension,” Klusák adds, noting that the topic of “green” can be understood in a number of ways.

Miloslav Šatra (Head of the Department of the Environment in Písek, Czech Republic) lists the achievements of the city as inspiration for how far “smart and green” solutions can reach: “We have come up with parking solutions, we collect organic waste and have built a compost plant, the produce of which we use for fertilization of green areas, we are researching energy potential of sludge disposal, adopting traffic measures.” We want to **motivate people to separate waste** – for instance we organize excursions for children into secondary waste separation facilities. We feel there is potential in the next generation. We want to do something for “green thinking” – not say that the future generation will take care of it, as we have seen in the past. This is our duty, we cannot be idle,” he stresses. “In the past, we had been asked by colleagues from other cities why we were doing it if there was no obligation to adopt such measures. We said that the time would come, and it did.” In concrete terms, **“smart and green” solutions can, in the future, proliferate in a number of areas**: “Firstly, there is a notable change in the **propulsion of transport** – primarily towards electromobility – which comprises charging stations, sharing and others. Next, there will be the trend of **energy savings** which will introduce self-sufficient houses or cities in terms of energy and lower

the load on the energy distribution infrastructure. In the green area, one of the important trends is **rainwater management** in the country as well as in cities. The Czech Republic suffers from notable warming and drying and the measures now supported by the Ministry of Environment under Dešťovka [rainwater management subsidy program for family houses, editor’s note] should also be applied to industry compounds. One aspect that could help are **green roofs which could be required** in a new construction area,” Šatra concludes his vision.

Nový Lískovec (Czech Republic) had begun with the adoption of “smart” measures far earlier than the term “smart city” even began to be used in various contexts. “For us, “smart” city is primarily about **purposefulness and using healthy common sense**. Therefore, it does not mean using technologies for everything and at any cost. For instance, our energy management program is like a better excel spreadsheet, but the data from it, because it is a unique arithmetic progression, is used by scientists and universities for their research and projects. For us, smart city is about **communication, participation and cooperation**,” says the Mayor, Jana Drápalová. In the city district, there are even plenty of smaller-scale projects which do not employ any sophisticated technology. “The greening of façades, waste container walls or concrete support walls, green roofs, utilization of resilient local woody plants adapted to the dry climate here at Kamenný Vrch and other measures help cool the concrete housing estate in summer and are in fact also smart,” Drápalová says. “I believe that there can be **no smart solution that does not include the green element**,” she concludes.

SOCIETY & LIVING

Renewal of the Danube riversides, the RAK-PARK project in Budapest. The potential of the Danube flowing across a city

Ideas in practice - Hungary

Several completed European examples show that the attractiveness of a riverside increases the quality of life and also the economy. The RAK-PARK project's goal is to establish connectivity between the city and the Danube.

The winner plan includes a floating system on Pest side of the Danube, which will be open to use for citizens. The new appearance will replace cars and guardrails next to the river with green areas. The plan contributes to innovative city facilities for a better life of citizens.



Plan of a floating system on the Danube in Budapest. Architect: Korzó Architect Studio, 2015. (Source: <http://duna.budapest.hu/?p=76>.)

According to Zuzana Hudeková (landscape architect, expert for the Climate Change Strategy and the key person for the maintenance plan of the green areas in Karlova Ves, Bratislava, Slovakia), the smart solution was based on the cooperation between experts, NGOs, local deputies from the environmental committee and municipality office. There is also necessary cooperation with the private sector, start up companies and universities as institutions with a strong research base.

Libuše Murinová (landscape architect at Department of Environment and Transport, Zvolen City Municipality, Slovakia) says that greenery can have a great contribution in the concept of "smart cities," but the concept of "smart cities" is also aimed at innovative approaches in: transport, public lighting, waste management, energy efficiency planning, environmental protection, green solutions or rainwater management.

Natália Puschmannová (architect at Department of Architecture, Bratislava City Municipality, Slovakia) notices the potential for developing of the system of smart solutions for greenery evidence, maintenance and development.

Jozef Dvonč, Mayor of Nitra city, Slovakia, pointed at synergic infrastructure, which will be the base for economy of 21st century. Smart city is a project for several years and it needs conceptual solutions.

Marzena Bronisz, (landscape architect from PoLandscape company) admits that "My Green Roof" project might be implemented in any city – the formula of the workshop is easy to adapt. For organizing the workshop the team will need a construction frame, where

people are able to create a green roof. A place needs to be found for it as well and green roof specialists who will lead the workshops. Of course also promotion and willing participants are needed, but there will be no problem, as people living in big cities feel the lack of green spaces and are aware of its consequences.

Marta Żaryn (python developer, Polish Green Roof Association) add, that also the Green Roof Mapping project is adaptable: promoting analysis results and the 'green roofs idea' is important so municipalities may see potential benefits coming along with creating green roofs. When they will provide incentives, for example tax reduction, more green roofs will be built, because people wish to have even small greenery close to their place of living.

Katarzyna Wróblewska (PhD from Wrocław University of Environmental and Life Sciences) says: "For several years I have been working on green solutions for cities, such as green walls and roofs, but recently I could deal with them in experiments. The main subject of my research is the use of recycled materials as media for plants on green roofs and vertical gardens. The other purpose is to increase the selection of plant species practicable in Polish conditions, demanding higher winter hardiness. As a lecturer, I also try to explain these issues to my students, as a gardener I also pay attention to the cultivation of vegetables, fruits and herbs in cities. This was the reason of an urban farm, done by my students at our University."

"Green roofs are the answer to urban modern challenges – greenery improves water management, absorbs air pollution, helps to save energy, reduces UHI

effect, expands green areas in the cities. It is important to raise awareness about the benefits of green roofs and to show that they don't have to leak as many people think." - Marzena Bronisz (landscape architect from PoLandscape company) said. "As a citizen of Wrocław I get to the city and notice that it is less and less friendly to its inhabitants - high concentration of pollutants in the air, particularly very dangerous benzo[a]pyrene, growing and thickening of urban development at the expense of green areas force us to use solutions, which are available even in such conditions" - Katarzyna Wróblewska (PhD from Wrocław University of Environmental and Life Sciences).

To sum up, developing smart and green innovations jointly in a city requires collaboration of all participants of the process.

ENVIRONMENT & ALTERNATIVE ENERGY

Trafostacja / Transformer - “ecological art” project

Ideas in practice – Poland

Trafostacja / Transformer - “ecological art” project Ideas in practice – Poland

Trafostacja / Transformer - “ecological art” is a project realized in the framework of activities related to the European Capital of Culture in Wrocław, 2016. The author, Joanna Rajkowska is an artist creating installations, mainly in public spaces. Polish Green Roof Association has been invited to the project as green infrastructure specialists. The project brought together residents of Wrocław, mostly from the nearby settlements.

“Trafostation is an attempt to re-naturalize the ecosystem at Niskie Łąki estate in Wrocław, Poland. A defunct transformer station building from 1930 becomes a scaffold for a living sculpture initiated by running a biological ‘machine’ of vegetation. The architecture will be covered by various species of plants, and water will flow from three windows, recalling the 1997 flood that devastated Wrocław. Direct human intervention for this small habitat involved planting ferns, ivy, geraniums, mosses, euonymus and seeding ruderal plants. In the future the building will completely turn into a new habitat. Water and plants are understood as agents and the driving force of the project, hence the form and future of the project is up to them. The vegetation cycle will be a spectacle of non-human forces playing out on a stage created by architecture. Although the performance is intended for humans, the actors of the trafostation are the organisms resident in the ecosystem. Trafostation is therefore a gesture of offering the human phenomena of architecture to other species.” – tells the artist Joanna Rajkowska.

The purpose of the project was to show how old, damaged buildings (present in each city) may become attractive places, and at the same time raise the biodiversity value of the space. Entering the evergreen climbing plants, such as ivy (*Hedera helix*) will make the temperature under the leaves slightly higher than in exposed locations. Because of the insects, which find here their place of living will be taken in a state of winter lethargy later. This will attract birds, which may also begin to nest. In addition, ivy blooms in autumn, the nectar from the flowers is food for bees and other insects at the time when other species are already after the flowering season. In this way, the transformer station becomes a place to live throughout all the year. This will allow the observation of life processes taking place here, both on an annual basis (because of seasonal plants) and long-term, through the observation of the dynamics of perennial climbing plants occupying more and more space.



Transformer station building, Niskie Łąki estate in Wrocław, Poland (Photo: Marta Weber-Siwirska)



Planting climbers in soil. Wrocław, Poland (Photo: Marta Weber-Siwirska)



Planting at altitude. Wrocław, Poland (Photo: Marta Krasnopióro)

Practical obstacles of developing and implementing smart and green innovations jointly

Our target Visegrad cities have to deal with similar practical obstacles. In the following you get insights in problem areas, such as the thinking and willingness of people to use smart city solutions, public utilities and trees, cars and parking places, legislation and the lack of rigorous requirements, and different opinions on the matter of finances..

Obstacles to smart and green solutions proved to be very diverse and specific to the respective Czech cities. Litoměřice deems the biggest obstacle to be in effective communication on the level of administration and with the public. Nevertheless, since the environment is a popular topic, challenges are not too significant but rather marginal.

In Uherské Hradiště (Czech Republic), one of the obstacles of new smart or green concepts is the **distrust** of responsible people working with public budgets. "Offentimes, it is also a fear of the unknown or the **lacking willingness to learn new things or change established "nepotistic" ways etc.** A proactive approach is quite scarce, even though that is slowly changing too," says the transport expert Marek Ščerba Head of the Department of Transport Telematics, Transport Research Centre (CDV).

Písek (Czech Republic), mentions a very concrete problem the city often faces due to its innovative solutions. "The biggest problem is with **designers**

– they do not want to and even cannot do it," says Šatra (Head of the Department of the Environment in Písek). "It is in their thinking, they do not search for new possibilities and try to ease it up for themselves. For instance, when designing a bike trail, they do not consider the area of lost agricultural land, they do not calculate with runoff water and terrain profile," the head of environmental department complains. "The city is for people but what most administrations are doing is driving people out of the city to the nature by absent vegetation, droughts, ill-designed water retention or drainage. The main problem used to be financial when the key tender criterion was price. **Nowadays, it is not a matter of finances, the city will gladly pay for quality measures,**" debunks Šatra a common misconception.

In Hungary there is still a strong technocrat thinking present, and the obstacle is mostly in the thinking of the people. As long as this separate thinking of the sectors is present, the approach will not change, and nature-based solutions will not come to the forefront. The interviewed experts in Hungary noticed the lack of harmonization in the regulation between the different sectors (Rab, 2017).

If we take a closer look at Budapest's structure, we might discover some practical obstacles as well. Budapest is full of public utilities, and sometimes it hinders planting trees. Zsombor Tatai

from Budapest Capital Urban Planning Ltd. tells the following: „Regulation can prevent planting a tree in the proximity of a public utility. While utilities have a protection zone, trees do not. Therefore, if a utility is installed next to a tree, it is not only that the tree is endangered but it cannot be replaced with a new one because of the same regulation – you cannot plant a tree in a proximity of a utility. Solutions like the tree is in a tub gives only the fragment of ecosystem services compared to a tree planted in the soil. In some foreign cities they already apply utility tunnels, where the utilities run in one tunnel so the surface will be available for trees and alleys.”

Each modern city encounters the problem of the growing number of cars and related parking problems. As Zsombor Tatai (Budapest Capital Urban Planning Ltd.) mentions: „**Parking.** It is a constant demand to assure parking spaces - which is a growing demand in Budapest's downtown. The only area where this can be enlarged are the green areas. But if we want to enlarge green spaces we encounter we would need to reduce parking spaces. We could build garages, parking houses, but who would take the costs for this? **We would need smart solutions for this.**”

MOBILITY

Mitigating the negative impact of transport in the city of Uherské Hradiště, Czech Republic

Ideas in practice – Czech Republic

SMARTNET is an exceptional project in the Central-European area because it integrates an unusual array of technologies at one location. Using a network of sensors distributed in the streets, the project aims to measure the quality of urban environment from a number of perspectives – pollutants, noise levels, congestions – all caused by traffic. It aims to assess the information and use it to improve the quality of urban living environment and propose a more effective and healthy means of transport. Based on the information about traffic, the city will be able to determine which areas are suitable for pedestrian or cyclist mobility and also identify areas not be impacted by increased noise or air pollution which could be designated for residential purposes. It also employs a methodology to detect, evaluate and quantify vehicles looking for a parking place and asses their impact on the flow of traffic. Last but not least, one of the project's aims is also to determine the actual costs of such monitoring measures, providing a key variable in planning procedures of similar intelligent systems in the future.



A set of noise, traffic and meteorological sensors in Uherské Hradiště, Czech Republic. (Source: Transport Research Centre)

One of the key obstacles - as learned during this study in Slovakia - is the willingness of people to use smart technologies and implement them to their lives.

A similar situation can be observed in Hungary, where often citizens and users can be the obstacles themselves. **"Citizens and users are one obstacle first. It may sound strange, but people use an innovation if it gives them a pain-killer. If the solution makes their life easier, and they understand the point of it, it will work."** - says Gyula Fekete, Road Management Co. of the Municipality of Budapest.

Offentimes, Visegrad cities encounter budget inefficiencies for smart and green solutions. Štefan Lančarič (authorized landscape architect, Manager for IROP in Nitra, Slovakia) says **"Legislation is a practical obstacle, there is no direct support for cities, for example in the form of subsidies or grants from the Ministry, and implementation of solutions supported in spatial planning"**. Libuše Murínová (landscape architect at Department of Environment and Transport, Zvolen City Municipality) added: **"There are no legislative requirements to apply the smart city**

solutions. Public awareness is low, also as knowledge and consciousness of investors and employees of the City Municipality".

Individual good solutions are not part of the long-term strategic document of the city development and people who determine urban investments could not follow one conceptual development of the city, notices Martina Paulíková (NGO Slatinka from Slovakia).

From a practical point of view, technical and technological readiness and associated financial demands and low experience are problematic - says Natália Puschmannová (architect at Department of Architecture, Bratislava City Municipality, Slovakia). **"Private ownership of the land, technical complications and high costs could enable implementation of some Smart City Solutions"** added Jarmila Garaiová (landscape architect at Department of Spatial Development and Urban Conceptions, Trnava City Municipality, Slovakia).

Marzena Bronisz, landscape architect from PoLandscape company and Green Roof Workshops organizer (Poland), said that interest in green

infrastructure workshops is very big, but it is limited by financial demands of the project. The biggest practical obstacles are financial issues. It needs time to prepare workshops and money to buy its components. "My Green Roof" project in Poland could take place thanks to the partners and local cultural organisations, who shared space. In the "Mapping Green Roofs" project - as Marta Zaryn notices - the main practical obstacle was analysis of building codes in different periods of time. Warsaw was in 90% destroyed during II World War and the rebuilding process gave a lot of opportunities in terms of green roofs - there are many buildings made of solid reinforced concrete. In the analysed three areas of the city almost 80% of flat roofs might be greened from among which over 20% has potential to build biodiverse or intensive green roofs! Practical obstacles are also financial and legal issues. Implementing the idea will be costly, so incentives would be big step forward. Lack of green roofs standards in Poland is a big obstacle - many roofs are planned and built in the wrong way or with inadequate materials.



Example of the municipal waste treatment, the waste underground tanks, which can signalise when they are getting filled, Nitra, Slovakia (Photo: Maria Bihunova)

MOBILITY

Smart City Mobility and Transport in Nitra, Slovakia

Ideas in practice - Slovakia

In June 2017, Nitra was awarded a certificate of the Smart Leader among Slovak Cities. The city was awarded for taking an innovative approach to intelligent solutions. There are 4 main fields, where smart solutions were and will be implemented (www.nitrasmart.sk):

City Mobility include introduction of smart and modern public transport, the integration of energy and emissions, less demanding types of vehicles, alternative modes of transport, modern and intelligent regulation of transport in city center and in residential complexes.

Improving of Living standards through quality of public spaces; development of the green infrastructure; support of urban safety; converting services to electronic, information and communication; modernization of public lighting with intelligent monitoring and lighting management.

Intelligent energy dealing with municipal waste treatment, water and heat management, introduction of new technologies providing own renewable energy sources, energy intelligent transport systems, energy intelligent houses and buildings, application of systemic measures for disposal, collection and use of rainwater.

Energetic Management - means Energy Efficiency and City Security

The Project **Bikesharing** came into life in July 2017. It was launched by the Arriva transport company in cooperation with the city of Nitra as a service in the urban public transport system. There are seven localities, where the bikes are available, which you can borrow them thanks to the app you download to your mobile. Six smart benches are complemented by a range of services where you can recharge mobile phones and other electronic devices through solar power. In the near future the City Municipality wants to include to the public transport five electric buses. Although 14 kilometers of new cycling routes are under construction, supported with 4 million Euros, 50 recharging stations for electric cars and buses will also be built in Nitra. The city extends the camera system and safe pedestrian crossings. We have restored some of the public lighting, listed Jozef Dvonč, Mayor of the city Nitra.



Project Bikesharing offers 70 bicycles within the city centre to borrow. Nitra, Slovakia (Photo: Maria Bihunova)



Using solar energy for smart benches and bicycle stands. Benches are complemented by a range of services where you can recharge mobile phones and other electronic devices through solar power. Nitra, Slovakia (Photos: Maria Bihunova)

How to overcome obstacles? What are the enabling factors for joint development and implementation of smart and green innovations?

In the previous chapters we could read about obstacles and challenges of implementing smart solutions in a city. Enabling factors are, among others, good partnerships and information exchange, awareness raising and user friendliness. Now let us see the suggestions of successful smart solution implementers.

Institutions like Organica Water and Budapest Capital Urban Planning Ltd. share the view that building good partnerships, repeating those good partnerships and exchange of information between cities in our neighbouring countries is of utmost importance in developing smart city innovations. **"The tools are already in our hands"** – tells Péter Varga, Senior Manager at Organica Water).

"It is important to have information exchange between governmental bodies or with foreign cities that struggle with similar problems but are ahead of us, like Vienna or Berlin. The solutions in these cities are way ahead of us. If the connections and experiences would be strengthened we could apply those solutions." - says Zsombor Tatai, Environmental Planning Office Leader at Budapest Capital Urban Planning Ltd.

Budapest's (Hungary) Green Infrastructure Concept is developed right now by the

Budapest Capital Urban Planning Ltd. (Budapest Főváros Városépítési Tervező Kft.). It is clear, that there is a need to harmonize different legislations to be able to protect green areas more efficient. New funding instruments are needed for green space investments, or for compensation measures.

Awareness raising should be taken seriously, as Budapest also needs to improve the culture of the society. Inhabitants do not take enough responsibility for their environment (Tatai, 2017).

A suggestion for smart and green city innovators concerning the budget: when decision-makers are choosing an innovation, it is important that it is cost-effective, so in an ideal case the smart solution is cheaper than a similar solution. (Fekete, 2017)

"From the user's side, the smart solution has to be very-very user-friendly. The user interface has to be very good" – says Gyula Fekete, Senior GIS Expert at Road Management Co. of Municipality of Budapest.

It is important to emphasize that smart innovations can be more than ICT solutions. Lechner Knowledge Centre gives 4 basic criteria on how to be a smart city. The municipality is optimizing its operation on environmental, societal level:

- Service-oriented operation (high quality)
- Resource-efficiency (financial, energetical, human)
- Participation based decision-making with long-term involvement and integration
- Economic (and other) sustainability
- The subsidiary principle has to be applied: what can be solved on the local level, has to be solved on local level.

And how to reach this practically? The successful Organica Water gives some advice:

- Actively look for partners (use existing tools for searching for partnerships)
- Do marketing, business
- Generate interest
- Concentrate efforts on key geographies
- Get the communication out
- Additionally, it is important to target the users in accordance to their behaviour and age. (adds Fekete, 2017)

Effective information activities are key to turn a plan into a reality. “Continuous information activities on all levels of the municipality need to be carried out in order to successfully advance progressive policies,” advises Jaroslav Klusák from his 8-year experience in Litoměřice, Czech Republic. “Despite not having a special PR department Litoměřice makes good use of face-to-face events and also new media channels,” he says. To facilitate communication with its citizens, Nový Lískovec makes use of a mobile application Česká obec [“Czech Municipality”, a **mobile application providing a communication platform between the municipality and citizens**, editor’s note]. “**IT helps provide faster and better communication with citizens and, using interactive elements, enable them to participate in the municipality’s administration,**” Jana Drápalová (Mayor of the district of Nový Lískovec, municipality of Brno) gives her account.

Marek Ščerba (Head of the Department of Transport Telematics, Transport Research Centre (CDV)). further stresses the need for information sharing and pooling. His experience in Uherské Hradiště taught him that the role of working groups, workshops and knowledge-sharing cannot be

underestimated. He further elaborates on the idea: “We should not be afraid to provide opportunity to pioneering companies and **small and medium enterprises**. Cities should, for instance, invest into “**living laboratories**” where there will be space for trials of new concepts/technologies. These approaches have a double effect. Cities will “get their hands on” new things in practice and eventually develop trust in them. Another effect is that emerging businesses will have a “playing field” to test their products. Finally, with every investment decision, **a measurable effect on the environment** should be taken into account,” he concludes.

Information sharing of progressive cities have, however, yet another and broader level. Jaroslav Klusák provides more detail: “Litoměřice has pioneered the approach of energy management in the Czech Republic and stands as **an inspiration to other cities**, connecting them by sharing its expertise on multiple platforms. The city also **partners with other municipalities internationally**, particularly under the Energy Cities initiative.” Successful achievements need to be presented and failures need to be analyzed to take lessons from – both nationally and internationally.

Miloslav Šatra (Head of the Department of the Environment in Písek), a seasoned expert responsible for the environmental department in Písek has even more recommendations. In his own experience, a keystone in the implementation of progressive policies is a **leader from the city government** supported by enough **political will**. Such leader should have the ability to push through plans, make them public and present them on the outside. Moreover, “there has to be willingness to make effort even at the grassroots administration’s levels – a **willingness to invest extra time**, not only 8 or 8.5 hours a day,” he says. And when it comes to financing innovations, cities should put **more emphasis on qualitative criteria in tenders** (e.g. innovation 40 %) and make effort to get the biggest share possible from **co-financing programs**, thus fending off the “no funds – no innovations” pitfall. Marek Ščerba (Head of the Department of Transport Telematics, Transport Research Centre (CDV)) adds: “Certainly, it is a **matter of investments** first. If there are no investments, there will be no innovations. A great example is the functioning of the Technology Agency of the Czech Republic.”

SOCIETY & LIVING

Urban horticulture

Ideas in practice - Poland

The project's idea is to increase green areas by the cultivation of roofs and walls and demonstrating the possibility of economic benefits by reducing costs of crops transportation. The project called 'UrbanHort' will popularize the idea of urban horticulture, to create more resilient, efficient and sustainable cities. From a comprehensive and quantitative perspective, there is a lack of methodological schemes in the 3 spheres of urban horticulture's sustainability: environmental, economic and social. Due to lack of space for crops in natural soil in urban spaces, the plots will be established on the roofs, living walls and in the school gardens.

UrbanHort aims to develop an innovative interdisciplinary framework that combines tools from different disciplines to obtain a more comprehensive and advanced knowledge of urban horticulture. As case studies, different cities will be used, representing different socio-economic regions and urban morphologies. The project will evaluate the efficiency of urban horticulture types, estimate the potential contribution to food security and urban resilience of urban horticulture, evaluate the urban ecology resilience of urban horticulture in terms of: traditional cultivars and contribution to biodiversity and quantify the sustainability of urban horticulture initiatives in terms of: environmental economic and social sustainability. UrbanHort project will support planning and implementation of more efficient, resilient and sustainable urban horticulture initiatives in EU cities.

SOCIETY & LIVING

Green Roof Workshops in Warsaw

Ideas in practice - Poland

Another Polish example of community sharing and education are green roof workshops, which were held during the summer of 2016 in Warsaw.

Each workshop started with a short presentation about the history, types and theory of building green roofs. During each workshop participants were building green roofs from the scratch. Each green roof was built in a construction made of corten, 2 m long, 1 m wide and as height so each participant may reach it inside. There were two workshops based on green roof systems, one with sloped green roofs and one was a no-system solution (hydroisolation, substrate and plants). The idea was to gather people wanting to create a small green roof by their house, but the result was different. Participants were mainly landscape architects, gardeners, officials connected to green areas, architects, local activists wanting to increase knowledge about green roofs and green infrastructure. Each participant might participate in each stage of the building process: glue hydroisolation, cut drainage and so on. Thanks to co-operation, there were lots of interesting ideas, sharing experience and knowledge.

Movie from the first workshop: <http://bit.ly/GRWorkshop1>

Movie from the second workshop: <http://bit.ly/GRWorkshop2>



Green roof workshops in Warsaw, Poland, 2016 (Photo: Wojciech Jasiński)



Green roof workshops in Warsaw, Poland, 2016 (Photo: Łukasz Rosenberg)

Regarding the Polish Green Roof Workshops Marzena Bronisz (Landscape Architect from PoLandscape company) tells “We found that there is lack of information about green roofs and green infrastructure in general. At the beginning we thought that workshops will be attended by people who would like to build green roof on their own terrace, garage or people who work for local communities. The reality was that most of the participants were professionals somehow connected to the topic – landscape architects, architects, restorers, officials. It was valuable to all of us to get to know each other and share knowledge and experience. It also showed huge demand on this kind of initiatives.”

Everyone of the interviewed experts in Slovakia mentioned as an enabling factor: Education of the Authorities (municipality representatives, officers), legal support (legislation), local support (Municipality), implementation of smart solutions – to have an experience, awareness in general at all age and professional levels and chance to visit existing good examples.

In Slovakia, new platforms have appeared - like Smart City Cluster (SSCC) or EMOCITY. They support innovation and the testing of new technologies in areas important for smart cities. The SSCC was established in Poprad (Slovakia) in 2016 as a non-profit interest group with seven members (City Municipality Poprad, the technology companies, energy suppliers and Slovak University of Technology in Bratislava). A similar initiative is EMOCITY, where Bratislava is an active member.

There are several levels of enabling factors for joint development and implementation of smart and green innovations. **Legal support, activities of the Municipality, cooperation with experts, and public participation.**

Jarmila Graiova (landscape architect at Department of Spatial Development and Urban Conceptions, Trnava City Municipality, Slovakia) sees the biggest challenge in modification of the legislation and changes in the grant schemes which support smart technologies. Martina Paulíková (NGO Slatinka, Slovakia) pointed out the necessity to understand principles of the Smart City concept on both sides –authorities and public.

Exchanges of experience, good examples, knowledge on national and international level, participation at conferences and workshops and establishment of the pilot projects, application of smart solutions/technologies into practice at the local scale is essential – thinks Natália Puschmannová (architect at Department of Architecture, Bratislava City Municipality, Slovakia).

Libuše Murínova (landscape architect at Department of Environment and Transport, Zvolen City Municipality) has good experience with including the citizens into planning, uses surveys to find out the requirements and needs of the users of the spaces, or use other forms to obtain necessary information: dialogues, events, online questionnaires, public participation planning.

“First of all there should be national or at least local regulations regarding to planning and building green roofs. Without standards sometimes it’s hard to promote green roofs on wide scale, because bad examples are spreading in people’s awareness” - Marzena Bronisz (Landscape Architect from PoLandscape company) concludes.

GOVERNANCE

Mapping green roofs in Warsaw

Ideas in practice – Poland

The Warsaw Green Roof Mapping project is creating a map of existing and potential green roofs in three areas (business, residential and industrial), analysing data and drawing conclusions out of it. Existing green roofs were divided to two types: intensive and extensive. Assumptions were made in terms of average substrate depth and drainage type. On the basis of this assumptions, it was possible to estimate countable benefits of green roofs presence like: water retention, avoiding the cost of expanding the sewage system, prolonging the service life of waterproofing, air conditioning and heating demand reduction, in consequence also reduction the emission of CO₂.

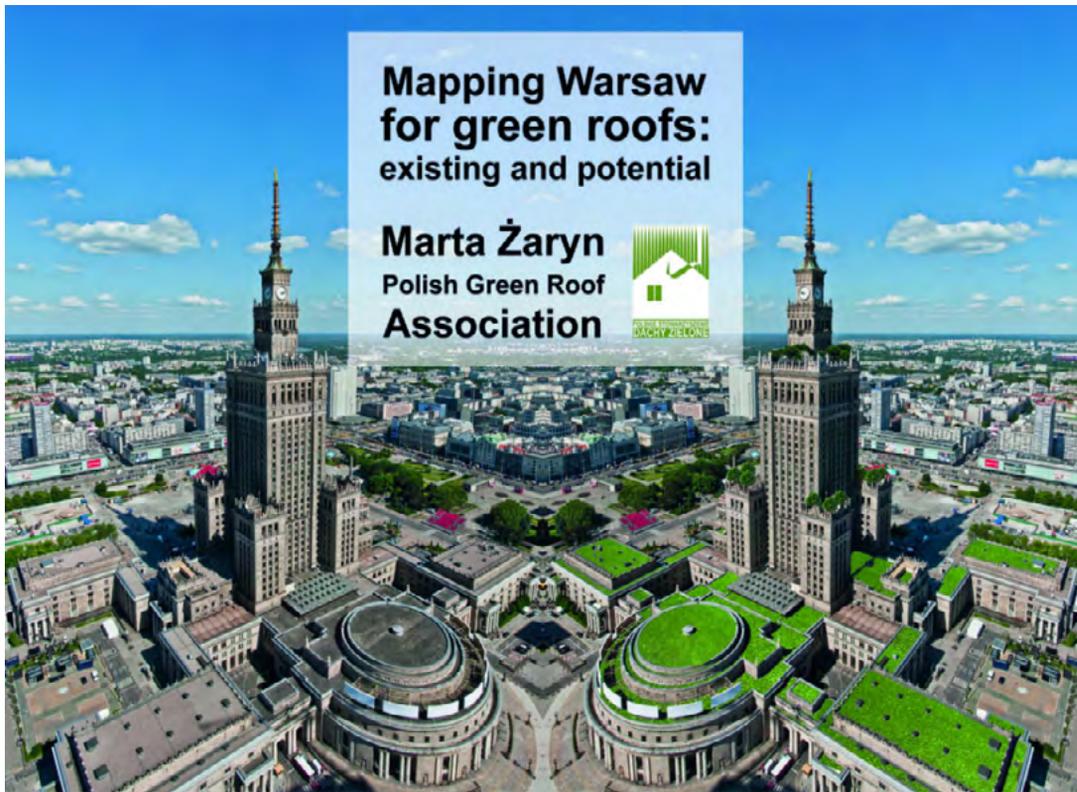
After II World War Warsaw was destroyed in 90%. Rebuilding the city in 40'/50'/60' was associated with using reinforced concrete which was popular at that times. Because of lack of possibilities to calculate precisely what are the minimum requirements of additional weight (as it is made now with computers), most of the roofs were oversized - they may maintain more than it is necessary. This is the main reason why the research showed, that the potential of building green roofs in analysed areas is 77%. That means almost 4/5 of roofs might have some kind of a green roof. The potential was assumed in 5 categories from lightest extensive green roofs to heaviest intensive gardens on the roof.

The last step was the recognition of public buildings, which might be greened first. Those buildings are among others: municipality buildings, Ministry of Treasury, Ministry of Infrastructure and a hospital.

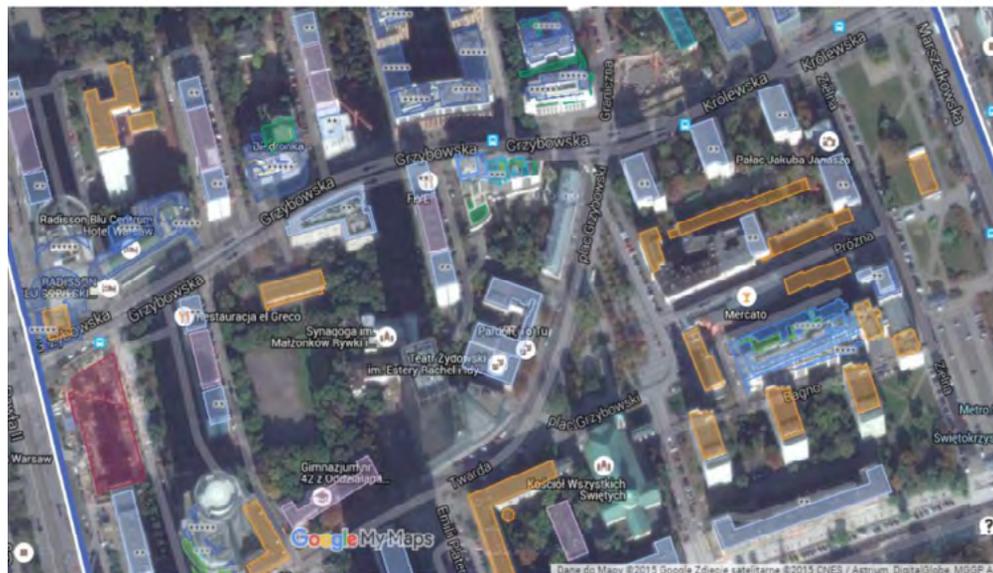
The aim was to create analysis showing local municipality and community, what are countable benefits of existing green roofs and what is the potential to create more green spaces in the city. Also very important was increasing the awareness of existing green roofs, which are mostly not visible to the people. In Poland there are no policies for green roofs, also no positive incentives on national level to build green roofs (only one for developers, but it is not perceived as positive because they build green roofs to expand size of the buildings, so they rather took away native lands instead of adding new greenery). It is hard to convince municipalities how many advantages they may receive by creating green roof incentives.

Link to the map: bit.ly/GRWarsawMap

Link to additional article: bit.ly/GRWarsaw



Mirror reflection with greenery - photomontage
photo: Paweł Jagiełło
graphic: Marta Żaryn



Warsaw Green Roofs Mapping - analysis results
graphic: Marta Żaryn

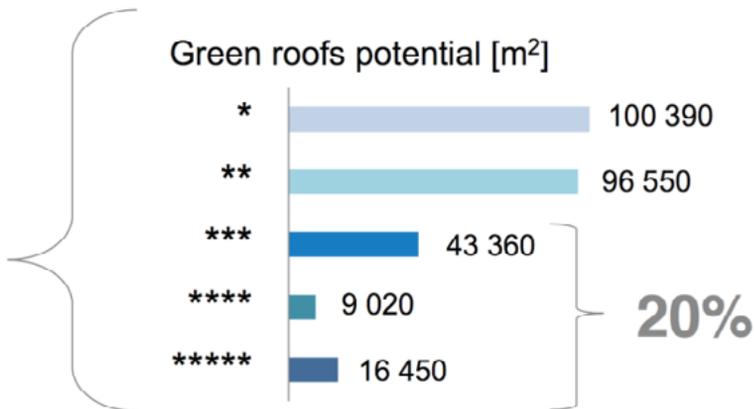
Flat roofs area*: **344 941 m²**

| | | |
|---|--------------|-----------------------------|
|  | Existing | 17 251 m² |
| | • Extensive: | 5 740 m ² |
| | • Intensive: | 11 511 m ² |

| | | |
|---|--------------|-----------------------------|
|  | No potential | 61 920 m² |
|---|--------------|-----------------------------|

| | | |
|---|----------------|------------------------------|
|  | With potential | 265 770 m² |
|---|----------------|------------------------------|

analysed area
potential:
77%
[265 770m²]



Warsaw Green Roofs Mapping - analysis results
graphic: Marta Żaryn

Benefits for citizens

Benefits of smart and green solutions together are present on environmental, social but also on the economic level. It is no question now that a greener city with smart innovations makes the citizen's quality of life easier and contributes numerous benefits.

"The benefits of green solutions are facts. We are losing our natural resources. If an innovation focuses on green, it will immediately support our future which can be even in our generation. The climate changes so dramatically. **We have no other way than to involve green to an innovation and being smart.** One of the most important parts is **environment and our green places, which are fading out to grey.**" - says Gyula Fekete, Senior GIS Expert at Road Management Co. of Municipality of Budapest.

Some of the benefits of the combination of "smart and green" technologies have been outlined above and, largely, they are field specific. The combination enables cities to make use of state-of-the-art technologies to promote healthy and attractive cities with content citizens. The vision of Litoměřice (Czech Republic) is, for instance, to **"create a self-sufficient city in terms of energy, i.e. independent as much as possible on external suppliers.** This will mean that energy revenues will not leave the region and the city will be able to **offer lower energy prices to its citizens,**" says Jaroslav Klusák. "Litoměřice aims to have a city center without cars, which will be enabled by conveniently designed rail and bus network and aided by **bicycle-friendly infrastructure** such as bikeways and trails. The progressive

transport will lead to the coveted aim of promoting citizen health and also allow historical sites to be renovated and made attractive for tourism. Apart from these goals, the city aims to be the **center of geothermal and sustainable energy research, even on the European scale, creating employment opportunities and increasing the city's prestige,**" concludes Klusák his ambitious plan to improve lives of 30,000 citizens of Litoměřice.

Marek Ščerba (Head of the Department of Transport Telematics, Transport Research Centre (CDV), Czech Republic) offers his view of the benefits of "smart and green" solutions: **"Greenery increases the value of apartments** and if it is linked in the city, it offers a suitable environment for pedestrian and cyclist transport which is the first step towards non-ownership of cars. City bicycles will be the cheapest and fastest means of transport," he says. Summarizing the gist of the combination, he remarks: "Smart technologies will tell us where we can find green solutions which will lower the impacts of our activities on the environment and our wallets."

"The aspect of the environmental education and showing the positive examples, finding the way to understand and support the natural processes is also important. Creating liveable environment through planting of flowers, creation of flowering meadows, etc. Some other actions that would lead to more climate/carbon resilience of Bratislava would be beneficial for the local inhabitants as well." Zuzana Hudekova (Expert at Regional ecological center Bratislava, Slovakia) said.

Natalia Puschmannová (architect at Department of Architecture, Bratislava City Municipality, Slovakia) sees the contribution of smart city solutions in providing a greater database of the public greenery, which enables better monitoring and management of the greenery, and also has the potential to improve the ability of the Municipality to communicate green interventions with the public. She supposes that there will be some financial savings, which will allow further development or the expansion of the necessary green areas and the public space.

"The first benefit which comes to my mind is health. Greenery absorbs air pollution (this process is called phytoremediation), makes people more relaxed, provokes air movement, reduces the urban heat island effect – it is about the quality of living in cities" - Marta Żaryn (Python Developer, Polish Green Roof Association) said.

On the economic level, the value of an estate is higher if it surrounded with green area. Read CEWeb's previous studies on economic benefits of nature: How much are Nature's Gifts Worth? – Summary Study of the Mapping and Assessment of Ecosystem Services in Natura 2000 Sites of the Niraj -Tárnava Mică Region: http://www.milvus.ro/ecoservices/images/MAES_ST_ENG.pdf Report on Socio-Economic Benefits of Wetland Restoration in Central and Eastern Europe: <http://www.ceeweb.org/wp-content/uploads/2016/04/Wetland-Restoration-Report-CEWeb-Michael-Otto-Project.pdf> Green Infrastructure: Training Manual for Trainers: http://www.ceeweb.org/wp-content/uploads/2015/03/Training_Manual_v3-Copy.pdf

Now let's see concisely how smart and green solutions benefit citizens, based on experts' opinion from the 4 countries:

- Reduce the impact compared to conventional infrastructure
- Improve the human environment, the urban habitat
- Support our future
- Improve our health (physical and mental) significantly
- Reduce sickness and psychological problems
- Improve the overall quality of lives
- Create self-sufficient cities energy wise
- Mitigate urban heat island effect (energy used for air-conditioning can be reduced)
- Improve water, soil and air quality
- Make our cities more beautiful
- Keep us fit by providing more opportunities for recreation
- Increase real estate values
- Creates economic benefits
- Reduce CO2 in the city
- Increase biodiversity and ecological stability
- Reduce the vulnerability to the climatic risks by implementing adaptation measures and restore soil retention capacity
- Increase the nature based ecosystems with the sustainable management of rainwater precipitation and eliminate soil, water and wind erosion
- Invest into human capital (social capital)
- Invest in city infrastructure (transportation, information and communication)
- Provide intelligent energy management
- Use modern technologies and solutions
- Look for effective solutions between public transport and passenger transport
- Support static transportation features with the completion of parking areas and parking spaces with minimal loss of public greenery and environmental degradation
- Modern solutions aimed at new technologies reducing operating costs, thermal emissions and losses
- Streamline, upgrade and replenish energy supply from centralized sources
- Energy input evaluation (processing of municipal waste for energy use)
- Apply systemic measures for the disposal, collection and utilization of rainwater
- Establish a system of controlled energy security of the city
- Optimize the city's administrative burden and improve the quality of services provided by the city in the form of an electronic and intelligent communication system
- Provides possibility to look for alternative solutions (due to new development on existing green areas) and revitalisation of brownfields, industrial complexes.

Conclusion

Problem areas regarding smart and green innovations are similar among the Visegrad cities. This project was useful for identifying those common issues and has made it possible for decision makers to learn about their shared problems and to work on these in the future.

We could read about numerous good practices and initiatives above implemented in the Czech Republic, Hungary, Poland and Slovakia: Nitra, awarded the certificate of the Smart Leader among Slovak Cities; the network of sensors in a Czech city that measures the quality of urban environment from a number of perspectives; the innovative, environment and citizen friendly wastewater management from Hungary; or a similar approach of a sludge utilization plant in a Czech city (Písek). Other projects included transforming an old defunct transformer station into an attractive place, creating a natural environment for insects, birds and citizens like in a Polish city and various energy saving initiatives like in Litoměřice, Brno, Bratislava and Trnava.

All of these initiatives not only create a better quality of life for citizens in the cities which are becoming more and more populated, but enables city administration to significantly reduce their costs, as well as contributes to our ecosystems and gives something back to nature; not forgetting nature can only provide us its life supporting systems if we enable it, not only outside in national parks, but also right in our cities.

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