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An Introduction to the euPOLIS Project

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Abstract. This paper introduces euPOLIS; an EU funded project, which emphasize on the appropriate development of urban ecosystems in a way that enhance Public Health (PH) and Well-Being (WB) without significant Life-Cycle costs. Such an approach has has the potential to regenerate urban ecosystems addressing multiple challenges, such as low environmental quality, fragmentation and low biodiversity in public spaces, water-stressed resources, undervalued use of space in deprived areas resulting in an improved urban livability. The proposed methodology is expected to improve people's quality of life, providing them with pleasant socializing open areas that stimulate social exchange while monitoring the impact of all those interventions to PH and WB of citizens. The euPOLIS suggested solutions will be demonstrated in 4 European cities: Belgrade, Lodz, Piraeus and Gladsaxe.

Keywords. Well-being, Public Health, Nature Based Solutions, Sustainability

1. Introduction

Urbanization, i.e. a population shift from rural to urban areas, dates back to 1800s. There are many reasons motivating such movements, including better education, housing, access to work, and less time and expense of commuting and transportation. Nevertheless, the continuously increasing trend of urbanization resulted in harmful social phenomena such as alienation, increased cost of living, and mass marginalization. A direct adverse effect is the deterioration of peoples' health, mental and physical.

On the one hand, Urbanization affects mental health through the influence of increased stressors and factors such as overcrowded and polluted environment, high levels of violence, and reduced social support [1]. On the other hand, urbanization is associated with increased risk of asthma due to the exposure to air pollutants such as nitrogen dioxide (NO2), carbon monoxide (CO) [2]. Both cases require for actions/solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience [3].

Nature-based solutions (NBS) is exactly what is needed to tackle most of the problems raised by increasing urbanization trends. One example of NBS is by protecting

and/or restoring forests and wetlands. This way, water supplies, protection from floods, soil erosion and landslides can be secured and succeeded. Another example of NBS, is the protection of coastal habitants which will result a mitigation of climate change.

The most important NBS is succeeded by bringing nature into cities by planting trees in our gardens-balconies. The NBS will limit the danger of heatwaves and air pollution while, simultaneously, will have positive contribution on our mental and physical health. Generally, being close to greenery make us feel more ease and reduces our stress levels. Plants and their leaves tend to absorb and reflect noise, which makes the environment more comfortable to visitors, residents or workers. Moreover, trees and plants can also be used as a decor for squares and most abandoned buildings by adding color, ambiance, personality and life to a bland space.

2. Related Work

Protection of the environment, sustainable management of natural resources, water, biodiversity and ecosystems are research areas of great interest; Their interactions with social systems will play a significant role in sustaining the economy and human well-being. The development of integrated approaches to address water-related challenges and the transition to sustainable management and use of water resources and services is currently addressed by multiple organizations and joint actions.

IN-HABIT project [4] proposes a systemic urban planning framework based on innovative gender and diversity approaches to improve Inclusive Health and Well-being. This system has been applied in four peripheral small and medium size cities – Cordoba (Spain), Riga (Latvia), Lucca (Italy) and Nitra (Slovakia). Project VARCITIES [5] aims to implement innovated and visionary ideas by establishing sustainable models for increasing Health and Well-being of citizens. The purpose of VARCITIES is to create an operation model that will convert the cities of the future into human-centered cities. The GO GREEN project [6] proposes urban design based on NBS with the goal of fostering a positive human-nature relationship, flourishing nature connectedness and promoting citizen engagement through digital, educational and behavioural innovation. The purpose of GO GREEN is to position European cities as world ambassadors of urban sustainability.

Another project, similar to the above, is NICE [7]. The overall objective of NICE is to enhance existing NBS to provide circular urban water solutions. NICE will propose solutions which will produce reusable water for different purposes, in addition to mitigating pollution and runoff and composing an attractive and integral part of the urban landscape. Another ongoing project proGIreg [8], which proposes NBS on three cities: Dortmund (Germany), Turin (Italy), Zagreb (Hungary). The proposed NBS will be co-designed, co-created and co-implemented with local communities and on the economic level with market-ready business models. .

3. The euPOLIS Project

EuPOLIS' approach supports the development of urban ecosystems in order to enhance Public Health (PH) and Well-Being (WB) without adding significant Life-Cycle costs. Such an approach has the potential to activate the hidden possibilities and services of

existing Natural and Engineered urban systems. During the process of integration, their joint environmental, social, cultural and economic effects will be defined, as a main vehicle for investments in advanced ESS and regenerate urban ecosystems.

All the above can be achieved, while facing challenges such as low environmental quality, fragmentation and low biodiversity in public spaces, water-stressed resources, undervalued use of space in deprived areas and therefore urban livability is improved. EuPOLIS will improve urban resilience via interventions designed using a set of proper urban planning matrices with the stakeholders' participation and with attention to every gender, age and disability perspectives within the process.

Another objective is the creation of inclusive and accessible urban spaces by systematically implementing gender mainstreaming strategies and novel participatory tools into all phases and processes of project development to ensure that the needs of diverse groups are considered. Therefore, an improvement of people's lifestyles is expected, providing them with pleasant socializing open areas that stimulate social exchange. Lastly, the project includes the monitoring and assessment of the impact of all BG \NBS interventions mainly regarding PH and WB of citizens, but also other factors, such as environmental and socioeconomical impacts, resilience-related (with emphasis on CC) results and long-term policy changes, etc.

3.1. Strategic Objectives

There are seven Scientific and Technical Objectives (STOs) in this project. The first STO refers to the systematic implementation of an NBS-based urban planning methodology, which will be enriched with cultural, economic, and societal aspects, based on the Blue Green Solutions (BGS). For instance, consider the creation of spatial and functional conditions that will enhance not only the PH and WB of citizens, but also the urban metabolism, the social cohesion and the resilience of cities to Climate Change (CC) and natural disasters.

The second STO proposes an intervention-aimed livability model, rooted in community needs and engaging community diverse potentials. This can be achieved through a three-pronged approach: 1) ensuring the relevance of interventions to specific communities' needs and preferences; 2) reflecting residents/users' voice in the planning process; 3) consolidating the sustainability of project outcomes by fostering a sense of ownership among citizens/users.

The third STO refers to the design and implementation of an online platform, to support and enhance participatory processes, through active socio-cultural hubs. This will re-design public spaces, while promoting new governance and new financing models. The fourth STO refers to the design and implement of customized spatial solutions for each case study (Front Runner -FR- cities of Belgrade, Lodz, Piraeus and Gladsaxe) and then monitor and assess their impact regarding PH and WB, as well as social and environmental results. A mixed-method approach will be developed via traditional questionnaires, ethnographies and interviews with quantitative data collected through wearable devices, behavioral games and mobile questionnaires. Climate hazards such as microclimate, biodiversity, pollution, Urban Heat Island (UHI) will be monitored via remote sensing and sensor networks.

The fifth STO includes the replication and demonstration for corresponding advantages of euPOLIS innovations via mentoring and coaching of the follower cities of the

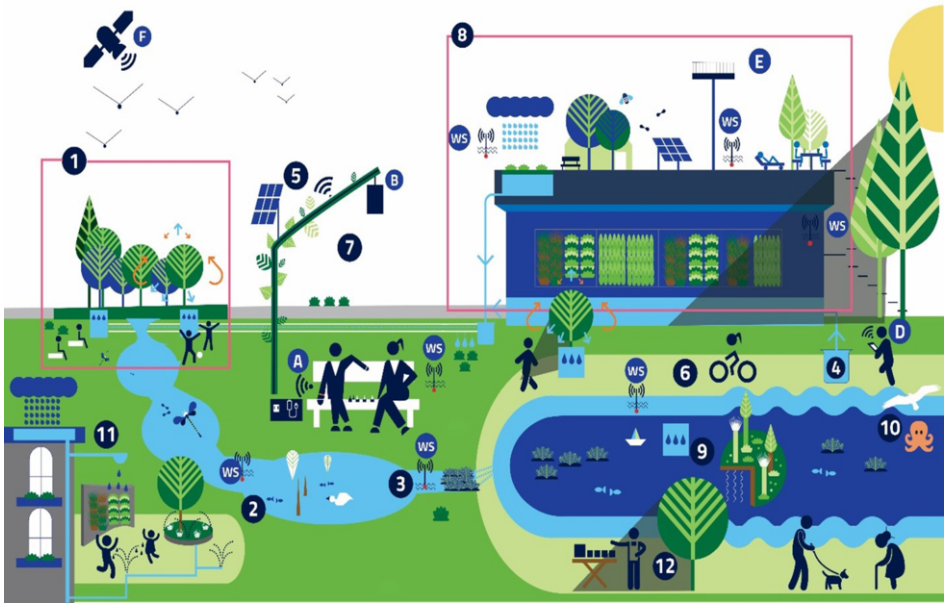

Figure 1. euPOLIS overall concept. 1. NBS-based MF pocket parks accessed by NBS locally conditioned pathways and shared spaces (1.1-1.9), 2. Waterway with mini biotope nodes, aquatic biodiversity – fead from groundwater aquifer or purified surface runoff, 3. NBS for surface runoff quality and pluvial flood management, 4. Groundwater abstraction for water, energy, greenery nexus, 5. MF NBS canopy for socializing, "recharging electronics", or "green bus stop" etc., 6. MF Live vegetation shaded waterfront promenade, 7. Air pollution abatement shrubs, trees and vertical green curtains, 8. Metabolic hub with MF ecotechnology demonstration/promotion, roof garden and art/culutural performance, 9. MF floating island, river water purification, 10. Coastal sea bottom marine aquatic biotope with euPOLIS-NBS, 11. MF euPOLIS Urban square/streetscape and other NBS (biotopes, sensory garden, waterfall, biodiversity kitchen garden for socialising, recreation), 12. Space for NBS business activation and promotion Monitoring- ICT System: A. Wearable devices for monitoring PH WB, B. Visualisation equpment, C. Renewable energy sources, D. Citizens observatories, E. Sensor network, F. Remote sensing, WS. Micro climate / wireless weather station.

project, i.e. Palermo, Limassol, Trebinje and Bogotá. The sixth STO includes the creation of long-term data platforms securing open, consistent data points about the impacts of the deployed approaches, mainly regarding PH and WB, and ensure interoperability with other relevant data infrastructures for effective public consultation, exchange and sharing of practices/experiences.

The seventh STO focus on the identification of sound business models, replicable to other markets and develop new resources activation techniques. This will support a gradual transition to a leading market position for the euPOLIS paradigm. One of the euPOLIS innovative planning tools is Business Activation Matrix. Communication and dissemination of project results, to various audiences through targeted activities, clustering with related projects and initiatives, aiming to spread the euPOLIS concept, is the last STO.

4. Action Plan

The euPOLIS is strongly depended on the deployment of NBS. The process is based on a two-fold approach. The first approach is the systematic activation of Ecosystem Services (ESS) and the use of their Multifunctional (MF) components to interact with the project's urban elements. EuPOLIS will assess ESS and their services, for each site, with the use of an analytical framework developed by the Working Group. Since ESS Provisioning functions (provision of clean air, crops, food, raw materials, etc.) have been dramatically degenerated, first action will be to identify present state of the Ecosystem and then introduce specific regenerative measures as primary planning criteria, in order to revitalize basic function - provisioning.

As for ESS Regulating functions such as microclimate, air quality, etc, euPOLIS will introduce mapping of existing regulating potentials and enhance systematically its impact with adequate urban components as greenery, water, etc. Lastly the Socio-Cultural ESS such as interaction and recreation facilities for mental and physical health or slow tourism, represent an area that is not included in the standard planning criteria and will be crucial for all planned interventions. Supporting services (habitat supporting, maintenance of genetic diversity, photosynthesis, nutrient cycling, etc.) will be treated as part of the underlying structures, processes and functions of urban Ecosystem. EuPOLIS will introduce a methodology for assessment and will use a matrix system to identify existing and potential NBS to enhance important functions, as shown in fig. 2.

Figure 2. euPOLIS planning methodology

EuPOLIS social goal is to improve the relationship between citizens and the nearby places. Measuring the feelings triggered over citizens by a place, can be used as an indicator of Well Being, since many people tend to stay in a place that provides them safety and feeling of rootedness. Different dimensions of sense of place play a different role in

establishing positive relation with place and will be therefore included in our research approach. One of the biggest challenges will be the lack of participation from the citizens. Synergies among euPOLIS' solutions, driven by citizens' initiatives, could generate a vast panorama of excellent practices, crystallized into our proposed methodology.

In case that technological tools are not attractive enough, some traditional methods will be implemented, such as public consultations and community workshops and introducing community card game to enable decision making as well as drama and live role-playing forms for releasing creativity and empathy among potential users. EuPOLIS will, also, employ social- cultural platform to engage people and enhance their knowledge, awareness and willingness for the visionary urban design. Connection with external digital libraries will also be supported, for further growth of its virtual repository. In addition, the project includes the development of a new, or support existing active, socio-cultural hubs in of the four cities. These nodes will communicate euPOLIS messages, carry the project's results and secure ownership and long-term commitment of local and creative communities, citizens including sensitive groups and general public to the euPOLIS participative process.

Data will be obtained through sensor networks and remote sensing. During days the most relevant weather conditions, ad-hoc Intense Observation Periods (IOP's) will be applied while permanent monitoring with continuous data acquisition, processing and storage will be performed all the other days. Monitoring data will be used for knowledge generation, model calibration, NBS evaluation, interactive modelling result visualisation and web-based dissemination/communication. Next, from the knowledge coming from employed platforms, euPOLIS expect to use a people-centred observation web to allow citizens to become the 'eyes' of the city authorities. The goal is to complement the monitoring of the carried-out interventions (e.g., satellite and remote sensing that are less cost-efficient and less dynamic) by using users' smartphones and tablets. Citizens, city authorities, policy makers, psychologists, sociologists and communication experts will be engaged during the adaptation of the euPOLIS toolbox to ensure it is practical and user-friendly, while respecting all relevant privacy issues.

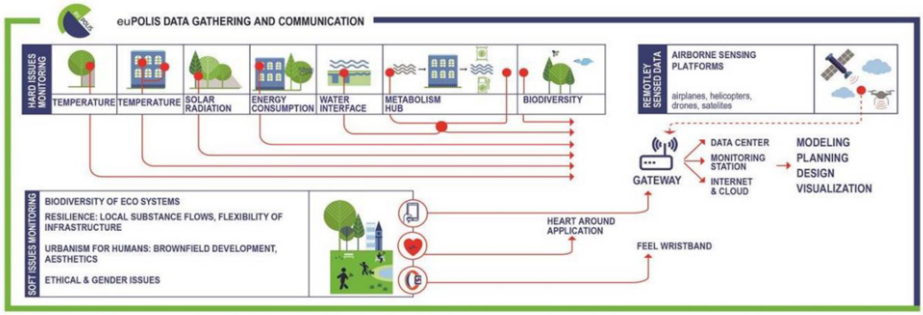

Figure 3. euPOLIS data gathering

Last but not least, data collection, as shown in fig 3, will involve a group of voluntary participants. Firstly, euPOLIS will provide them with feel wristband, which will be used for monitoring of wearer's bio-signals and the monitoring and assessment of the emotional status and stress/anxiety levels. Specific biological indicators will be sought for, and will be integrated with the urban planning methodology, while the different al-

gorithmic components will be calibrated and validated for the use cases.The impact and value of the NBS interventions on people's stress/anxiety levels will be assessed both in the long run, by quantifying the pre- and post-implementation anxiety/stress levels of the citizens as well as in near-real time. Activity monitoring, video communication, analysis using effective computing services and integration of Serious Games will support provisioning, regulation and sociocultural ESS. Through the euPOLIS mobile apps, citizens will be informed about the effectiveness and the impact of NBS on Public Health and Well Being.

4.1. Design and implementations in the four cities

This section includes various insights regarding the upcoming actions on the four front-runner cities. This section will also focus on all health/environmental/social issues and the demonstration activities, of each city.

4.1.1. City of Belgrade

The city of Belgrade has (approximately) 200 km of riverfront length and population 1,374,000 people. Only the 25% of the population have access to water, greenery, and public spaces. EuPOLIS' interventions will be applied on "Linear park" and "Ušće", which is the biggest urban park and is located in new Belgrade. Currently, the lack of necessary infrastructures result in air/water/soil pollution, noise, and lowers PH and WB. Unemployment and an aggressive behaviour, related to stress, are also reported.

Eupolis will address the lack of proper NBS, which jeopardize PH. Also, in "Linear Park", project plans involve the creation of a visual and functional path between city main body and river. That way the ecological corridors will be connected with neighbouring greenery spots, including nodes related to NBS-based environmental education and local business activation. In Ušće park, an integrated constructed wetland will be proposed, with several bio filters of different types for storm water treatment. The project will also recommend NB connections with Sava river and multifunctional floating island with practical demonstration of natural river water purification, also used by visitors to be entertained and experience additional views on Belgrade panorama and learn of new technologies.

4.1.2. City of Lodz

The city of Lodz, with 696,708 inhabitants, includes a historical city center, inhabited by 152,292 people. In Lodz there are many buildings in poor technical condition, and a few green and attractive public spaces. Lodz is considered as low environmental quality city due to high air pollution in the urbanized center. In addition to low air quality, it also lacks a systemic approach to water management to mitigate pluvial floods, resulting in risk for raw sewerage overflows. There are no NBS to address drought and heat wave problems. Therefore, multiple MF-NBS interventions will be considered. Those NBS will include two multifunctional parks with green spaces, an air pollution abatement/mitigating greenery through shrubs and vertical green curtains and environmentally friendly corridors to create quality access to the historical city center.

4.1.3. City of Piraeus

The city of Piraeus, in which you largest port in Greece is located, is one of the most densely populated cities in Europe. EuPOLIS will intervene in three mutually interlinked neighboring sites at the main harbor area (Mikrolimano). These sites are Seaside Promenade Mikrolimano area, the riverine inland area in Akti Dilaveri,and the Ralio Complex Pilot School (RCPS). Different characteristics such as visibility, stage of development and need for interventions, apply for each site.

Piraeus, also, lacks open green spaces, parks and there is not enough shading for protection against solar radiation and other UHI effects. Moreover, the city has old high-density buildings and narrow streets with limited pedestrian free space and high levels of air pollution. In addition, the riverine inland area in Akti Dilaveri is connected to the promenade, which is underdeveloped with polluted water. The social profile of Piraeus has been affected from high unemployment rate, increased economically non-active population lack of SME business opportunities and substantial "people friendly" welfare structures.

During this project, the restoration of the coastal pedestrian promenade of Mikrolimano will include implement of acceptable Mediterranean types of pollution mitigating vegetation in open green spaces for the improvement of micro climate and reduction of air pollution. The project will also propose NBS public places conducive to small business for new job creation opportunities. Eupolis will also make two more interventions. First intervention refers to the extension of the coastal promenade to the riverine area closer to the Sailing Boat Marina and Athletic Area in the Akti Dilaveri which will be used as a demo site for training of local planners with full support of euPOLIS team. Live vegetation covered multifunctional-NBS canopies encompassing info-points will be established in the area that "merges" the running Promenade with Akti Dilaveri. This will include places, where people can be protected from direct solar exposure, socialize, sit, wait, relax, recharge batteries (electronic), socializing, enjoy the freshness of scent gardens, etc. Second intervention refers to coastal blue green sea bottom marine aquatic biotope with euPOLIS -NBS. This way city-ports have succeeded to make many former heavily polluted/ex harbor underwater areas attractive, clean and eco-friendly. The site in Piraeus will be the first international case, where the synergy between terrestrial and aquatic meet and interact. As for the area of RCPS, a Pocket Park in the wide sidewalk will be introduced and also an educational-eco center for promotion of NBS will be established.

4.1.4. Municipality of Gladsaxe

Last city is the Municipality of Gladsaxe, which is located in the north western suburb of Copenhagen. Previous analyses showed that the Gladsaxe Municipality represents a city district with a negative social development. Our attention is focused on the housing development Pilenparken which hosts a total of 1700 inhabitants.Main issues of the selected site are the poor environmental quality, the high groundwater level which exposes the local citizens to health risk during heavy rainfall, the backflow from the sewage system that occurs with high risk of infection caused by raw sewerage flooding. Generally, euPOLIS will propose NBS at this site that will rely on creative development of new solutions for urban revitalization based on facilitation of intensified evaporation to reuse locally harvested rainwater which in parallel support the other NBS. This will secure the

unfolding of the recreational potential of the site and reduce the load on the sewer system thus prevent its harmful effects on public health during heavy rainfall events. In particular, NBS include natural cleaning of storm water to be used for other purposes. Moreover, euPOLIS will support the creation of evaporation playing field (underground water storage moistening grass and evaporating storm water), green sponge hill (a rolling landscape of artificially grown media to act as a water buffer magazine), an evaporation reactor, a water filtration unit, and pavement irrigation (sprinkling irrigation of paved areas during hot weather for speeding evaporation process, surface cooling and kids playing grounds).

These NBS will access pathways to make stronger unity in the community by making better connectivity between the facilities of the area. As for environmental awareness, water square playground (grove and water mist, art and culture interface, scent gardens) will create a framework for play and mediation for people in all ages, to create awareness of water and environment through play.

5. Measuring the Impact

There are 10 Key Performance Indicators (KPI) which will measure the impact of the proposed solution. First KPI is the psychological and physiological responses, psycho-emotional states. There will be optimization of relevant psychophysiological parameters among users of re-designed public space, including the reduction of stress, depression and anxiety levels. Second KPI includes health indicators related to physical activities such as walking, running, cycling, skateboarding, or activities related to an intervention such as running in the new park, strolling along the new pedestrian street. Third KPI includes health indicators related to improvements of local conditions. Forth KPI refers to the enhancement of social cohesion and cultural particularity through ensuring sense of security and inclusion for all (focusing on gender and age equality) allowing for the strengthening of exploratory and socializing/culture behaviors among users. Fifth KPI defines the sense of place and place attachment among users. There will be data from studies showing an increased positive emotional attachment to the neighborhood as well as re-designed public space. Sixth KPI will measure the density and strength of local community ties. Seventh KPI will include the number of planned natural systems. In particular, the improvements of local conditions will be quantified by implemented NBS. Eighth KPI will measure the improvement of habitat, biodiversity, resilience, EcoSystems (ES) in case studies. Ninth KPI will present a list of implemented business models. Last KPI will present the deployed communication activities. This includes all cities involved through technology adoption, and people involved in participatory processes.

6. Conclusion

This work provided a short introduction to euPOLIS; an EU funded project, which emphasizes on the appropriate development of urban ecosystems in a way that enhance PH and WB, without imposing significant Life-Cycle costs. Such an approach has has the potential to regenerate urban ecosystems addressing multiple challenges, such as low environmental quality, fragmentation and low biodiversity in public spaces, water-stressed

resources, undervalued use of space in deprived areas and therefore urban livability is improved. The proposed methodology is expected to improve people's quality of life, providing them with pleasant socializing open areas that stimulate social exchange while monitoring the impact of all those interventions to PH and WB of citizens. The euPOLIS suggested solutions will be demonstrated in 4 European cities: Belgrade, Lodz, Piraeus and Gladsaxe.

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