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Sustainable Green Infrastructure Planning in Greece: Proposal for an Urban Greenway Network in the Greater Athens Metropolitan Area

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Abstract

Athens, the capital of Greece, epitomizes the opportunities and constraints of modern urbanization, sustainable mobility, green infrastructure, greenway planning, and the associated quality of contemporary Greek civic life. Though the country's economy has been suffering tremendously for the past consecutive eight years with harsh austerity measures holding back any developmental commotion, signs of recovery and appropriate funding are lately emerging.

Physically, Athens has overcome its natural containing barriers, the Pikilo and Hemmitos Mountains on east and west borders, the southern waterfront expanding over to the Thriasio and Mesogeia Fields and the island of Aegina respectively. Culturally, contemporary Athens is thriving, living up to her own historical heritage and legacy. Socially, the latest abrupt surge of immigrant and refugees influx has altered both demographical ratios and civic life in the congested downtown and CBD of the city as well as the dispersed residential neighborhoods within a chaotic urban fabric. Economically, foreign and local investors have shown a keen interest in large scale projects (e.g. the former Hellinikon International Airport) but national debts to both the International Monetary Fund (IMF) and the European Central Bank (ECB) have led to governmental hesitation and procrastination of any developmental plans, halting in turn the investors' much anticipated and crucial momentum. Lastly, clashing stakeholders' interests within the broader green infrastructure and targeted greenway planning process, provide the fertile basis for a wide spectrum of alternative development scenarios.

One of the most discussed and highest-profile projects in Greece today is Hellinikon, an ambitious plan for converting the former Athens airport into an enormous park. The site of Hellinikon lies 8 km southwest of the center of Athens being approximately 1,500 acres and boasting a 3.5 km waterfront, including a marina. Exploiting the Hellinikon site as the main organizing impetus, this paper presents a proposal for an Urban Greenway Network in the Greater Athens Metropolitan Area (GAMA) as a response to prudent city planning, attempting to address the vision, the strategic issues, the governmental and private synergies, the planning criteria, the physical design and standards of greenway planning required for its implementation at the city scale and beyond. At the background, ecological, social, and economic issues weave the sustainability concerns and processes of green infrastructure planning.

Introduction and Background

Today, Athens, a city of over five million people is being plagued by enormous urban sprawl pressures and suffocated by an ever increasing rate of everyday traffic congestion, factors that contribute immensely to degrading both quality and standards of living in the Greek capital.

At the heart of this paper's conceptual framework, the challenge lays in juxtaposing the 2030 Agenda for Sustainable Development's long term Investing, Infrastructure and Development, and Sustainable Mobility with Athens's respective planning constraints and potentials. The urban development for the former Athens airport site of Hellinikon, a promising planning effort, is used here as a "starting point" for supporting sustainable mobility, bringing once again the Greenway Planning argument to center stage.

Drawing inspiration from the proposed Metropolitan Park of the Hellinikon site redevelopment by the Pollalis study as its driving force, and a response to sustainable city planning, an ambitious Urban Greenway Network "Vision" Plan proposal on a master plan level in the Greater Athens Metropolitan Area (GAMA) is presented to prove the case.

(<http://pollalis.com/projects/master-planning/hellinikon-former-airport-athens-gr>,
<https://thehellinikon.com/the-metropolitan-park/a-multi-dimensional-experience>).

Theoretical Concepts

This paper elaborates upon known literature by proposing a Greenway Planning approach being developed as part of a broader Sustainable Green Infrastructure Planning and Sustainable Development. (<https://www.iisd.org/topic/sustainable-development>). Infrastructure provides essential services and fundamental functions to the development of society, the economy and the environment, having both positive and negative consequences on the former (Jochimesen, 1966)

<http://www.sprawlwatch.org/greeninfrastructure.pdf>,

<http://unepinquiry.org/wp/content/uploads/2016/06/SustainableInfrastructureandFinance.pdf>).

Green Infrastructure, as a subset of Sustainable and Resilient Infrastructure Planning, advocates natural environment (the "green features" of nature) in land-use planning decisions, land development, growth management, and built infrastructure planning by: a) providing an ecological framework for environmental, economic and social sustainability at all scales, b) protecting biodiversity in both rural and urban settings and c) implementing related techniques such as greenways, green roofs, permeable pavement, water harvesting etc. (Pötz & Bleuze 2012, Benedict & McMahon, 2006,

<https://www.epa.gov/green-infrastructure/what-green-infrastructure>,

<http://www.sprawlwatch.org/greeninfrastructure.pdf>,

<http://gggi.org/site/assets/uploads/2017/11/GreenInfrastructureDefinitionandNeeds.pdf>,

http://ec.europa.eu/environment/nature/ecosystems/docs/green_infrastructure_broc.pdf).

Unlike conventional approaches to open space planning Greenway Planning solves urban and climatic challenges, increases quality of life through recreation, provides shelter and shade at the town and city scale, increases productivity of natural resources, reduces emissions, encompasses mass urban transport infrastructure etc. In character, Greenways are multifunctional, by enhancing the interaction and integration of various functions/activities on a plot of land (Ahern 2002, Jongman & Pungetti 1999, Little 1990).

Goals and Objectives

The paper's overarching goal is to develop a viable landscape design strategy in hope of solving the highly urbanized dense metropolitan areas' critical sustainable mobility issues, based on linkage and connectivity approaches of available open spaces, the regions' important socio-spatial role, its economic potential and its unique topography.

At the center of this investigation and within the umbrella of sustainability at both the environmental and socio-economic levels, urban mobility incentives constitute the prime objective. The paper presents a series of clear study objectives: a) to frame a development strategy for Athens that explores mobility alternatives and improves economy, b) to link the resources of Athens's broader municipal region by employing an innovative greenway network and its related green infrastructure, c) to exploit greenways as an attractive and integrated planning tool for economic growth throughout the year and a magnet for cultural expression, ecologically compatible recreation, and innovative mobility development, d) to create a synergy by linking Hellinikon, the former Athens airport with a new network of urban greenways, thus adding value to Athen's infrastructural base, e) to determine highest landscape, social, health and economic values, that the greenway system will address and promote, and f) to improve internal connections throughout the municipality of Athens by connecting its cultural/historic landmarks, its few remaining parks and greenery via a public open-space greenway system.

Methods of Sustainable Green Infrastructure Planning: “The game changers”

Expressed on January 22-25 2019 at the Davos World Economic Forum, “Globalization 4.0, the new Fourth Industrial Revolution” has transformed the geopolitical, economic and environmental outlook. The 2030 Agenda for Sustainable Development's 17 Sustainable Development Goals (SDGs) and 169 goals and targets narrow down to long term Infrastructure & Development, and Sustainable Mobility as the most pertinent future shaping 14 System Initiatives (http://www3.weforum.org/docs/WEF_AM19_Meeting_Overview.pdf).

The Geneva 2030 ecosystem, a dynamic network of organizations dedicated to advancing the 2030 Agenda is co-convened by the International Institute for Sustainable Development” (IISD) and the SG LAB residing @ UN Geneva offices (<http://geneva2030.org/en/ecosystem/#operating-principles>, <https://www.iisd.org/topic/sustainable-development-goals>, <https://sustainabledevelopment.un.org/post2015/transformingourworld>, <https://www.sdgmapping.ch>, <https://www.ethz.ch/en/the-eth-zurich/sustainability/goals.html>).

Greenways' compliance with 6 SDGs, focus on: #9) quality, reliable, sustainable and resilient regional infrastructure for economic development, human wellbeing, affordable and equitable access for all, #10) reduced inequalities, #11) inclusive, safe, resilient and sustainable cities, settlements and communities, #13) climate change and its impacts, #15) sustainable ecosystems, land degradation and biodiversity loss, #16) justice for all, effective, accountable and inclusive institutions at all levels (<https://www.sdgmapping.ch>, https://www.theguardian.com/global-development/ng-interactive/2015/jan/19/sustainable-development-goals-changing-world-17-steps-interactive?CMP=tw_t_gu).

Global Green Growth Institute (GGGI) at South Korea (GGGI 2011, <http://gggi.org/country-programs>), GI Audits in the UK (<https://www.arup.com/news-and-events/best-practice-guide-supports-urban>).

greening) and Leadership in Energy and Environmental Design (LEED) in USA, are some of the first successful rating system for green buildings and sustainable sites (<https://meetingoftheminds.org/envisioning-smart-cities-sustainable-infrastructure-10385>).

Committed to infrastructure planning, design, construction, and maintenance, the Institute for Sustainable Infrastructure (ISI) has collaborated with the Zofnass Program for Sustainable Infrastructure (ZPSI) at the Harvard University Graduate School of Design to develop the holistic and state-of-the-art, Sustainable Infrastructure rating system ENVISION as a decision-making planning guide that supports higher performance sustainable choices (<https://sustainableinfrastructure.org/about-isi/>, <https://sustainableinfrastructure.org/envision>).

According to Envision, landscape as sustainable infrastructure is deciphered at four systemic levels: demand for services, program of activities, pattern, and maintenance of cycle. Its strategies toward a sustainable landscape system are based on: preservation of natural areas' ecological integrity (biodiversity preservation), restoration (habitat loss rectification, compensation, degradation, and fragmentation), self-sufficiency (maintenance minimization), and new resources (landscapes carrying capacity maximization) (<http://zofnass.gsd.harvard.edu/planning/#landscape>).

Athenian oxymoron: The heartbeat of contemporary Greek context

Almost half of Greece's population resides within the Greater Athens Metropolitan Area (GAMA) of over five million. As with any overpopulated urban region, Athens's city and regional planning efforts focus on sustainably resolving -often highly antithetical- critical issues/challenges and opportunities/constraints:

Ecological issues

Physically, Athens has overcome its natural containing barriers, the Pikilo Mountain on east over to the Thriasio Field, the Hemmitos Mountain on west over to Mesogeia Fields, and the southern waterfront expanding over to the island of Aegina. Pentelikon Mountains blocks any serious attempts of urban sprawl to the north. Athens' contemporary physical asphyxiation is a result of poor urban planning that originated after WWII. Athens has exceeded its carrying capacity many decades ago mismanaging natural resources, leading to their depletion. For its daily consumption needs it relies on imported water, imported food, imported energy, and a sludge treatment plant that is marginally managing the heavy loads of urban waste. The infamous Athenian air pollution and urban smog completes the picture.

Social challenges

According to the United Nations refugee agency (UNHCR), there are nearly 60,000 refugees and migrants in Greece while Greece refuses to turn the country into a "warehouse of souls". The uncontrollable influx of over one million immigrants & refugees in 2015 and 2016 alone created a need for shelter/housing and indispensable hygiene conditions. The majority of them either come seeking employment or transit through the Athens area onto further European destination countries. Still to date, there are refugees and immigrants that live in poor conditions (cheap tents, portable toilets) at Athens' downtown CBD Pedion Areos gardens, other former Olympic 2004 infrastructure open areas as well as the abandoned former Athens airport. The EU has allocated funds for bettering their standards of living but they are many and the respective government mechanisms are slow. The refugees/immigrants uncontrollable influx problems contribute further to the already high carrying capacity and social cohesion problems of the city.

Economic constraints/opportunities, Private Investors as the new economic drivers

After eight consecutive years of EU imposed harsh austerity economic measures, in the summer of 2017, Standard & Poor's, Moody's and Fitch upgraded Greece's credit rating to positive acknowledging the country's recovering economy, improved unemployment rate, and shrinking national debt, finally replacing external financial aid with domestic market capital.

Services account for about 80% of Greece's GDP. The number of international tourist arrivals increased from 14.9 million in 2009 to 24.8 in 2016. Undoubtedly tourism is the main driver of Greek economy on the rise. 9,700 hotels in Greece accommodate 900,000 people reinforcing the actively growing hospitality market. Net volume of direct **foreign investment** has grown more than tenfold from an all-time-low of €249 million in 2010, to €2.8 billion in 2016.

Strategically-located in terms of commercial **logistics**, Greece is at the crossroads of East and West boasting some 46 airports, over 100 seaports and a modern network of roads and railways to match its **transportation infrastructure**.

As Greece ranks among the best tourist destinations in the world, in 2017 Fraport Greece (a German-Greek co.) took over 14 public airports in Greece, agreed to invest €400 million, has already paid €1.234 billion to the state and will continue to annually render €22.9 million and 28.5% of its revenue. Chinese global port operator COSCO, acquired 51% shares of the Piraeus Port Authority for €280 million, and Ferrovie dello Stato Italiane, Europe's third-largest railway company, bought 100% of Greek railway operator TrainOSE for €45 million writing off the €700+ million company's debt based on EC's decision (https://tranio.com/articles/the-feast-on-mount-olympus-investors-return-to-greece_5441).

Hellinikon former Athens airport redevelopment

One of the most discussed and highest-profile projects in Greece today is Hellinikon, an ambitious plan for converting the former Athens airport into an enormous park. The site of Hellinikon lies 8 km southwest of the center of Athens being approximately 1,500 acres and boasting a 3.5 km waterfront, including a marina (<http://pollalis.com/projects/master-planning/hellinikon-former-airport-athens-gr/>).

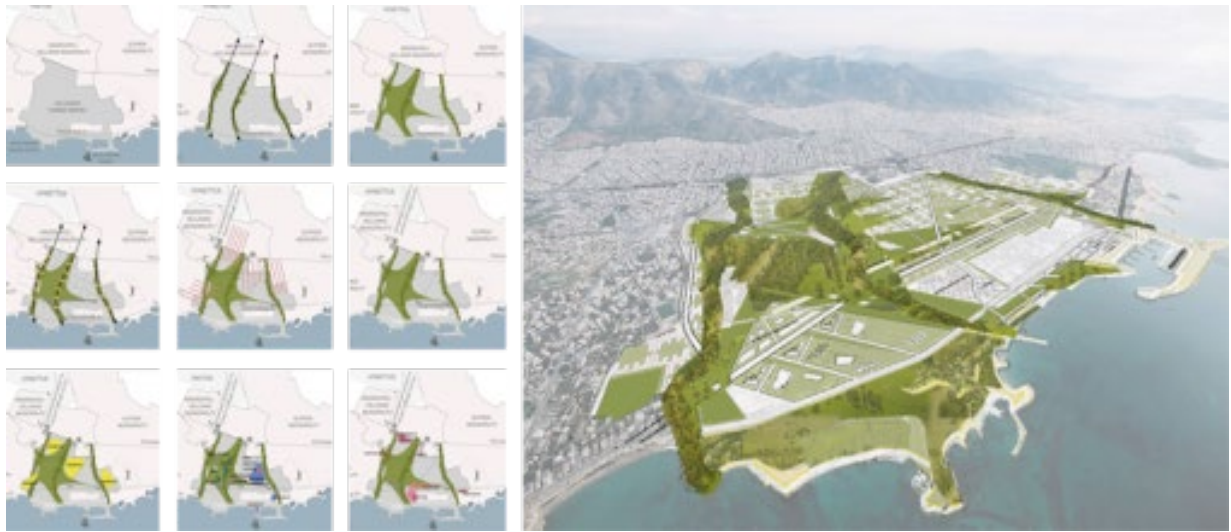
After its closure, the northwest portion of the airport was redeveloped, converting runways into a sports park and refitting hangars that housed some 2004 Summer Olympic venues. In 2005, the international design team led by architects David Serero, Elena Fernandez, and landscape architect Philippe Coignet, won the international competition to design a metropolitan park on the former site of the Hellinikon Airport over more than 300 other teams of architects (<http://serero.com/press/hellinikon>). Through two development phases, the project was further developed in 2006 and 2007. By 2012, government plans to attract investors and develop the site commercially were overshadowing the proposed park, though nearby communities remained vocal about their preference for a park.

From June 2011 to April 2013 Prof. Spiro Pollalis had been appointed by the Greek government as the Chairman and CEO of Hellinikon SA, the public corporation for the administration, management and development of the land of former Athens Airport of Hellinikon. The study for the development of Hellinikon, had been carried out by Prof. Pollalis and his associates (figure 1) before his involvement with Hellinikon SA. Prof. Pollalis's planning team provided extensive analysis of the site, suggested new land uses and set up the guidelines for new master and business plans. Contrary to prior studies, it has a viable business plan that aims towards the restarting of Greek economy making Athens competitive worldwide

and increasing the land value as part of a public/private partnership. The project includes: residential complexes, hotels and recreation areas; Olympic venues to be reopened, while new sports facilities, study and research centers and a golf course to be erected. A 2.6 million m² Metropolitan Park - larger in size than London's Hyde Park and occupying 42% of the total area of Hellinikon – is to be created. http://pollalis-hellinikon.com/wp/wp-content/uploads/2013/09/2012_01_30_Harvard_Club1.pdf

Figure 1: Spiro Pollalis & Associates study for the development of Hellinikon





In 2017, an international consortium of Chinese conglomerate Fosun Group, Abu Dhabi-based developer Eagle Hills and Greek company Latsis Group were to invest €8 billion in the project. Investors believe Hellinikon will become the greatest example urban redevelopment in Europe, and will attract over 1 million tourists annually. According to the developers, the project will bring the state €14 billion in taxes (2.4% of Greece's GDP) over the next 25 years, and will create over 75,000 jobs (http://pollalis-hellinikon.com/wp/?page_id=11, https://en.wikipedia.org/wiki/Ellinikon_International_Airport).

Proposal for an Urban Greenway Network in the Greater Athens Metropolitan Area (GAMA)

On greenways

Greenways are linear open spaces which provide people with access to open spaces close to where they live, linking together rural and urban spaces in the landscape...threading through cities and countryside like a great circulating system (President's Commission on American Outdoors, 1987). Jack Ahern (1995) offers an inclusive definition of greenways: "Greenways are networks of land containing linear elements that are planned, designed and managed for multiple purposes including ecological, recreational, cultural aesthetic or other purposes compatible with the concept of sustainable land use". Charles Little defines five types of greenways: urban riverside, recreational, ecological, scenic and historic, comprehensive (Little 1990). Greenways cover the primary planning topics of mobility and town planning, social impact of green routes, conservation and reuse of natural and cultural heritage and the promotion of leisure activities and environmentally respectful tourism. The reuse of communication routes offers non-motorized city dwellers safe, easy, accessible and continuous transport infrastructure which links commercial, residential, historical, cultural and natural areas to one another. By stimulating the areas they come across, greenways can facilitate urban renewal programs (EGWA 1998).

High-performing Greenways, being linear recreational, travel, and habitat corridors that link pedestrians and cyclists to surrounding communities and regional open space system, can provide important green infrastructure and ecological functions, such as habitat connectivity, surface storm water conveyance, and biofiltration (Fink & Searns, 1993), creating a balance between built and natural environments while offering economic and social benefits. Urban canopy supplements are pivotal in managing storm water

and reducing energy costs and runoff. Bioretention systems can work along a green transportation system. Higher abundance of green space in communities or neighborhoods is observed to have higher frequencies in participation of physical activity. More green space around housing is associated with better mental health.

Greenways are planning assets that steward natural ecosystems, lower carbon and environmental footprints, maximize the use of infrastructure services provided by natural ecosystems, trigger green technological and industrial innovation, spur investment in education skills building research & development, increase employment and green jobs growth, are financially viable, crowd-in domestic investors and businesses, increase foreign direct investment, and bring value for money for taxpayers and investors.

An Urban Greenway Network “Vision” Plan

Here, a case is made that the concept of greenways exploited as a viable planning strategy of sustainable urban mobility combined with existing infrastructure projects such as the redevelopment of the Hellinikon former Athens airport may be in fact Athens’ hope for a promising and sustainable new way of urban living and future commuting. In fact, an Urban Greenway Network “Vision” Plan on a master plan level is being presented here to prove the case.

Greenways being a resilient man-made infrastructural system, an interconnected network of green space that conserves natural ecosystem values and functions, respond extremely favorably to the urban planning parameters of Athens’s contemporary fabric and issues related to sustainable mobility by enhancing cultural sites and landmarks, ecological parks and open green spaces. Studies worldwide have proven that open space and greenways actually raise property values, increasing the city’s tax base.

Athens’ public sustainable mobility can improve by the creation of greenways as they offer safe ideal sustainable infrastructure for non-motorized transport and positively influence the autonomy of children, the elderly and the disabled. Studies show that the majority of journeys in cities scarcely exceed five kilometers. Therefore the bicycle is recommended as the means of transport best adapted to an urban environment. By promoting and stimulating Athens’ everyday use of bicycle and walking for daily commuting and leisure by all ages, greenways indirectly contribute to urban atmospheric pollution mitigation. Neighborhood and district parks can become irreplaceable aspects for the social functioning of the Greater Athens Metropolitan Area Urban Greenway Network, well suited to storm water infiltration. The total sum of linear open spaces (greenways, green routes, bike routes and public parkways) can connect the movement of people, water and wildlife throughout GAMA.

Making clear connections, thus “restoring the missing links”, is based on criteria and design guidelines chosen and founded on layers of open space functions by considering greenways as connected ecological, everyday social, cultural/historic, recreational, commercial, residential, and transport networks. In formulating the proposed regional scale network of urban greenways, aside of the quality of living benefits (eg. health benefits related to air pollution issues), the following four major planning and design criteria were established concerning links within the Greater Athens Metropolitan Area:

1. Connection of all major parks and green open spaces (National Gardens, Pedio Areos, Tritsis Park, Ktima Syggrou, Philadelphia Park, Tourkovounia, Mt. Pililo, Mt. Hemmitos, Mt. Penteli, Mt. Parnitha,

Athens and Piraeus waterfronts, Hellinikon former Athens airport, Tatoi airport) and beyond (Venizelos new international airport etc)

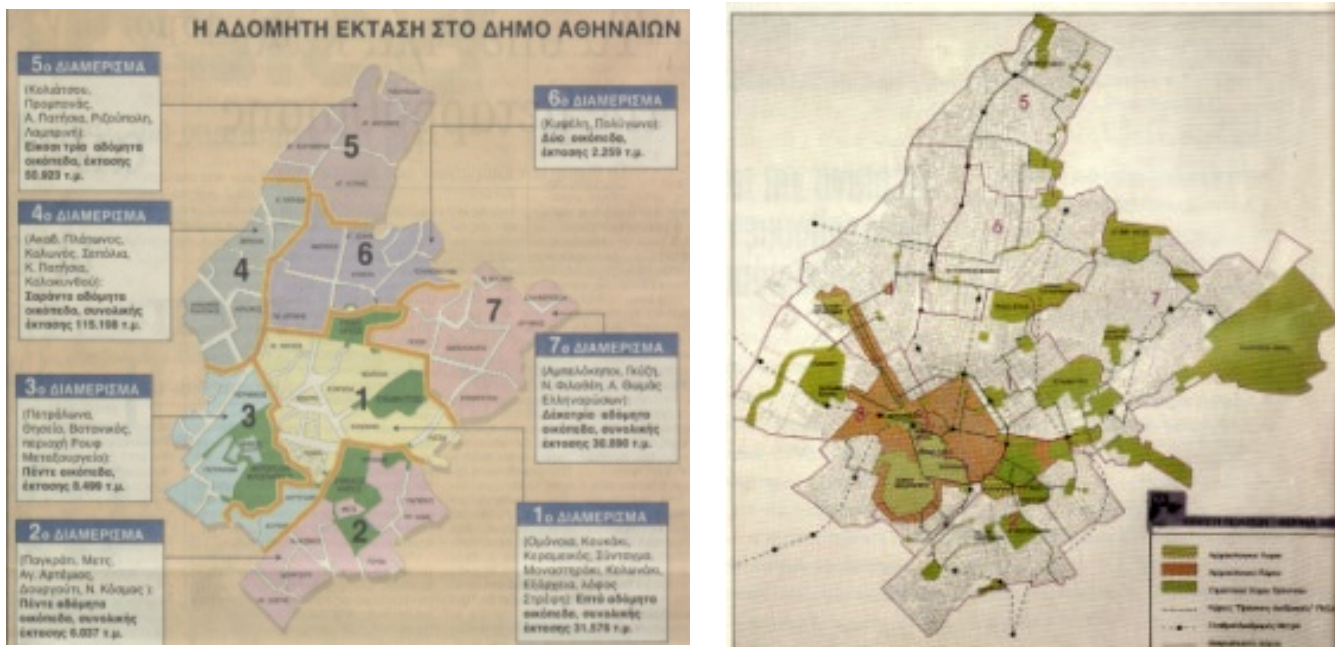
2. Connection of the major cultural heritage sites and monuments (Acropolis, Lecabetus, Academia Platonos, etc)

3. Connection of major athletic facilities (OAKA, SEF, etc)

4. Connection with the Athens Municipality Urban Greenways Study (Kantartzis & Varras 2005)

The Athens Municipality Urban Greenways Study

The Municipality of downtown Athens is divided into seven districts. The limited unbuilt area within each district is shown in the following figures 2 and 3 below:



Figures 2, 3: Limited unbuilt area within each district of Athens Municipality

Every district as a sustainable public or private community, serves an ecological function. The green network of streets, parks, schools, and utility rights-of-way serves both ecological and social purposes, providing areas for both active and passive recreation. The interlaced system of greenway corridors provides a network of bike, pedestrian, and wildlife routes, known as green routes that connect important natural, cultural, social, recreational, commercial, residential destinations within each district. They connect individual components of the ecological network and provide valuable habitat and storm water management services not only within each district but throughout the entire municipality. Scale-wise, importance is placed on connecting each district to the CBD of Athens. Greenways are means of connecting all green areas left within the Athens Municipality into an integrated open space network, providing the necessary “missing links” among natural areas contained within the built urban fabric environment. Below (figure 3) a master plan of all major green space along with the green routes exhibits the missing connections.



Figure 3: Kantartzis & Varras Athens Municipality Urban Greenways Study Master Plan

Sustainability for the Greater Athens Metropolitan Area in environmental, economic and social terms needs to be guided by: a) a Development Strategy in the form of land-use zoning, density, infrastructure, open space, links b) a Connections Development Strategy focusing on available connections offered (links, connections, green infrastructure, open space), and c) a Landscape Master Plan for the proposed Greenway System.

In a broader scale, the master “vision greenway plan” below (figure 4) all four of the major planning and design criteria are met, offering exceptional sustainable green infrastructure value added to the Greater Athens Metropolitan Area.

Discussion and Conclusion

The holistic basis of resilient landscapes implies the integration between natural and human aspects through the sustainable potential assets of optimized green infrastructure. As a case in point, the high-performing greenways and linked green spaces are to provide real economic, ecological and social benefits to the citizens of Athens.

Infrastructure and innovation comprise a single goal paramount to planning problem solving. Infrastructure innovations as solutions to environmental challenges dictate that infrastructure needs to be conceptualized and designed differently by: a) thinking systematically, b) planning holistically, c) choosing the right project for the problem, d) planning for resource-efficiency, e) aiming at cross-sector synergies, f) enhancing existing business processes, and g) educating users from project scale (Envision) to city scale (Zofnass Sustainable Planning Cities Guidelines) (Pollalis UNEP Geneva 2018, <http://zofnass.gsd.harvard.edu/planning>, http://www.greengrowthknowledge.org/sites/default/files/uploads/20180905_Infrastructure%20Innovations-lr_0.pdf).



Figure 4: Proposed Urban Greenway Network in the Greater Athens Metropolitan Area (GAMA)

The business case for investing in green infrastructure projects is paramount: mitigated environmental costs, motivated inward investment, heightened productivity, increased visitor spending, increased capital investment based on an available range of funding programs which support GI activities. Making the wise investment decisions in regard to sustainable green infrastructure is crucial for supporting growth, forging the sustainable development foundation with current economic growth models, and timing the investment decisions. The challenge that lies ahead is finding solutions which enable investors to channel funds into better infrastructure with more sustainable growth, in spite of the notion that it will be costlier upfront. Investors' perspectives, public/private partnerships, and an understanding of possible clashing stakeholders' interests are critical keys for implementing the proposed Urban Greenway Network in the Greater Athens Metropolitan Area.

In concluding,

As a study on sustainable mobility, the paper achieves three main goals:

- Advances the green infrastructure concept as a key tool for sustainable economic development encompassing the Hellinikon Redevelopment plan
- Develops a new Urban Greenway Network in the Greater Athens Metropolitan Area proposal using existing green infrastructure spaces.
- Outlines an agenda for more extensive and accurate future research data required for the Urban Greenway Network in the Greater Athens Metropolitan Area that can be explored within each of its municipalities.

Hopefully, the development of an integrated greenway planning strategy within the Greater Athens Metropolitan Area will not only guarantee a more sustainable future for Athens but will simultaneously

place a strong emphasis on the immediate need for implementation at the regional and local, physical and administrative scales.

As a proposed sustainable green infrastructural project, The Greater Athens Metropolitan Area's promising Urban Greenways Network further builds upon and reinforces its Hellinikon Redevelopment coupling project by achieving and safeguarding new heights of sustainable living for Greece's national capital.

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