Buenos Aires 2010-2060.

A strategic model to enhance sustainable mobility through a green infrastructure

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Abstract

The City of Buenos Aires has begun a transformation aimed to reverse many urban conflicts as a result of urban sprawl to adapt itself to the challenges and requirements to come in the next fifty years. Nowadays the City of Buenos Aires presents three weaknesses closely interconnected: the lack of public spaces, the reduction of its natural capital, and a chaotic mobility which has reached its critical point causing serious urban struggles.

The main challenge for Buenos Aires 2060 is transforming these difficulties in an opportunity to become a high performance city in terms of sustainability. Thus, the Territorial Model 2060 set out a planned model where the urban environmental quality is the guiding thread and the key to achieving a healthy and liveable urban environment for citizens.

The Territorial Model outlines the strategies to strengthen and recover the relation between the City and its natural capital. Structured according Buenos Aires Verde, a green network of urban spaces, green corridors and connectors, will increase in the short and medium term the level of accessibility to different scales of urban green space. Thus, different types of green space structure a network of public spaces, aiming to reach in the future 50% of the area of the city.

In addition, the green structure is closely linked to a new conception of densification and an intermodal mobility proposal to reduce the prevalence of cars in streets. Buenos Aires Verde is the basis if the future tissue to densification with a sustainable morphological criterion. The structure connects urban centralities of the City of Buenos Aires each other and with the metropolitan area. The design and spatial distribution of future green spaces are defined by several criteria such as compactness and build up density, flood risk, pollution and greenhouse gases reduction, focusing on the ecological services provided by their environmental functions.

Thus, public spaces take on relevance in the regional planning, structuring the territory as a scope of social, environmental, economic and landscape value, enabling the urban integration.
The Present Day City

The Autonomous City of Buenos Aires is the core of a metropolitan area of 1,200 square kilometers where live more than 14 million people, forming one of the largest urban agglomerations in the world.

The Metropolitan area in a territory equivalent to 1% of the country area, concentrates 39.6% of urban population and 40% of national production. It has a primacy index of 9.3, which is nearly ten times greater than Cordoba (including its metropolitan area), the second largest city in the country.

The City of Buenos Aires, the capital city of Argentina, has an area of 202 square kilometers and a population of 2.9 million. With a GDP of 65,000 billion, and a production of U$S 22,000 per capita, are among the highest rates in Latin America, meaning deeply differences with its metropolitan area. The main characteristics are as follows:

- Life expectancy is 76 years
- The fertility rate is the lowest in the country, with an average rate of 1.8 children per woman, showing a regressive demographic profile, with a significant aging.
- 7.1% of population is structurally poor, 50% lower than the national average.
- 2% of households are in critically overcrowded conditions
- Child mortality rate is 6.5 per thousand.
- A rate of less than 0.5% of population is illiterate; 50% of the workforce has university education and 75% are graduated.

![Trends of aging population](image.png)

Figure 1. City of Buenos Aires Population Pyramid. Source: DGPlan – SSPlan – MDU - GCBA

Its strategic location favored the connection between Argentina and the rest of the world. Thus Buenos Aires historically had had an important participation in Argentina’s economy holding many complex functions like government entities, financial companies, commercial activity and private and public utilities. Most of these activities are located in downtown, the historic, economic and political centrality par excellence given that 23% of jobs in the city are concentrated in this area.
The main conflicts affecting environmental quality of public space in Buenos Aires

*Mobility*

Since its foundation, the expansion of the metropolitan city took place on a radial converged structure responding to the dynamics of railways growth, the main driver of urban sprawl. The historic center of Buenos Aires, located at the convergence point, became the major economic social and cultural centrality of the agglomeration around the City of Buenos Aires, and became a metropolitan regional benchmark (Figure 2).

![Figure 2. Historical evolution of Buenos Aires City. Source: DGPlan – SSPlan – MDU - GCBA](image)

On the axis of expansion, firstly following the railways and then according the main routes, crowded the suburbs, consolidating the current disperse urban fabric of the metropolis (Figure 3). During the twentieth century the urban sprawl intensified the modification of mobility patterns.

![Figure 3. Historical evolution of the growth of Metropolitan Area of Buenos Aires. Source: DGPlan – SSPlan – MDU - GCBA](image)
In Buenos Aires the urban space originally occupied by the pedestrian to travel or socialize, has been replaced by vehicular traffic, reducing the availability of areas for pedestrian mobility, social meeting and recreation (Figure 1).

The current characteristics of mobility in Buenos Aires are summarized in the Figure 6.

Figure 4. Evolution of mobility patterns and public space occupation from 1900 to 2011. Source: DGPlan – SSPlan – MDU - GCBA

Figure 5. Mobility options in Buenos Aires. Source: USIT, MDU. GCBA.
### MASS TRANSIT RAIL

**Current Flows**
- 8 train lines
- 6 subway lines (metro)
- 1.9 million daily passengers including metropolitan area

### BUS DENSITY
- 110 bus lines
- 9,500 vehicles
- 70% of vehicles circulate in downtown

### DAILY VEHICLE ENTRANCE
- 1,200,000 cars
- 40% cars to downtown

**Private cars**
- 900,000 private cars from the City
- 16% annual growth rate
- Road structure converging to downtown

**Highways**
- 300,000 private cars circulating in city highways

### METROBÚS

Recently inaugurated
- 13 km of track
- 21 stations

**Connection with,**
- 3 train lines
- 2 subways lines

### PUBLIC BIKES PATH SYSTEM

**Existing Bike Paths**
- 78 km.
- 40 km incremented during the last 4 years.

**Stations Currently Operating**
- 12 stations.
- Location in parks of downtown

**Projected**
- 2,000 stations
- 60,000 bikes

**Goal**
- Reduction of the private car prevalence from 32% to 15%

### COMMUTING POINTS

**Main intermodal nodes**
- Train - Subway Connection
- Train - Bus
- Subway - Bus

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Figure 6. Transport modalities in Buenos Aires. Source: DGPlan – SSPlan – MDU - GCBA
Downtown: the heart of conflicts

Buenos Aires downtown is the focus of economic activities concentrating 23.3% of city employment. Since its foundation, the national, regional and metropolitan mobility systems were structured around the central area contributing to the process of urban growth, and becoming one of the most critical areas of the City in terms of mobility conflicts. Nowadays it concentrates national and local governmental functions, educational activities, cultural events and the most advanced services in health.

Approximately 2.8 million people live in Buenos Aires City. Every day over 3 three to four million people enter in the city from the metropolitan area to get their works. Almost 1.5 million of them remain in downtown. Concerning to mobility, 20 million daily trips in all modes are made in the metropolitan area, accessing 1.5 million vehicles added to 1.8 million living in the city, which means a heavy pressure on urban infrastructure.

The trend indicates an increment by 10% per year of motorized transport, while during the last ten years the increment of private cars in the streets rose sharply increasing the struggles associated to the motorized traffic density.

Consequently, the massive vehicular traffic in downtown cause serious urban system dysfunction, having saturated demand for transit and parking space, occupying almost one third of public space.
The direct impact on the quality of life may be summarized as follows:

- The increment of cars, cabs, buses and trucks of transport of goods circulating along the city has generated a raise of the transport congestion and therefore noise annoyances and disturbance.
The use of public space as a "free place available" for parking, bus stops and transfers to public transport.

The prevalence of vehicular traffic on public space at the expense of sidewalks and spaces for transport interfaces / activity; the sidewalks are not enough wide to allow the pedestrian walk safely and comfortably. Therefore there aren’t places where the people can stop and rest. The narrow sidewalk combined with the narrow street and the transport congestion increase risk of accident for pedestrian denying the social function of the public space.

The health consequences of urban transportation include air pollution, noise, variety of mental and social affects, contribution to global warming and fossil fuel depletion.

The deterioration and congestion of the sidewalk where pedestrians are exposed to all sorts of risk, environmental aggression, denying the essence of amenity and diversity of urban life.

These factors contribute to the environmental degradation of urban areas, threaten pedestrians and recreational activities, but they also affect activities linked to tertiary sector concentrated in downtown.

Indicators of public spaces environmental conditions affected by mobility patterns

Contaminants production

Motorized mobility is the main source of air pollutants emissions in the public space of Buenos Aires. The air quality in more congested streets of Buenos Aires is mainly affected by traffic, mitigated only by the favorable geographical location of the city favored by the prevailing winds from the Rio de la Plata. Nevertheless, the air pollution in Buenos Aires can exceed recommended levels by the World Health Organization. In downtown, mean level of carbon monoxide hovers almost invariably around 9ppm during working hours, exposing people continually to the dangers of high contaminated air with negative consequences for health.

<table>
<thead>
<tr>
<th>Amount in tons of CO₂ emitted per year and inhabitant</th>
<th>5.23</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISU</td>
<td>0.17</td>
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</tbody>
</table>

Noise pollution

In Buenos Aires the public space is affected by unacceptable noise levels from several sources, cutting the balance of city life without leaving space for relaxing and peaceful soundscapes, but also impacting on the quality of life causing health disorders. As a result, Buenos Aires is one of the noisiest cities in the world: the transit-related factors that determine the level of noise are the speed, congestion, traffic intensity, the passage of large vehicles and trucks, pavement type and urban morphology. Excessive noise reduces the potential uses and functions of urban public spaces and urban quality limiting their chances of attraction given that the conditions do not allow guarantee the livability. Thus tackling noise in public spaces implies substantial changes in mobility policies.

<table>
<thead>
<tr>
<th>Acoustic Level (Decibels)</th>
<th>90</th>
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<tbody>
<tr>
<td>ISU</td>
<td>0.2</td>
</tr>
</tbody>
</table>
**CO₂ production**

CO₂ production is associated with the consumption of energy. The total amount of CO₂ produced by the City of Buenos Aires in 2008 is 15,682,846 Tons eq¹. This value distributed in the stable population of the city of 3 million inhabitants, means 5.32 Tons of CO₂ per capita with growing trend since 2004 (Figure 2). The territorial distribution of emissions in the City of Buenos Aires is shown in Figure 24.

<table>
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<th>5.23</th>
</tr>
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<tbody>
<tr>
<td>ISU</td>
<td>0.17</td>
</tr>
</tbody>
</table>

Figure 10. Buenos Aires. CO₂ evolution from 2000 to 2008. Source APRA, CGBA.

Figure 11. Territorial Distribution of CO₂ Emissions. Source: Modelo Territorial Buenos Aires 2010-2060. SSPlan – MDU – GCBA

¹ Source: Environmental Protection Agency, Ministry of Environment and Public Space, Government of the City of Buenos Aires
Public Space in Buenos Aires: origins and evolution

The first public space in the City of Buenos Aires was the Plaza Mayor, created by Juan de Garay in 1580 when the second foundation of Buenos Aires. Around it were built the Fort, the Church, and the Jail. Years later it was settled the Theatre, the Bank and the National Congress. The Plaza Mayor was the community space used to held parties, games, funerals or religious celebrations. Today, known as the Plaza de Mayo is the convener space par excellence, and the main scenery of Argentina’s political history (Figure 4 a, b, c, d, e).

During the colonial period, vacant or empty lots or municipal land became squares. The majority of them appeared as a result of public occupation and rarely from a project, being open spaces with no scenic or natural value. Originally they were stop carts, markets, small farms, slaughterhouses, brick kilns, yards, garbage dumps, cemeteries or municipal empty lots. Many of these early squares created in the colonial era disappeared replaced by buildings, streets and avenues.

In 1870, President Sarmiento implemented the creation of public parks with educational, social and productive purpose. During this period the hygienist approach contributed to the creation of urban green spaces such as urban lungs that even nowadays are key pieces of urban natural heritage. The first and most important for it scenic value until now is Tres de Febrero Park, designed by architect Carlos Thays.
From 1880, when Buenos Aires became the capital of the country, experienced an accelerated growth and a scenic transformation. In 1910 the City had yet the diversity of green space required to be considered a first class city: urban parks, civic squares, promenades and scientists gardens. In parallel with the consolidation of first districts, the square in the neighbourhood turned into the meeting convener for the population. Between 1921 and 1946, were created numerous green spaces as parks, squares, boulevards and coastal improving the relationship between city and nature. Thus, the public park designed primarily for general recreation became the "green space", contributing to shape the urban image of the City.

Figure 14. 1910 to 2010. Evolution of San Martin square and context in the Downtown of Buenos Aires. Source: DGPlan – SSPlan – MDU - GCBA

Figure 15. Green spaces in the Northern neighborhoods of Buenos Aires. Source: DGPlan – SSPlan – MDU - GCBA


From 1950, the spaces added with natural, scenic and environmental value were not enough considering the urban growth, affecting environmental urban conditions, but also reducing opportunities of accessibility to open areas of a population that nowadays include every day more than six million people.
Access to public green space: the existing structure

During the twentieth century the urban development contributed to the degradation of the natural environment meaning a rupture in the continuity of the natural ecosystem. The pressure on natural environment is more intense than its natural capacity to respond, readjust and restore the balance. These negative impacts are beyond the loss of nature, affecting directly the people quality of life.

Nowadays over 50% of the public space area in Buenos Aires is occupied (either directly or indirectly) for vehicular circulation networks, reducing the pedestrian area prevailing noise, air pollution and road risk.

According to Rueda (2008) there is evidence that green public spaces as "environmental units" within the urban system play a key role restoring the balance between the natural and the built environment. Thus to the traditional role of urban green space as public space for recreation and scenic enjoyment, vegetation and woodlands add many environmental services for the urban ecosystem.

Each type of green space has a social function and the accessibility is a key to achieve it. Many squares appropriate for the neighborhood scale do not replace a metropolitan scale park. On the other hand, a metropolitan scale park cannot fulfill the social requirements of a neighborhood public space sized for short distance pedestrian access.

Squares, parks and green woodland corridors can contribute to control atmospheric pollution fixing particulate matter; mitigate the noise impact; contribute to oxygenation and CO₂ fixation; improve thermal comfort at urban and micro-urban scale reducing the effect of urban heat island; increment water infiltration creating consequently healthier environments.
The environmental contribution of green spaces on their immediate environment is given by the ratio of vegetated surfaces in relation with paved areas, which must be a minimum area of 30% of paved public space. As we point out Buenos Aires has grown without incrementing their green open spaces. Figure 17 shows the more critical areas according to the accessibility and built up density criteria, while the areas in the city with lack of urban green spaces accessibility, considering a maximum relative distance of 500 m, are shown in ¡Error! No se encuentra el origen de la referencia..

![Buenos Aires. Proximity buffers and lack of accessibility to green spaces. Source: DGPlan – SSPlan – MDU – GCBA](image)

The territorial distribution of green spaces accessibility indicators showed that 50 % of the city as public space. Nevertheless, many areas remain out of the 500 meters buffers, while others require more green areas due to built up density or to mitigate bad air conditions.

**Indicators of public spaces accessibility**

**Accessibility**

This indicator reveals the deficit of green space in the City. The tool GIS allowed us to map the existing squares and the optimal location of new hypothetical green spaces to ensure the accessibility of every citizen to a green space at a distance of no more than 5 minutes on foot (Figure 26). It also was possible to calculate the area required to guarantee accessibility for all people to different types of green spaces. The current indicator of proximity to green space is 0.59 and the desired value for the City of Buenos Aires is 0.82 (Figure 28).

Compactness

The relationship between built volume and the area of accessible public space is measured by the indicator of corrected compactness whom spatial distribution shown in Figure 20. The indicator allows distinguishing the most and less compact areas determining the need of green spaces. The map shows areas where the greater built density, must be offset by the incorporation of new green areas to mitigate the impact of densification.

Figure 21 synthesizes in graphics the proportion of green public spaces needed to fulfill four basic criteria used in the assessment stage. As shown to mitigate CO\textsubscript{2} emissions requires almost the same area of the city.

As a result we firstly determined the required green area considering accessibility and compactness given that both are more feasible goals in Buenos Aires. The geographical distribution of green spaces by type and location is shown in Figure 22.

<table>
<thead>
<tr>
<th>Green space Typology (scale)</th>
<th>Number required of Green spaces</th>
<th>Area required</th>
<th>Location</th>
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<tbody>
<tr>
<td>Metropolitan</td>
<td>1</td>
<td>40 ha</td>
<td>West area – East area</td>
</tr>
<tr>
<td>Urban</td>
<td>3</td>
<td>15 ha</td>
<td>West area</td>
</tr>
<tr>
<td>Neighbourhood</td>
<td>45</td>
<td>45 ha</td>
<td>Downtown – West area</td>
</tr>
</tbody>
</table>

Figure 22. Buenos Aires. Typologies of green areas required. Source: DGPlan – SSPlan – MDU - GCBA
Indicators of current and desired conditions for green spaces

**Figure 23.** Territorial distribution of current synthetic sustainability indicator of public space. Source: DGPlan – SSPlan – MDU - GCBA

<table>
<thead>
<tr>
<th>Accessiblity</th>
<th>Average distance to a green urban space (m)</th>
<th>Current</th>
<th>Desired</th>
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<tbody>
<tr>
<td>ISU (*)</td>
<td></td>
<td>612</td>
<td>350</td>
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</table>

<table>
<thead>
<tr>
<th>Ratio population density – green spaces</th>
<th>Green area per inhabitant (m²)</th>
<th>Current</th>
<th>Desired</th>
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</thead>
<tbody>
<tr>
<td>ISU (*)</td>
<td>3.9</td>
<td>10</td>
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<table>
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<tr>
<th>CO₂ Emission</th>
<th>Tons of CO₂ emitted per year and inhabitant</th>
<th>Current</th>
<th>Desired</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISU (*)</td>
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<td>1.31</td>
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<table>
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<th>Noise Intensity</th>
<th>Acoustic Level (Decibels)</th>
<th>Current</th>
<th>Desired</th>
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<td>ISU (*)</td>
<td>90</td>
<td>50</td>
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<thead>
<tr>
<th>Air Contaminants</th>
<th>Contaminants (mg/m³)</th>
<th>Current</th>
<th>Desired</th>
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<tbody>
<tr>
<td>ISU (*)</td>
<td>7.89</td>
<td>1.46</td>
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**Figure 24.** Summary of current and desired indicators according to environmental conditions in public green spaces

(*) Indicator value: 0 (worst) to 1 (optimal)
The Territorial Model for Buenos Aires 2060

The Environmental Urban Plan of the City of Buenos Aires is the legal and policy frame to refer the City planning and management process. Among a set of objectives it establish to incorporation of the environmental dimension, cross-cutting planning strategy throughout the process and the need to implement monitoring and control instruments.

The Territorial Model 2010 – 2060 synthesizes territorial planning guidelines in response to three legal frames: the mandate of the City Constitution, the Urban Environmental Plan and the National Strategic Plan.

To fulfilling the environment imperative the Territorial Model raises a new urban cycle in which the resolution of social, urban and economic needs, are compatible with reducing the environmental impact of the different urban processes. This challenge requires actions to reverse the current distortion of urban metabolic cycles, using more efficiently existing urban resources, incorporating renewable energy production, water cycle management, materials, waste, promoting recycling, reuse, and urban design solutions environmentally responsible.

It involves a commitment to all social sectors, focusing especially on lower socio economics groups with less resource, whose quality of life is greatly affected by environmental conflicts. On the other hand also implies a sectorial monitoring where demand and consumption patterns contribute to the metabolic imbalance of the City.

The proposals set out by Urban Environmental Plan to include the environmental dimension will involve the following guidelines:

- Habitat and Housing: to reduce the impacts of urbanization process including bioclimatic strategies, efficient patterns of water, energy and materials consumption as a condition for future developments and urban regeneration.
- Structure and centralities: to avoid the urban sprawl, recycling and increasing urban fabric, creating centralities to enhance the mix of urban uses and proximity as the basis of accessibility, shaping a polycentric structure connect public transport to sustainable mobility options.
- Public Space: Buenos Aires Green through a structure of green corridors and connectors link different scales of new and existing public green space, expanding and regenerating permeable urban surface and biodiversity.
- Mobility: to link development and equipment to enhance displacement preferably by public transport, walking and cycling, promoting multimodality and sustainable mobility.
- Production and employment: To create the necessary conditions for sustainable economic development, building a critical mass of activities in each urban area, enabling the diversity of services, basic equipment, commercial and public transportation to develop a pattern of more efficient urban life, prioritizing the use of proximity.
- Urban Heritage: to promote the sustainable management of urban stock building through conservation, improvement, efficiency, rehabilitation and reuse.

The Territorial Model is made up of six topics the Produced City, The Present Day City, the Trend City, the Desired City and the Sustainable City, whose characteristics are detailed in the next Figure 25.
The Produced City
It develops an historical view of the city focusing on its territorial setting, the evolution of the population, the creation of public space, the development of transport and mobility.

The Present Days City. The comprehensive diagnosis of the current territorial configuration of the City is structured around different topics set by the Environmental Urban Plan, in the metropolitan scale as well as in the national context. The analysis of the current city allows identifying its strengths and weaknesses.

The Designed City. It is a historical review of the rich tradition on planning that goes back since the early twentieth century to contemporary plans. The review evidences the recurrence of ideas and issues such as the imbalance between north and south areas in the cities; the relationship with the River, and the metropolitan fragmentation.

The City Trend. Shows main aspects that shaped the current growth of the City of Buenos Aires: the building density consolidated by sustainable and morphological criteria, the Polycentrism and the future creation of new centers in the south; the new public spaces created according multi-criteria approach to increment its accessibility and its territorial distribution; the heritage protection; the productive development balancing mixed areas with the incorporation of public green spaces.

The Desired City. This component of the Territorial Model, explain the general criteria and propositional guidelines to achieve a sustainable city. Its objective is to achieve an integrated and anticipated view, and the monitoring of urban processes in the medium and long term, to reduce potential negative environmental externality in the future.

The Sustainable City. The Sustainable City reflects the current situation and the desired future for Buenos Aires 2060 through a set of criteria representing the model of Desired City. It is a theoretical-methodological proposal to evaluate and quantify the sustainability of Buenos Aires, represented by thematic indicators of current, future and wanted conditions for Buenos Aires.

Figure 25. Topics of the Territorial Model. Source: Modelo Territorial Buenos Aires 2010-2060. SSPlan. MDU, 2011
According the guidelines previously mentioned, a system of sustainability indicators were applied to assess the current status of different issues concerning the topics mentioned (Figure 26). These monitoring and control instruments are required by the Environmental Urban Plan to assess current conditions and design urban policies. Nevertheless, in the frame of Territorial Model were calculated indicators for a future and desired scenarios as goals to be fulfilled.

From this approach the inventory of indicators is a matrix of control for plans, projects and changes in the current city as well as the future directions that will drive to the Desired and Sustainable city. Differences between the Desired City and the Present Day City have been territorialized and will be a guide policy to monitor its progress and to correct its course.

Figure 26. Sustainability indicators for Buenos Aires 2010-2060. Source: SSPlan, MDU, 2011

The Urban Sustainability Synthetic Index for current scenario (2011) is 0.68 and the expected in 2060 is 0.94. Sectorial index are shown in the six boxes (Figure 27).

Figure 27. General and sectorial Urban Sustainability Synthetic Index for Current and Desired scenarios. Source: SSPlan, MDU, 2011
The Desired City: The green structure linked to the mobility model

The strategy to implement by the Territorial Model in order to incorporate new green public spaces in all its forms is the project Buenos Aires Verde. This project aims to fulfill the needs of urban green spaces from innovative approaches in response to the territorial different demands based on a multi-criteria approach including at least accessibility, compactness, CO₂ mitigation, hydrological risk, heat island mitigation.

Buenos Aires Verde proposes a green tissue to accompany the future densification with morphological criteria, improving the compactness and the connectivity among the existing and future green unities in the city. This approach aims to integrate solutions for mobility as a strategy crucial. It is clear that mobility is a dependent aspect of structural factors that determine the demand for travel as the location of residential areas, productive economic powerhouse, consumption patterns or social needs like education, health and recreation.

Therefore, the Territorial Model promotes a more efficient model based on sustainable patterns in response to the economic and social needs, increasing the territorial linkages to strengthen the multimodal connection.

In the path to the next 50 years, one of the main challenges of urban sustainability is to implement mobility strategies towards models based on the use of clean and renewable energies. So, sustainable mobility policies have the commitment to encourage the improvement of the quality of urban life minimizing negative impacts such as urban congestion, production of greenhouse gases, noise pollution, air pollution affecting the public space livability.

The concepts of public space, natural areas and environmental quality should be integrated given that all the elements of urban structure are essential for the conservation of the biosphere. In this way, the city becomes as reserve itself and the linkage between urban and natural ecosystems must be based on new approaches to recover the lost environmental quality.

The structure of the city as an urban ecosystem is defined by the distribution, size and relationship between built spaces, empty spaces, green areas and the main road network. In this sense the green areas are essential to achieve a balance between the natural environment, the built environment and the impacts of urban activities.

The number, variety, characteristic and area of green public spaces play a fundamental role given that they provide environmental services as the production of oxygen, carbon dioxide and other contaminants fixation, and the regulation of urban heat island improving the air quality and urban livability.

Proposal for structuring a green public space system

The Territorial Model guidelines related to public spaces focus on freeing the streets from the stranglehold of the car, strengthening a network of neighborhood, urban and metropolitan green areas.

This goal involves the creation of a network of units called Basic Units of Sustainability or Macromanzanas² (in Spanish) composed of several blocks and limited by avenues and an Integrated Green Spaces System. Both are associated each other conforming the structure of the green public space proposal that will increase vegetated areas, pedestrian areas and develop different scale of greenways.

The Territorial Model defines the Basic Units of Sustainability (BUS) as a set of blocks bounded by a primary network of circulation. Inside each BUS, streets prioritize sustainable

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² Macro block
mobility and the prevalence of useful public space, displacing most of car traffic to the primary roads. The essential goal is to shape neighborhoods where the domain of wide areas for living, socialization, exercising, and the presence of vegetation, sized according local characteristics, would improve the environmental quality of the outdoors.

The BUS network is the base structure of green spaces that meet different environmental functions given by the size, volume and type of vegetation, and the green surface in relation to built-up density in order to improve the balance between built and natural environment. The BUS units articulate each other shaping a mosaic linked by a network of green corridors and green connectors which also connect three scales of green spaces. (Figure 28 and Figure 29).

The BUS network is the base structure of green spaces that meet different environmental functions given by the size, volume and type of vegetation, and the green surface in relation to built-up density in order to improve the balance between built and natural environment. The BUS units articulate each other shaping a mosaic linked by a network of green corridors and green connectors which also connect three scales of green spaces. (Figure 28 and Figure 29).

The micro-urban scale or neighborhood subsystem, is comprised by existing and future plazas or micro urban environmental units linked by green connectors designed to increase the supply of local vegetated areas (Figure 29).

Inside the BUS, the improvement of existing green areas through the maintenance of hard areas consisting on paved floors with furniture and recreation functions, while soft areas where prevail permeable soil and vegetation, enhance the generation of environmental services adding value to recreational uses. Within the BUS, the internal lanes as wooded
axes that bound each block shape the green connectors, generating better air quality and microclimate conditions for pedestrians and residents. (Figure 31).

At the residential scale, the future existence of squares within 350 meters of each resident implies the increment of public green space in the whole city.

![Figure 31. Tipología de la red de conectores verdes. Source: SSPlan, MDU, 2011](image)

The second greenways system at urban scale confining the macro-blocks is shaped by green corridors, another category of wooded axes located on the primary road network. They consist on avenues with high flux of transit, connecting green spaces at neighborhood scale to urban parks (Figure32). The green corridor is known as a strip of land whose biodiversity characteristics allows to link two natural areas. In urban areas a green corridor has a similar function, connecting different types of green areas within the City or located in adjacent areas, being its main relevant features as follows:

- **Linear Park**: has medium to large size trees. Belong to this category the urban green corridors projected on primary traffic routes, prioritizing the creation of green public space on tree-lined boulevards and sidewalks. They are located in areas of high building density and consolidated urban fabric, where there is not land available for the existence of traditional public spaces.

- **Green corridors**: according to the size and scale of their connections they can be regional and urban. The regional green corridors connect large scale parks or Biosphere reserve, as well as woodlands, used for recreation, pedestrian activities and cycling. They can also link two or more green spaces of varying scale as biosphere reserve with squares or smaller green spaces.

- **Small green pieces**: urban acupuncture, green roofs, vertical gardens and vegetation on facades can be linked as a continuous path shaping a green corridor. These kind of linear parks are transforming elements of urban public space, as they fulfill the biological corridor functions and contribute to the consolidation of public green space with all the social and environmental benefits.
The green synergy between the three proposed systems will create a network of interlinked, multi-purpose and high quality open spaces. On one hand they connect with areas where people live and work with green open areas; on the other hand the green grid contain the transit area reducing its impact on the public space.

The system of greenways will connect neighbourhoods to nearby parks and squares, shopping, schools and other neighbourhoods, forming part of the multimodal transportation network. The goal of Buenos Aires Verde is to improve the quality of life for residents by incrementing the green coverage with a greenway system providing recreational opportunities, increasing our natural environment and open spaces, and opportunities for walking, bicycling or translating to any destinations in a more liveable context.
First steps: Freeing streets from motorized transit in downtown with the Pedestrian Priority Programme

According to the mobility conflicts yet explained the first actions are taking place in downtown through Pedestrian Priority Programme which is aimed to improving the conditions of the public space and the pedestrian accessibility recovering the place for meeting where the people can stop and rest.

The actions taken are shaping several BUS in downtown, moving cars and other vehicles to avenues. Thus the public space is becoming more human, while recovering its social function.

According to these objectives were defined pedestrian streets, called pedestrian priority street, enlarged and leveled sidewalks to help the pedestrian circulation without obstacles, improved the street furniture and lighting and planted new trees. Significant project has been finished in Carabelas, Reconquista and Suipacha Street. Main action may be summarized as follows:

- Enlarge sidewalk: The pedestrian accessibility and the circulation was made more comfortable after improving the sidewalk design.
- Pedestrian priority: In Buenos Aires downtown the accessibility of motorized transport was limited in order to make easier the pedestrian accessibility.
- Better urban environment: The roadways and the sidewalks were leveled and new furniture was designed to give new value to city space.

The Pedestrian Priority Program is being carried out successfully in the whole city of Buenos Aires. Different actions were defined for every area of the city, considering the special features such as functional, patrimonial, social and environmental peculiarities.

Objectives of the program

- Improve environment quality (reduce noise annoyance, air pollution, etc).
- Increase accessibility and connectivity.
- Progressive displacement of public transport to the avenues.
- Enlarge the pedestrian space.
- Implement a public bike system.
- Reduce parking area on roadways.
- Regulation of loading and unloading of goods.
- Increase and renewal street furniture.
- Preservation of cultural heritage and identity.
- Revitalization of commercial and service areas.

Due to the complexity that it presents, for this paper there have been selected the interventions realized in Reconquista Street.

The assessment performed on Reconquista Street revealed the benefits of the Pedestrian Priority Programme intervention, and shaped the basis for conducting future similar projects. The new configuration implies more comfortable outdoor conditions for pedestrians, less conditioned by the presence of the car, allowing safer and more fluid displacement.

Reconquista becomes a reference area for public meetings, creating points of social activity and enhancing the diversity of uses of the area with local shops, bars and restaurants, extending the hours of use of the street until late at night.
In terms of environmental quality, the restriction of vehicular traffic to the minimum required, allowing only the entry of private cars and vehicles for inward transport, removed the parking on the street as well as the negative consequences as vibration and harmful emissions. Despite the chances of increasing the vegetated area are limited, it is verified a significant reduction in noise, pollution reaching better conditions of livability.

**Functional**
The project enables the creation of new spatial reference land marks generating urban activities and meetings places for the public bringing a new vision of vehicular traffic limiting their speed, impact and occupation.

**Social**
The area is activated by the presence of pedestrians extending the travel times on the street, even at night given that the complexity and the mix of social activity promote diversity of uses: offices, local shops, bars and restaurants.

**Environmental Sustainability**

_Improvement of air quality in the street Reconquista_

The emissions caused by motorized sources in narrow streets with tall buildings on both sides, cause higher concentrations of particulate and combustion gases in streets or micro urban spaces, due to shortcomings in ventilation and dispersion of particles and gazes in the air. That was the situation in Reconquista Street before the intervention.

Several studies undertaken in the central area of Buenos Aires examined the relationship of CO concentration and other pollutants with prevalent winds, showing that at the time of measured peak close to the 40 ppm winds conditions allow to decrease rapidly the alarming concentration. The concentration of CO naturally changes according to traffic density along the days and hours and more closed to intersections, and the highest average concentrations of pollutants occur in calm and humid days.

<table>
<thead>
<tr>
<th>Origin of the impact</th>
<th>Impacted factor</th>
<th>Impact</th>
<th>Results</th>
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<tr>
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<td></td>
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<td>% Improvement</td>
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<tr>
<td><strong>Emission and radiant temperature</strong></td>
<td>Air quality</td>
<td>CO₂ Emissions (Ton. / year)</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Reduction of the Average temperature of the air % (change of materiality)</td>
<td>T °C Average / %</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Temperature reduction for change of materiality and vegetation</td>
<td>T °C Average / %</td>
</tr>
<tr>
<td><strong>Noises</strong></td>
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<td>Noise level</td>
<td>Decibel</td>
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<tr>
<td><strong>Vibrations</strong></td>
<td>Buildings</td>
<td>Useful life and pathologies</td>
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<tr>
<td><strong>Motorized street</strong></td>
<td>Percentage pedestrian surface + Reconquista intervention</td>
<td>%</td>
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</tr>
<tr>
<td></td>
<td>Transport circulation</td>
<td>%</td>
<td>-3 %</td>
</tr>
</tbody>
</table>

Table 1 Environmental improvements identified in Reconquista Street. Source: DGPlan. SSPlan, MDU, 2011
Figure 34. Pedestrian Priority Programme roads in downtown. Left: Historical pedestrian streets. Right: BUS and Public transport priority in avenues. Source: DGPlan. SSPlan, MDU, 2011

Figure 36. Current conditions of Reconquista Street. Source: DGPlan. SSPlan, MDU, 2011

Conclusions

The objectives of the Desired City suggest the need for an integrated vision, monitoring early urban impacts in the medium and long term, reducing the potential negative externality to the environment. This is reflected by the Sustainable City through a set of indicators that characterize the current, desired and future situation of Buenos Aires in terms of economic, social, urban and environmental issues.

The Desired City aims to move towards a model of efficiency and sustainability. The criteria and objectives of the Territorial Model, seek to reverse the prevailing conflicts caused by territorial segmentation, reducing the dysfunction of the existing city, promoting a compact and complex model with continuity, multi-functionality, heterogeneity and diversity.

From this approach to solve mobility dysfunction and lack of green open spaces can be the opportunity to link their potentialities shaping a new grid green that can be managed for mobility, recreation, conservation.

Unlike traditional parks and recreation areas, greenways have the potential to link neighbourhoods through a network of trails and open spaces connecting a variety of land uses.
The existence of linear parks as green corridors containing the transit flux serve as buffer strips, help increase our degraded natural environment, reverse the negative impact of vehicular traffic, offer mobility options, and provide opportunities for healthy outdoor activities improving our quality of life.

Even though, the green system not only is a network of green spaces and greenway linkages of protected sites or nature reserves. In the Territorial Model is seen as a green infrastructure that should provide for multi-functional use, operating at all spatial scales from downtown to centralities and the metropolitan area contributing to the proposal of achieving a compact - complex city for Buenos Aires 2060 integrated to the following goals:

- Increased complexity and mixed uses: the proximity of heterogeneous systems ensures the vitality of areas by providing stability and social cohesion. Mixed uses compatible each other, even with industrial activities, higher residential density, delivery services, the presence of economic activities and equipment provide the right context to increase exchanges of information. The increased complexity enables a cohesive social life, a competitive economic platform, while requiring less land resources, energy and materials to maintain the system.

- Proximity. The green structure of the Territorial Model, improves the urban quality providing pedestrian routes and green corridors in synergy with the diversity of activities.

- Efficient use of resources. Today Buenos Aires demands high amount of energy to maintain low complexity organizations. The compactness proposed in Buenos Aires Model 2060, will allow reducing distances between heterogeneous units and centralities, increasing energy efficiency.
Competitiveness and sustainability. The competitiveness of the city is based on its ability to operate in its complexity, consuming efficiently the energy and offering attractiveness for communitarian activities.

Bibliography


