Ciudades Sostenibles
Plan Nacional de Adaptación al Cambio Climático

Curitiba's model as an example of a sustainable city in Latin America

Green infrastructure, cultural guidelines, environmental impact assessment, flood control, etc. urban planning, integrated planning of sustainable neighborhoods and management instruments

Architect Emanoele Leal

IPPUC

Ciudades Sostenibles
Plan Nacional de Adaptación al Cambio Climático

main challenges of adaptation and mitigation policies in cities

Ciudades Sostenibles
Plan Nacional de Adaptación al Cambio Climático

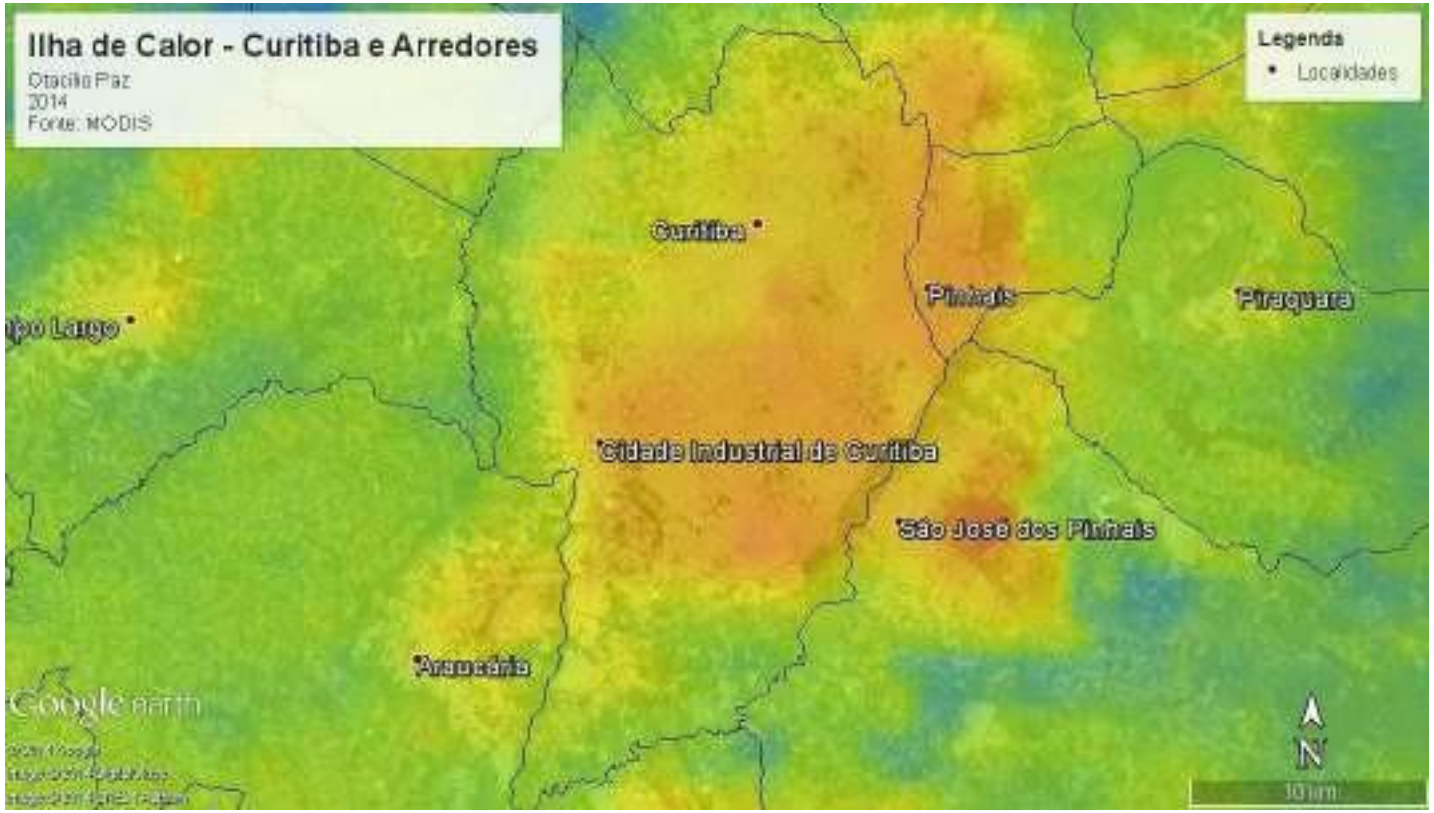
Flooding Curitiba, 2019

Source: IPPUC

Orla Rio de Janeiro, 2019

Source: Observatório do Clima

In view of warming trends in tropical regions, suggested by climate models of the *Representative Concentration Pathways* type, the **estimated annual temperature increase in these regions is around 4 to 5°C by the end of the century** (*Diffenbaugh and Field*, 2013) with consequences for overheating and increased heat stress externally, and, more intensified, internally in buildings "



Curitiba, 2014, Ilhas de Calor

Source: KRUGER, Eduardo and ROSSI, Francine. Quantificação da ilha de calor de curitiba considerando aspectos de atmospheric stability. *Rev. bras. meteorol.* [online]. 2015, vol.30, n.4, pp.394-404. ISSN 0102-7786. http://dx.doi.org/10.1590/0102-778620130093.

Desertification in the Brazilian Amazon
Photo: Ana Cintia GAZZELLI/WWF-Brazil

Source: WWF

MITIGATION

Greenhouse gas (GHG) emission reductions

Sinkhole Increase

Preservation of natural ecosystems

Central Park - New York

Source: *El Pais Uruguay; Gazeta do Povo; Daily Overview*

ADAPTATION

Resilience

Resilience to the effects of climate change

reduce vulnerability

sea level rise, heat waves, storms, drought, diseases, destruction of ecosystems, etc.

Sustainable development

social + economic + environmental

Urban resilience is the ability of any urban system, along with its inhabitants, to **maintain continuity despite shocks and impacts**, while **adapting and transforming positively towards sustainability**. A resilient city assesses, plans and acts to prepare for and respond to hazards (natural and man-made, sudden, gradual, expected and unexpected) in order to protect people's lives, ensure development, foster an environment for investment and drive positive change.(UN,2018)

Source: *El Pais Uruguay; Gazeta do Povo; Daily Overview*

Source: *Google Earth,* 2019

Source: *Google Earth,* 2019; IPPUC, 2015.

city made x new city

Source: IPPUC, 2007

"The **protection of the environment is of general interest**. **Persons shall refrain from any act that causes serious depredation, destruction or contamination of the environment**. The law shall regulate this provision and may provide for penalties for transgressors." Constitution Uruguay

X "reaction and correction" X "foresight and prevention"
X "prevention and prevention" X

(Embazador Calleiro Rodrigues and Professor Paulo Afonso Leme Machado".

Source: Uruguay Constitution
Citation:Machado, Paulo Afonso Leme. General Principles of Environmental Law and Brazilian Environmental

"(General duties relating to real property) - **The** following, among others, **constitute territorial duties for the owners of real property**, within the framework of the legislation in force and in **the general interest**:

(...)

Duty to protect the environment and diversity. All owners shall be subject to the rules on protection of the environment, natural resources and natural heritage**, refraining from any activity detrimental to them**. This includes the duty to protect the property against the productive use of risk or the occupation of land for housing purposes in risk areas." LOT Uruguay, (grifón nuestro)

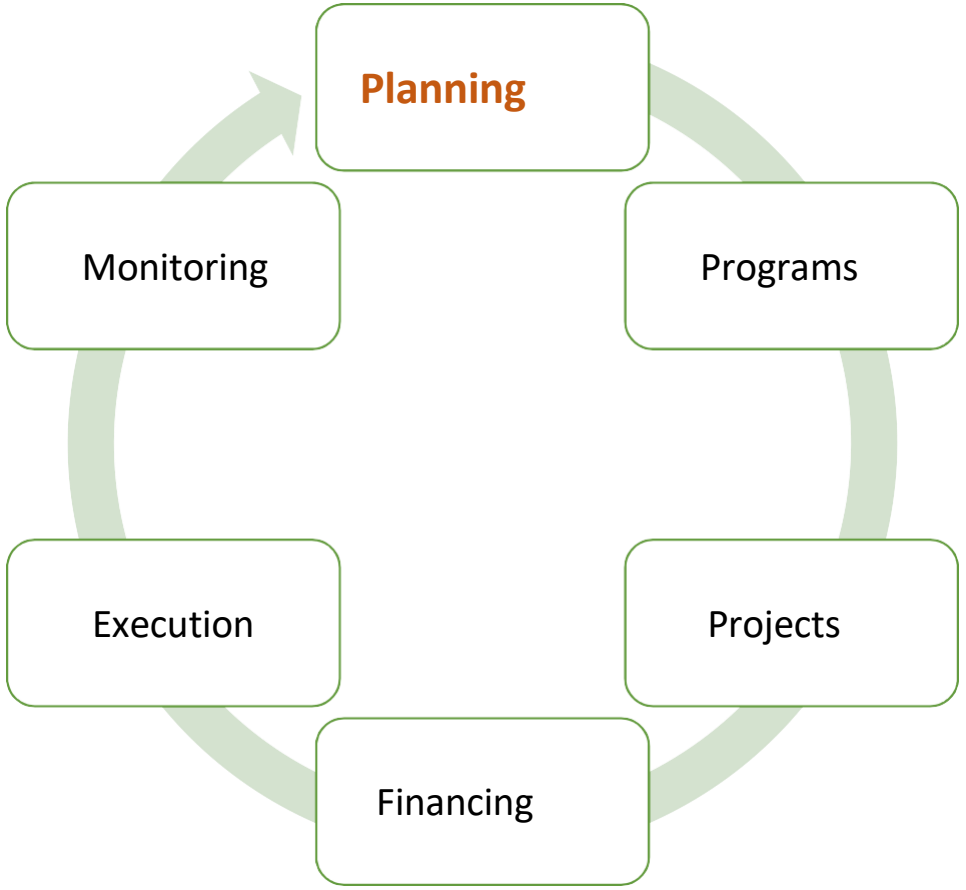
Source: Ley de Ordenamiento Territorial Uruguay

"The **exercise of the right to develop** activities and uses, to modify, to subdivide or to build, by any person, private or public, natural or juridical, in any part of the territory**, is conditioned** to obtaining the respective administrative act of authorization, except for the exception foreseen in the productive rural category land. It shall be a condition for the issuance of this administrative act, the **fulfillment of the territorial duties** established by the present law." LOT, Uruguay (grifón nuestro)

Source: Ley de Ordenamiento Territorial Uruguay

Prevention as a principle and planning as its main instrument

"This principle (of prevention) requires that **environmental damage** be **avoided**, on the basis of **the known risk**, through the use of appropriate information and decisions in advance. The **adoption of planning** in the face of a given undertaking that may cause environmental damage with the requirement of Prior Study and Environmental Impact Report is a practical example of the application of the principle of prevention."



Source: Silva, Marcos Souza. Direito ambiental: principais princípios e seus reflexos na legislação e na jurisprudência.
available at <https://www.unaerp.br/revista-cientifica-integrada/edicoes-anteriores/volume-3-edcao-2/2421-rci-direito-ambiental-principais-principios-e-seus-reflexos-na-legislacao-e-na-jurisprudencia/file"

Curitiba and its planning system

Ciudades Sostenibles
Plan Nacional de Adaptación al Cambio Climático

CURITIBA

Area: 435 km².

Population: 1,751,907 (2010)
1.929.700 (2018)*

METROPOLITAN REGION - 29 municipalities

Area: 15,602 km².
Population: 3,224,286 (2010)
3.667.338 (2018)*

*Dice Bank / IPPUC Estimates - 2018

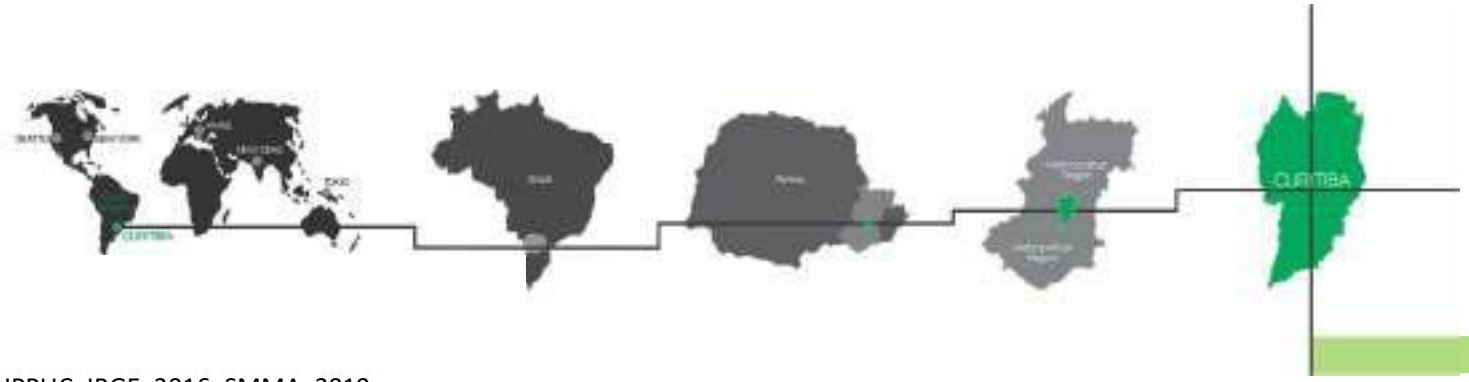
CURITIBA'S POPULATION GROWTH RATE

70/80 .... 5.34%
80/91 .... 2.29%
91/00 ..... 2.11%
00/10.....0.99%

CURITIBA AND METROPOLITAN REGION 70/80 5.33%
80/91 .... 2.89%
91/00.....3.09%
00/10.....1.37%

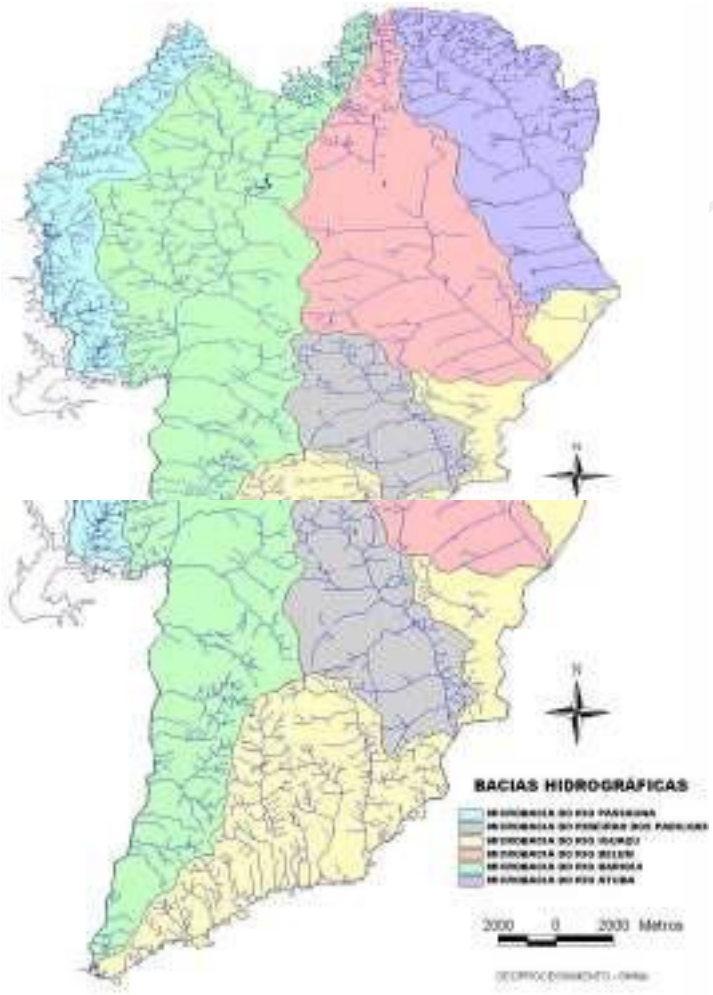
TOTAL EXTENSION OF CURITIBA ROADS 4,814 Km.

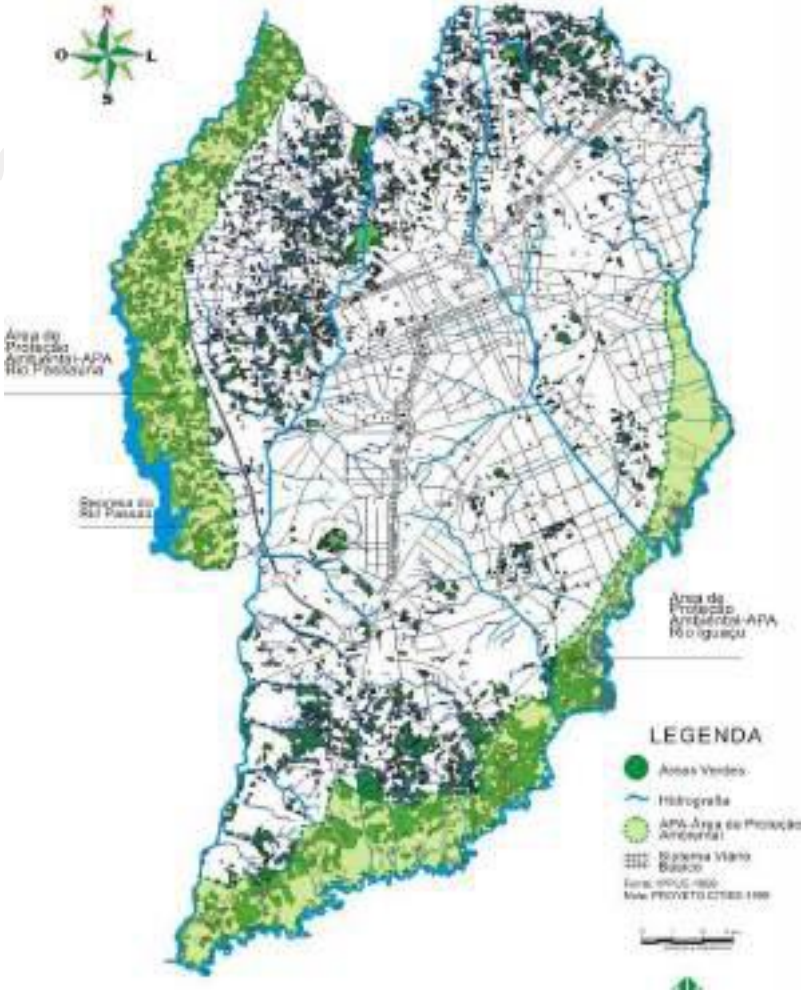
GDP PER CAPITA$ 11,300 (2016)



Source: IPPUC; IBGE, 2016; SMMA, 2010.

Curitiba and its planning system

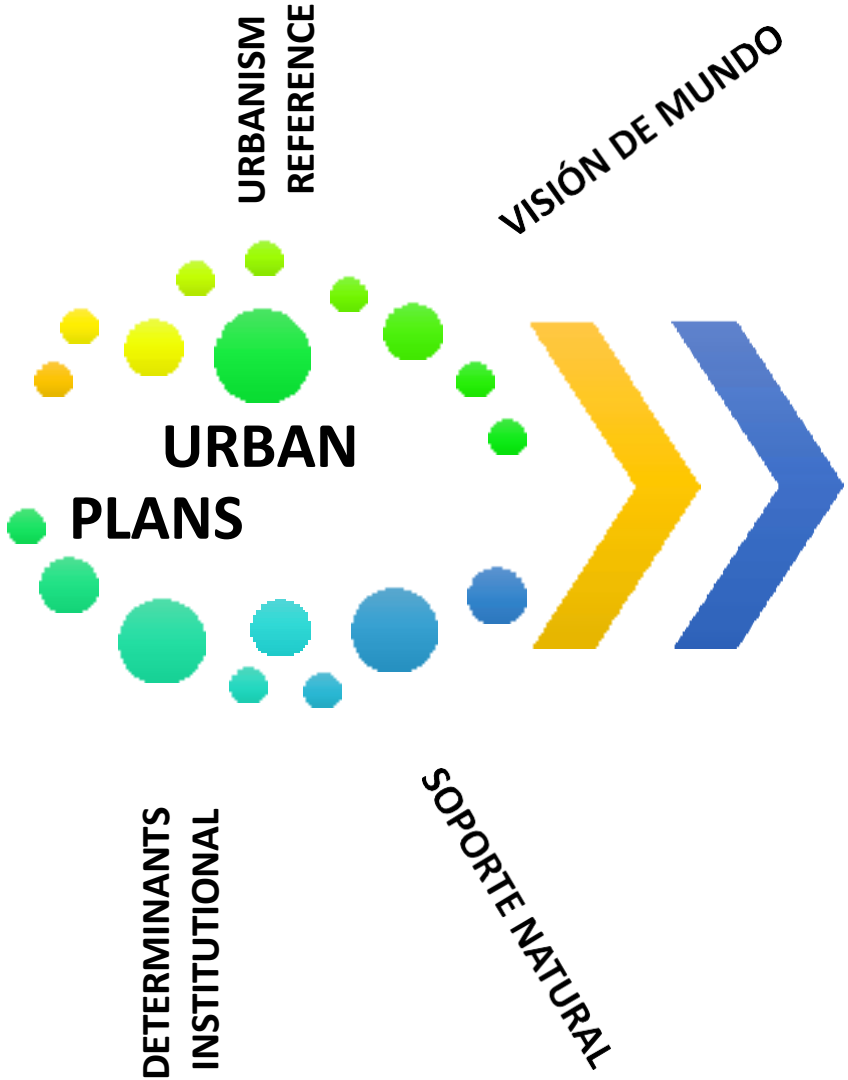




Source: IPPUC; IBGE, 2016; SMMA, 2010.

Emissions Curitiba

Source: IPPUC



LAND-USE PLANNING

URBAN DEVELOPMENT GUIDELINES

FEDERAL CONSTITUTION 1988

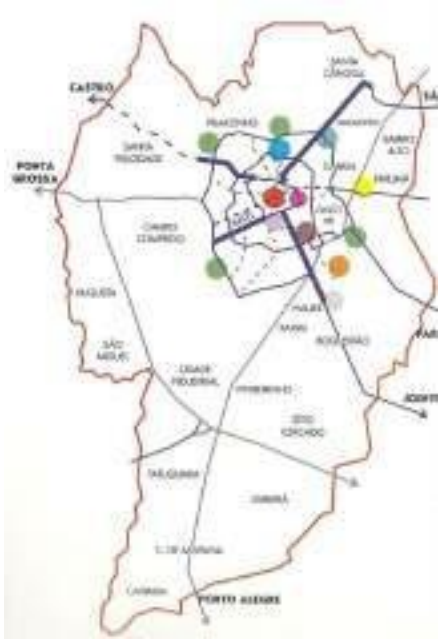
1 AGACHE PLAN

2 PRELIMINARY TOWN PLANNING

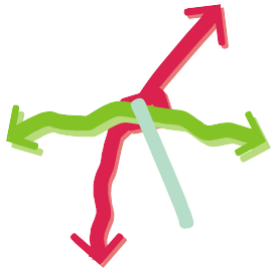
3 COMPLIANCE OF THE MASTER PLAN WITH FEDERAL LAW

4 MASTER PLAN REVIEW

1943



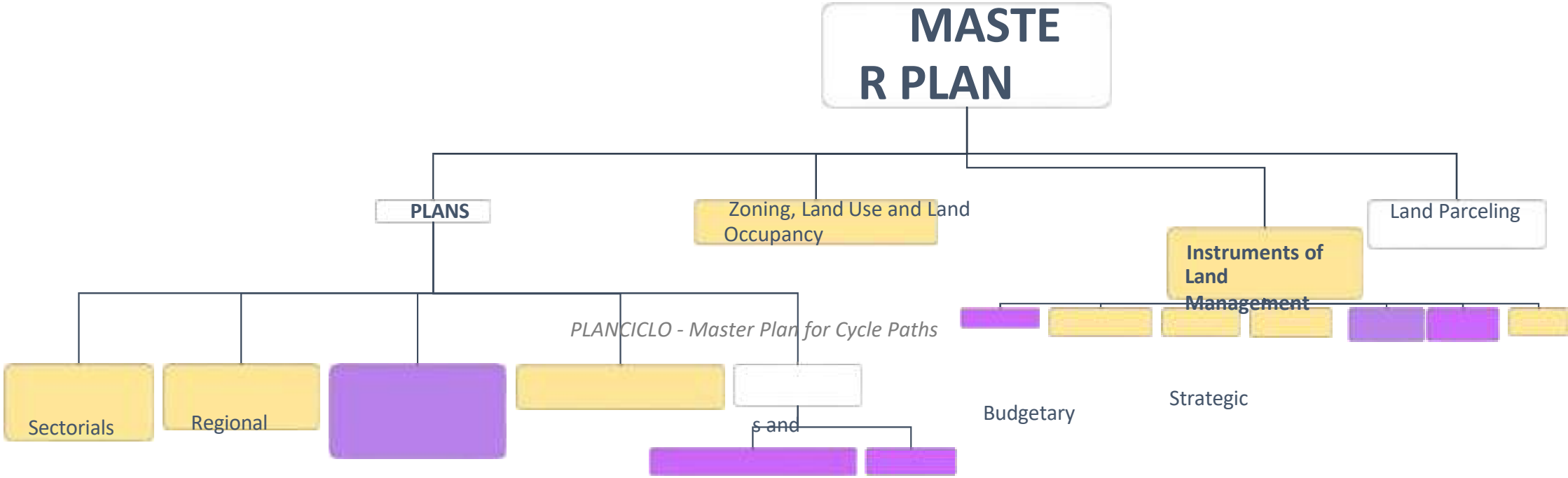
1966



2015

Source: IPPUC

Source: IPPUC

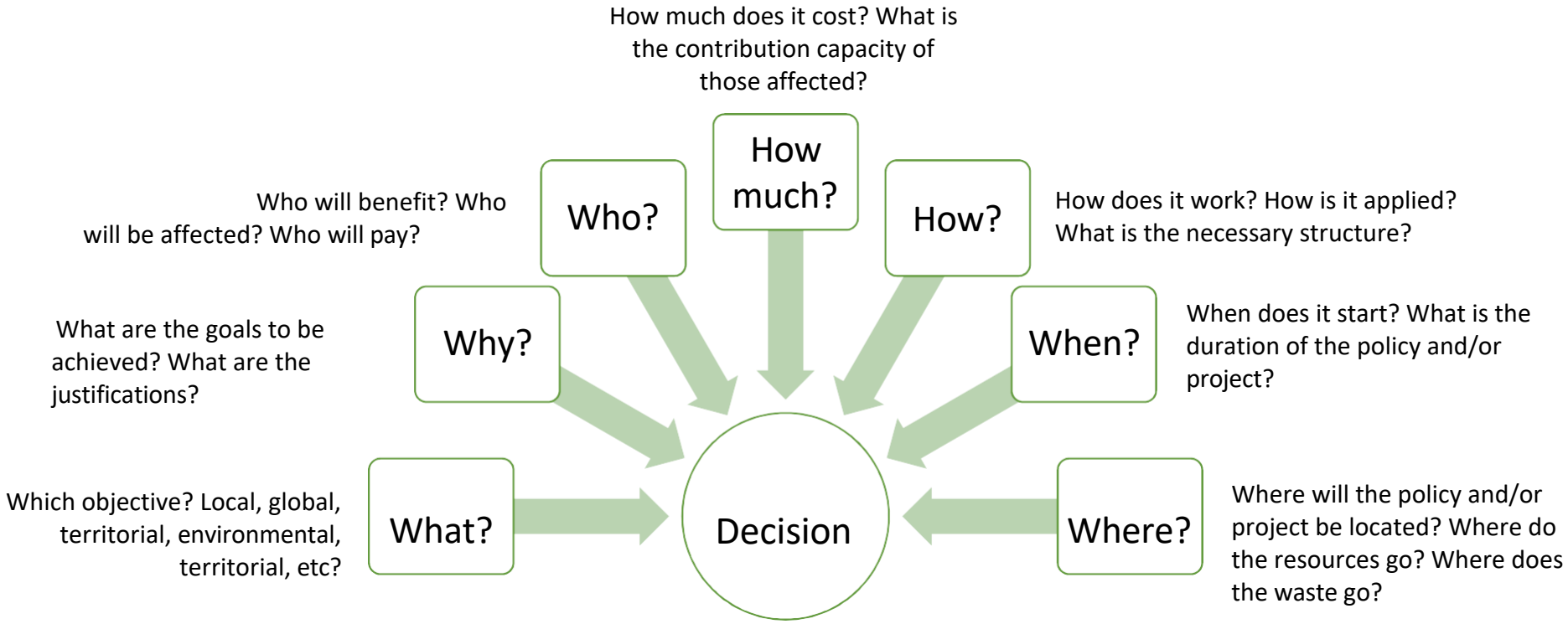


PLANCAL - Strategic Plan for Sidewalks

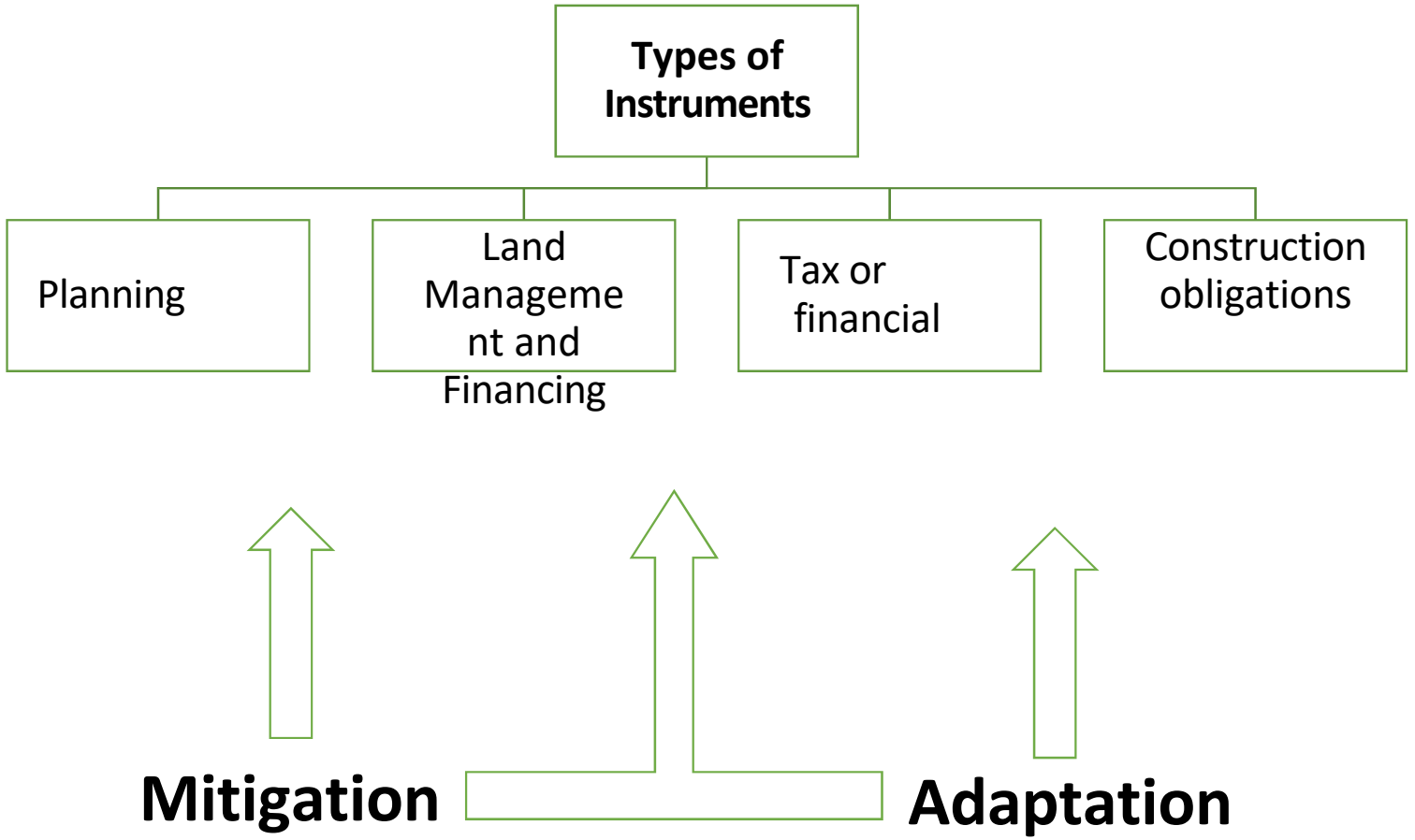
Source: Curitiba Municipal Law 14.771/2015 - Curitiba Master Plan.

PEUC - Plotting, Building or Mandatory Use
SEHIS - Special Social Housing Sector
OODC - Onerous Grant of Construction
Right OUC - Urban Consortium Operation
RDU - Urban Redevelopment
EIV - Expenditure Impact Study
TDC - Transfer of Construction Right

Source: Curitiba Municipal Law 14.771/2015 - Curitiba Master Plan.



Instruments do not generate manage with the existing or created situation Look at the consumer market > Look at the payer market Looking at the demands on the markets as a whole


Types of Instruments
Planning
Land Management and Financing
Tax or financial
Construction obligations
Mitigation
Adaptation

Soil tools x adaptation and mitigation measures

Ciudades Sostenibles
Plan Nacional de Adaptación al Cambio Climático

Type of instrument	Mitigation	Adaptation
Planning	Emission Reduction Plan of GHG	Sanitation Plan (Drainage)
	Land management plans Sector Plans Strategic plans	
Land Management and Financing	Conservation Units Private Environmental Preservation Reserves	Neighborhood or Environmental Impact Assessments Drainage Plan
	Consortiated Operations | Partial Plans | Unidades de Actuación Environmental Fees Transfer of Construction Right Transfer of Construction Right Onerous Grant of Construction Right	
Tax or financial	Taxes Urban blue-green property taxes Payments for environmental services	

Obligations for construction

Compensation trees

Mandatory tree planting

Sustainable Design Rainwater Retarders

MITIGATION OR ADAPTATION

URBAN PLANNING AND LAND MANAGEMENT INSTRUMENTS

STRUCTURAL

NON-STRUCTURAL

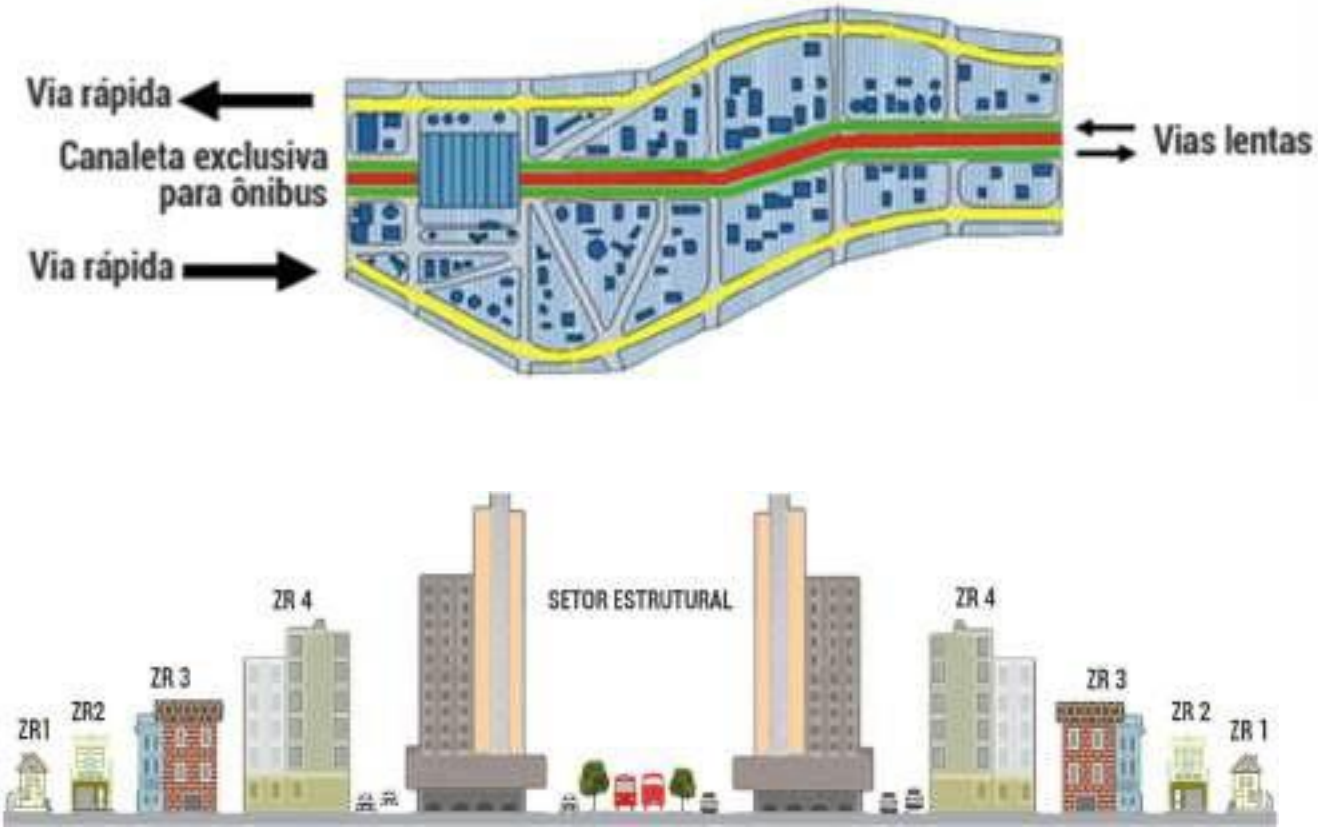
Case Study - Structural Axes Curitiba

1974

2010

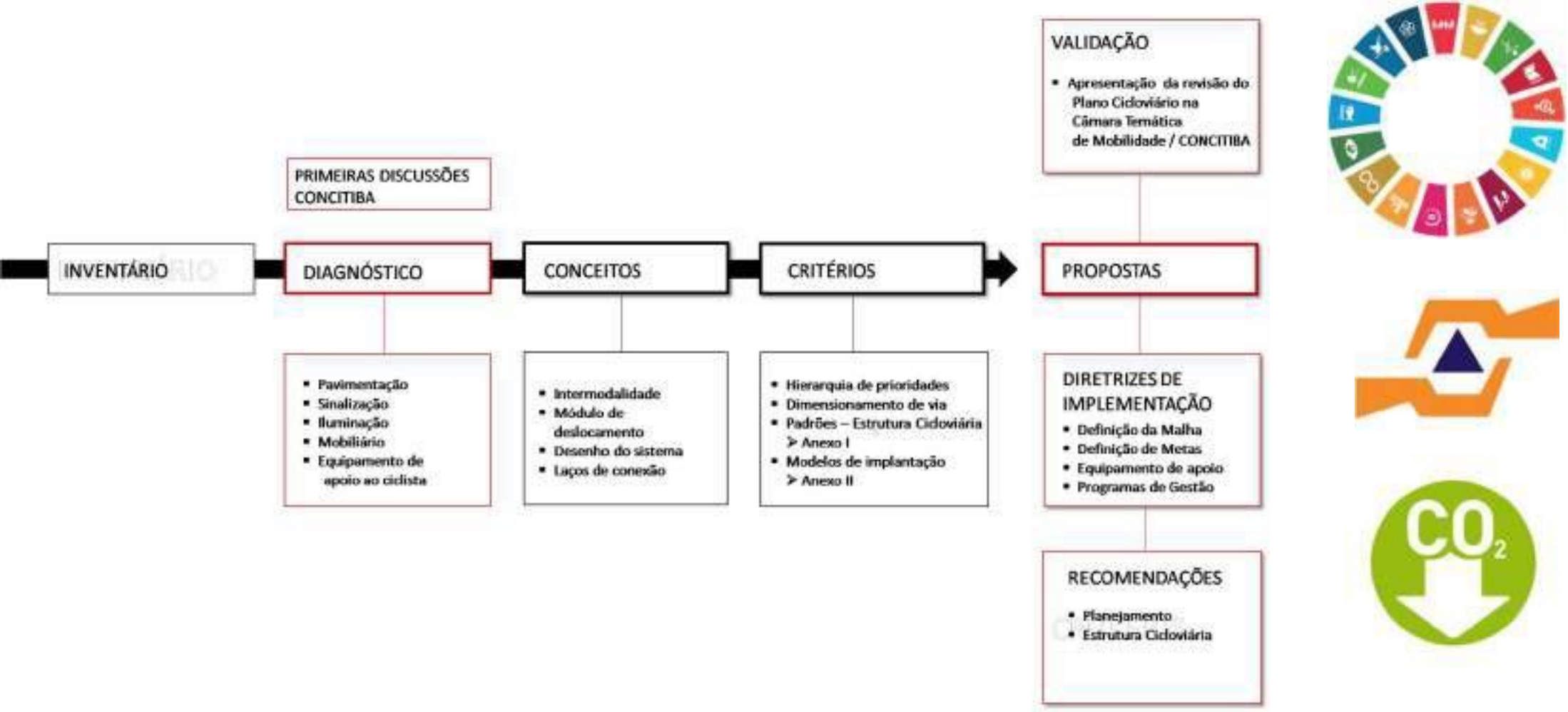
Source: IPPUC

Case Study - Structural Axes Curitiba



Source: IPPUC

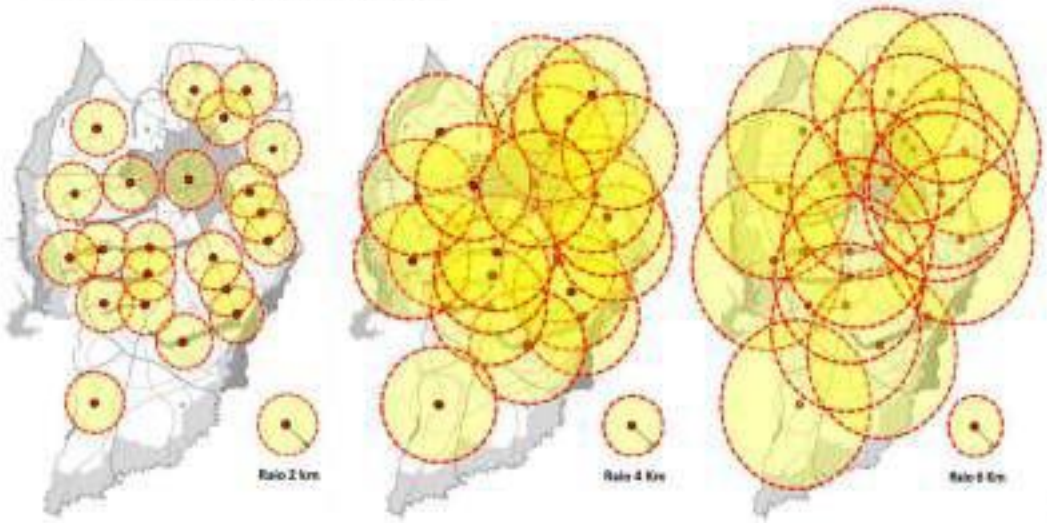
Case Study - Master Plan for Bicycle Paths



Source: IPPUC

Case Study - Master Plan for Bicycle Paths

radio de desplaciamiento
velocidad adoptada 12 Km/h



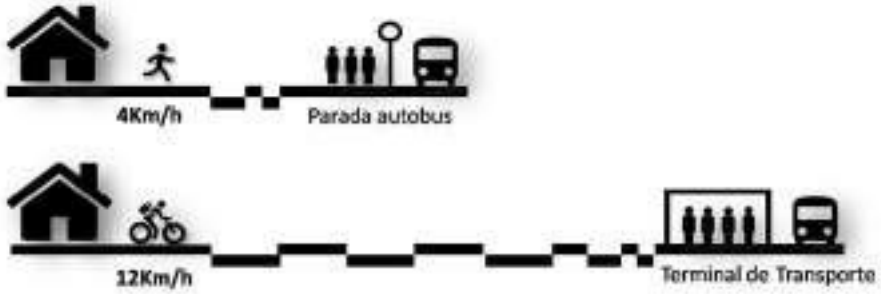
2 Km – 10 minutos 4 Km – 20 minutos 6 Km – 30 minutos

Por que los terminales?

- Para favorecer el cambio de modales (bicicleta X autobús)

Por que 12 Km/h?

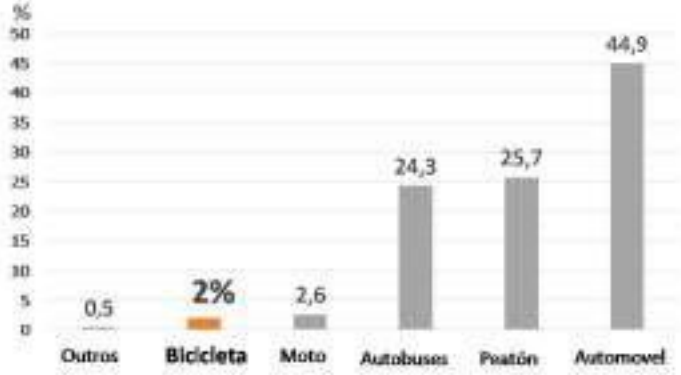
- Mientras la bibliografia especializada indicar 15Km/h, adoptase la velocidad inferior buscando incluir la población mayor.
- Criar referencia de velocidad adecuada al medio urbano.
- **Andar de bicicleta é, no mínimo 3X más eficiente do que andar a pie.**



Source: Cycle Track Master Plan, IPPUC

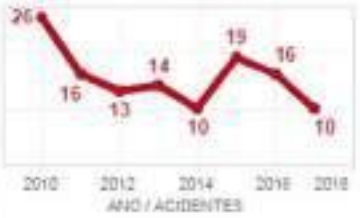
Case Study - Master Plan for Bicycle Paths

DIVISIÓN MODAL EN CURITIBA

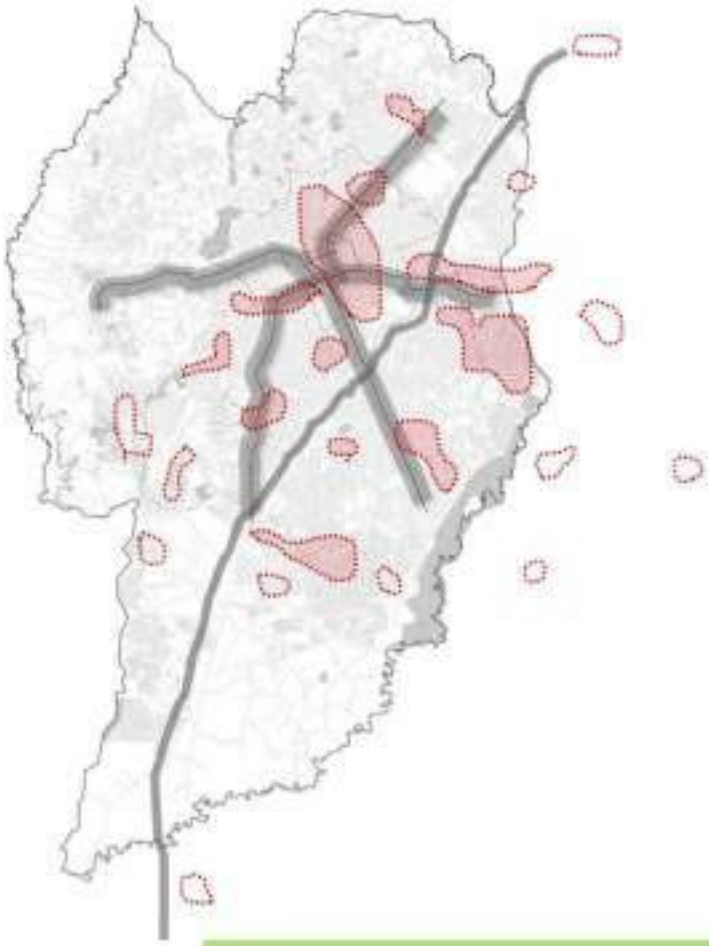


ACCIDENTES FATALES ENVOLVENDO CICLISTAS

TOTAL 124 ACIDENTES



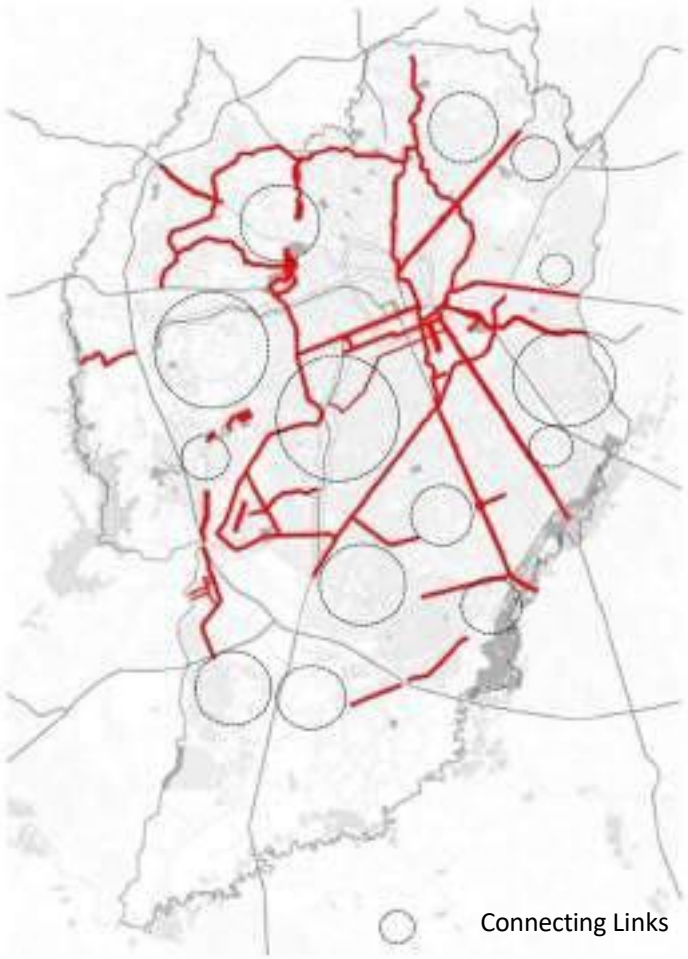
MAPA DE CALOR
Proximidade con los Ejes Estruturales

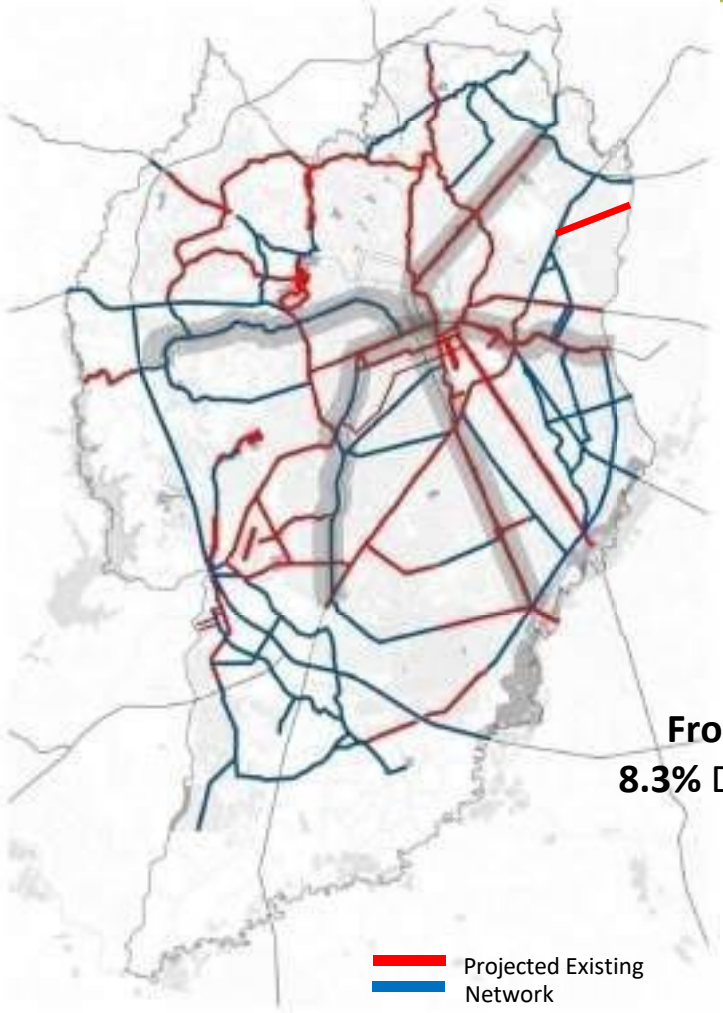


Source: Cycle Track Master Plan, IPPUC

Case Study - Master Plan for Bicycle Paths

proposal for the dating of the cycling road network





From 208.5 km to 400.6 km

8.3% DA MALHA VIÁRIA URBANA

Source: Cycle Track Master Plan, IPPUC

Case Study - Master Plan for Bicycle Paths

SLOW LANE MODEL - STRUCTURAL SECTOR

PASSEIO COMPARTILHADO

P1 - PADRÃO
CICLORROTA

P3 and P4 - PADRÃO CICLOFAIXA
+ SECURITY BOX

P2 - PADRÃO CALÇADA

Source: Cycle Track Master Plan, IPPUC

Public bicycle

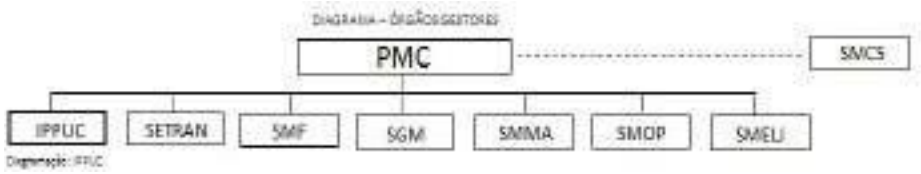
- The insertion of bike sharing in the urban space may or may not be integrated into the transport system.
- Extends the use of bicycles in the urban space.
- It is an important induction factor for the use of private bicycles. It incorporates compatible technologies for the production of useful information for urban planning.

Source: Cycle Track Master Plan, IPPUC

Case Study - Master Plan for Bicycle Paths

Management

1. MANAGEMENT
   - Definition of competences for the management of the cycling network



   - Cost and investment management
   - Definition of the legal and regulatory basis
     Regulation of cycling circulation
   - **Definition of forms of social participation**

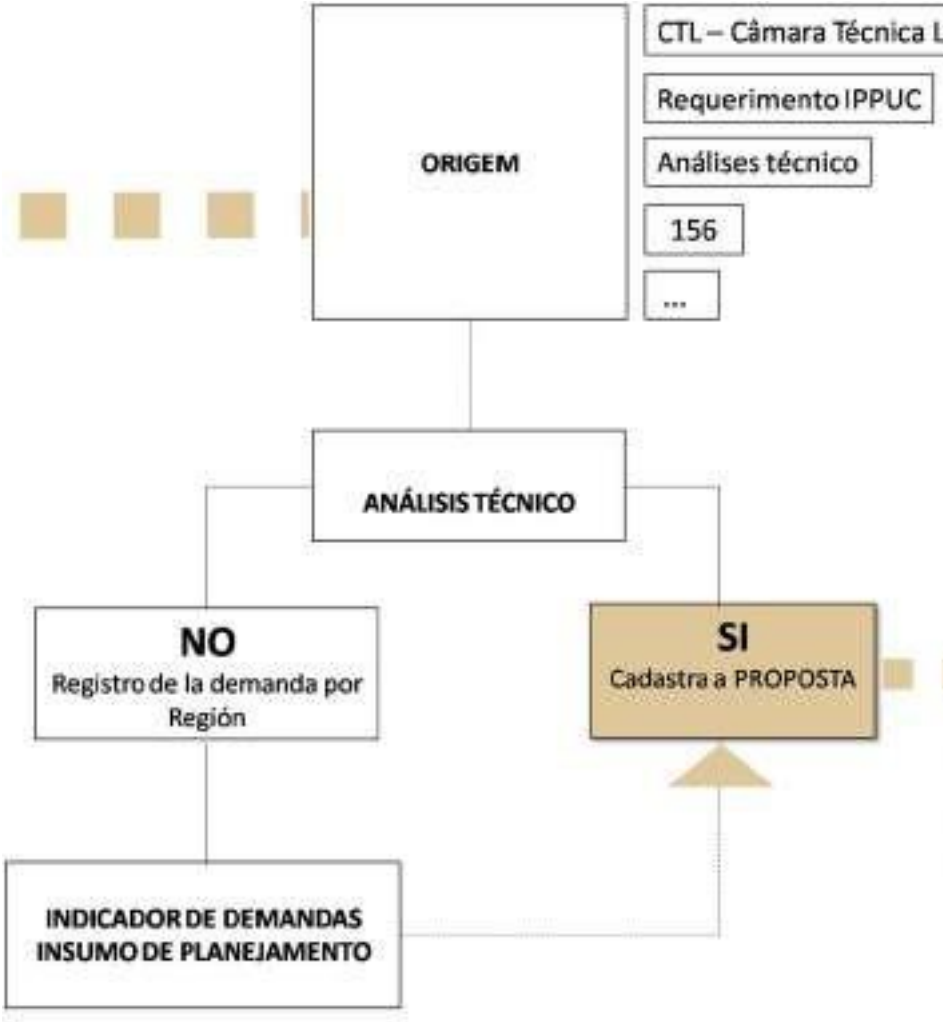
2. INFRASTRUCTURE
   - Definition of priorities for infrastructure maintenance and implementation
   - Incentive policies for the implementation of support equipment

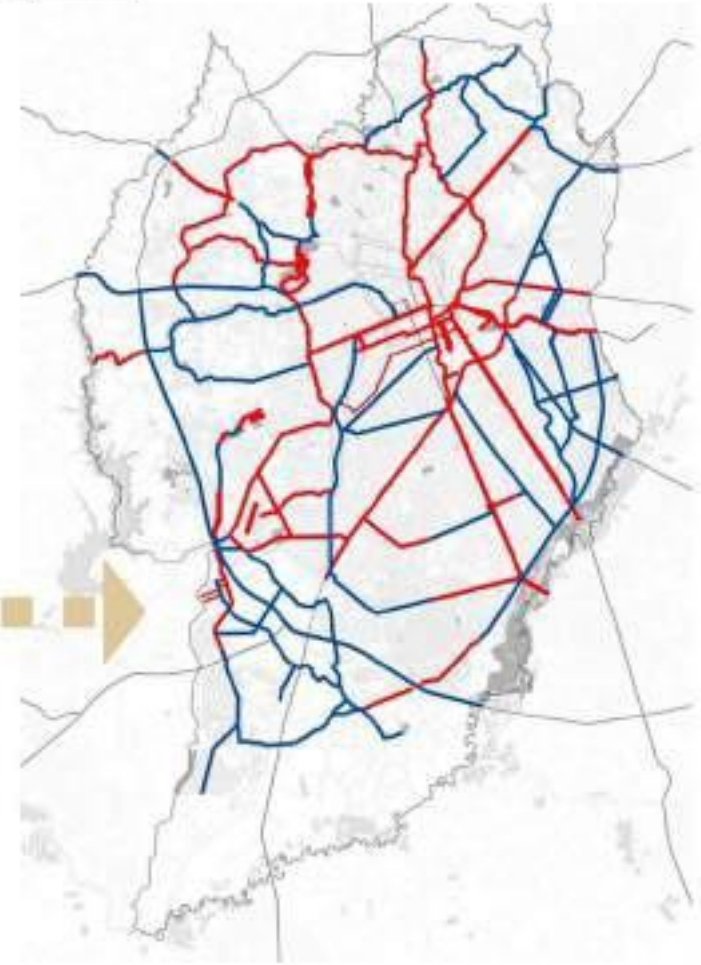
3. INFORMAÇÃO
   - Awareness of pedestrian - cyclist - motorcyclist behavior
   - Transit education program
   - Stimulus to use
     Cycling events
     App - reinforcement / identification of the cycling road network

Source: Cycle Track Master Plan, IPPUC

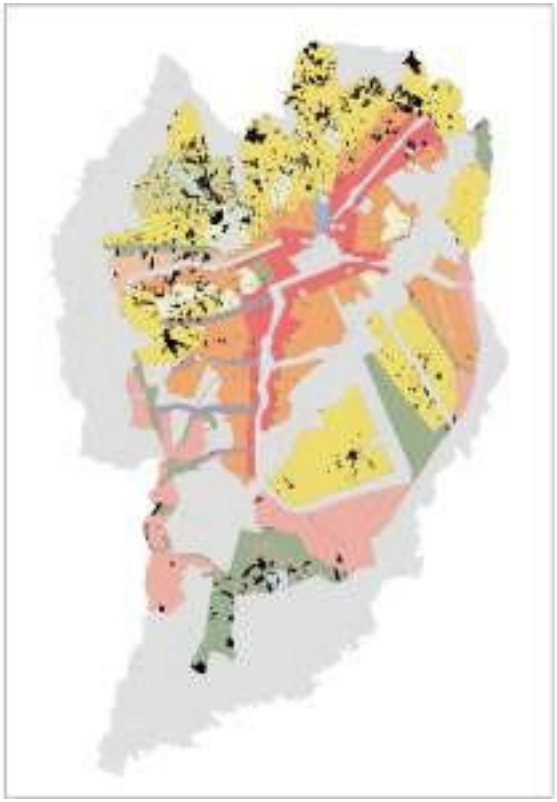
Case Study - Master Plan for Bicycle Paths

Management





Source: Cycle Track Master Plan, IPPUC



Criteria:

- Lot area equal to or greater than 800m².
- Relevant native forest cover equal to or greater than 50% of its total area.
- Neighborhood impact assessment
- Special conditions for occupancy on the lot itself
- No payment by the Municipality

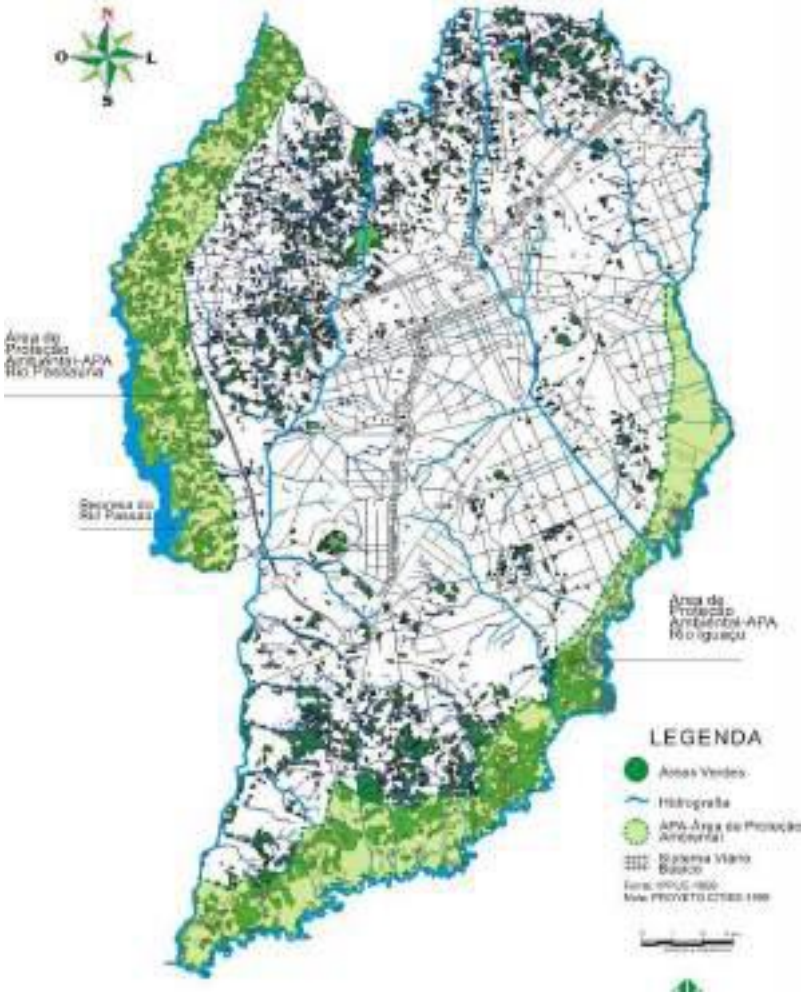
Source: IPPUC

Potential of the Special Green Areas Sector:

Preservation by private entities

4 m² green area/ inhabitant

Green area to be protected: 8km².



Source: IPPUC

"Urban drainage seeks the **change of paradigms** of Brazilian public management from **management by crisis to management by planning**, where the **investment of** unforeseen **costs** occurs for an investment plan, of proven technical, economic, environmental and social feasibility."

Source: Curitiba Municipal Sanitation Plan, 2015.

Case Study - Drainage Plan

Curitiba Master Plan

National Sanitation Policy

National Plan for Risk Management and Response to Natural Disasters

Sanitation Plan

Drainage Plan

Diagnosis

Structural Measures

Non-Structural Measures

Management:

Financing
Execution
Monitoring

Source: Curitiba Municipal Sanitation Plan, 2015.

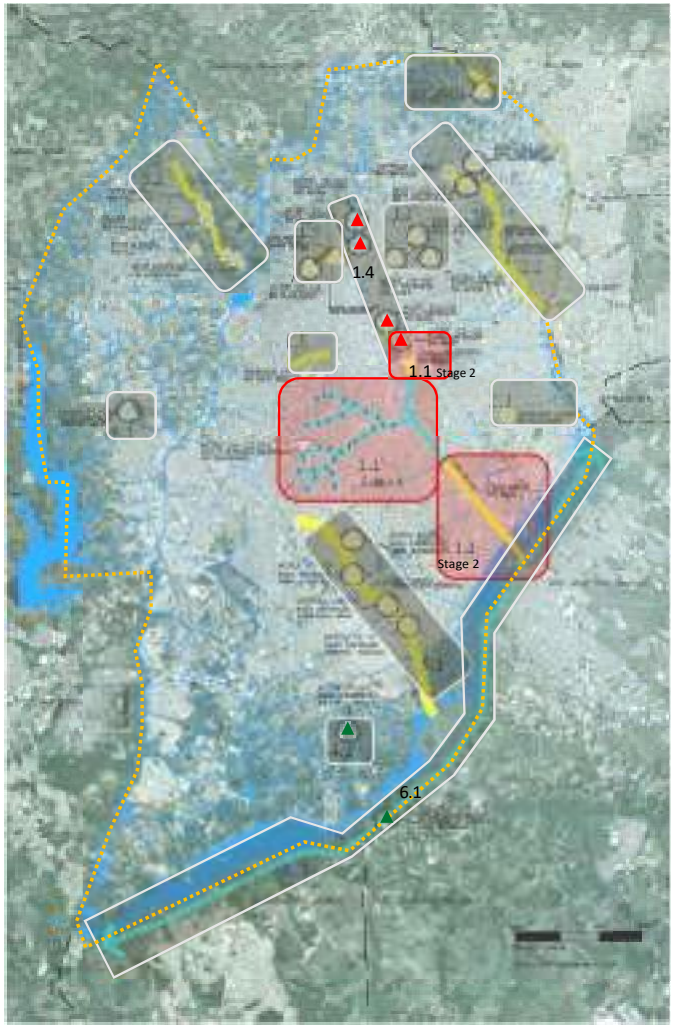
Source: Curitiba Municipal Sanitation Plan, 2015.

Axles for Curitiba:

- Increase conditions favorable to infiltration and flow path time.
- Seek the preservation of the natural conditions of the macro and micro drainage system and the renaturation of watercourses.
- Adopt multifunctional interventions as solutions, through drainage systems combined with green areas, sports areas, linear parks and other uses.
- Design and plan interventions according to different levels of flood risk to establish priorities compatible with the characteristics of different watersheds and with different levels of vulnerabilities.

Source: Curitiba Municipal Sanitation Plan, 2015.

Case Study - Drainage Plan



Legend / order of priority

Belem River Basin

- 1.1 Stage 1/Stage 2 - Bacia Belem/ Rio Pinheirinho Basin
- 1.2 Belem/ RioBelem
- 1.3 Belem Watershed/ Pilarzinho
- 1.4 River Belem Watershed/ Juve
- 1.5 River Belem Watershed/ Agua Verde River

Atuba River Basin

- 2.1 Atuba Basin / Bacacheri
- 2.2 River Atuba Basin/ Atuba River

Cuenca do Rio do Rio Barigui

- 3.1 Cuenca Barigui/ Rib. Mueller
- 3.2 Barigui Basin/ Uvu and Cascatinha
- 4.1 River Iguaçu Basin /Ponta Grossa River
- 5.1 Padilhas basin/ Rib. dos Padilhas
- 6.1 Iguaçu Basin/ Iguaçu River

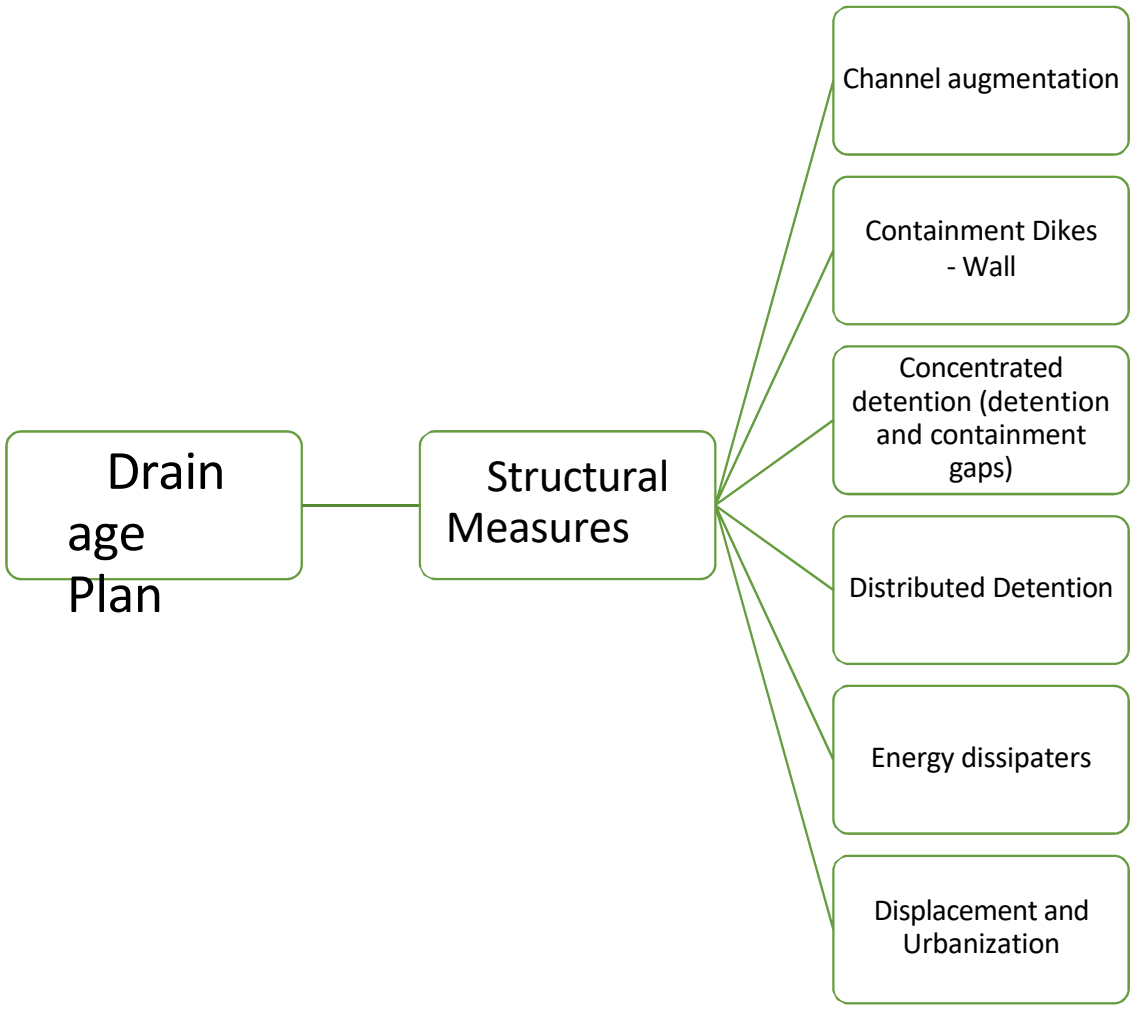
- 01 Project completed
- 01 Projects being finalized - PMC
- 27Projects tendered - Federal Government -
- PAC2/Drainage 04 Projects to be contracted for

Source: Curitiba Municipal Sanitation Plan, 2015.

PAC2/Drainage - Natural D.D. 02 Projects to be contracted for PAC2/Drainage - Natural D.D.

35 PROJECTS - Sustainability Concept

Source: Curitiba Municipal Sanitation Plan, 2015.



Economic Criteria:

lower implementation cost lower amortization cost better cost/benefit ratio

Source: Curitiba Municipal Sanitation Plan, 2015.

Source: Study of wall and reservoir implementation in the Atuba River basin.

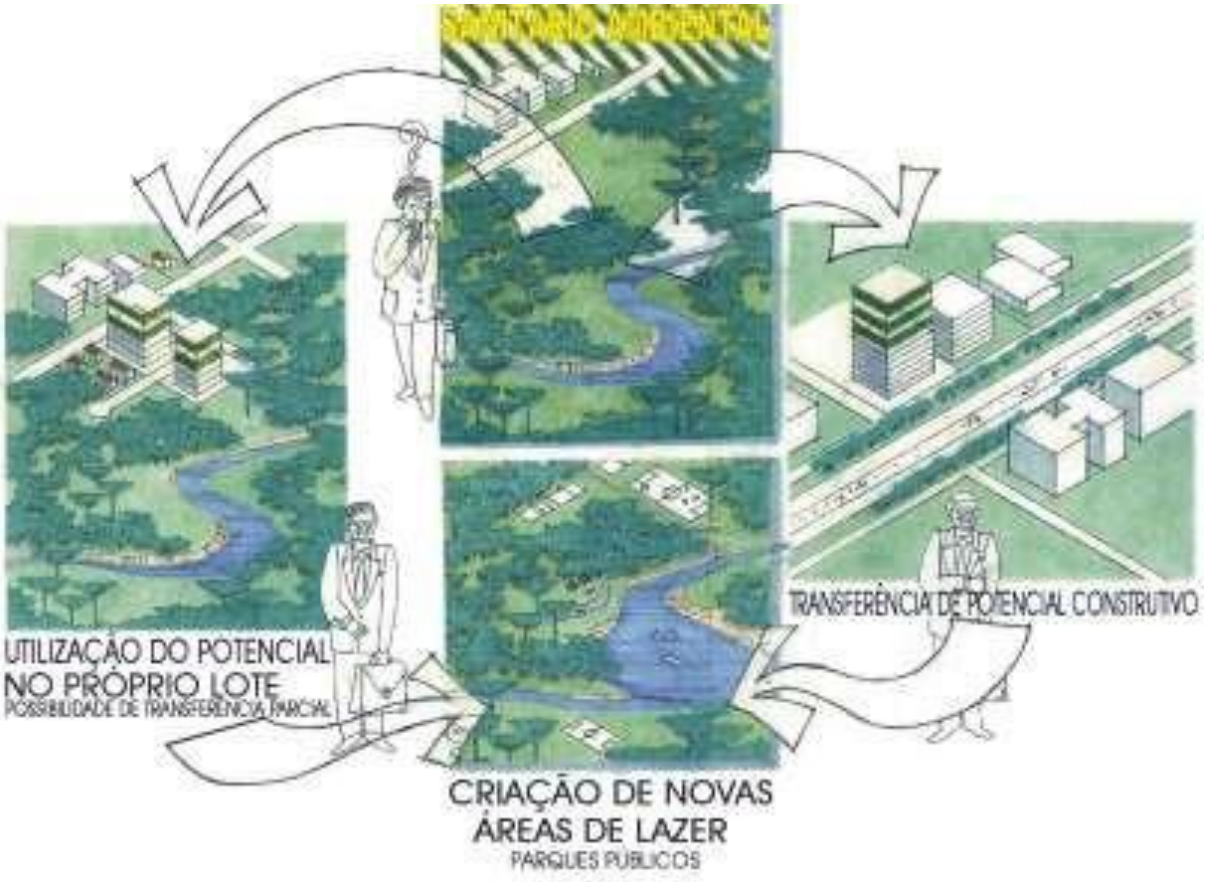
Figura 18: Reservatório de contenção de cheias em derivação do parque Guairacá Próximo à Rua Dionira Moletta Klemtz, bairro Fazendinha, Curitiba (2014).
Fonte: Google, 2015. Adaptação: Schellin ,L, 2015.

Figura 71: Estudo de Implantação de bacia no rio Atuba com um novo parque urbano.
Fonte: Matheus, S., SEPLAD, 2014

- Drainage Plan
  - Non-Structural Measures
    - Control of land use and occupation - Zoning
    - Permeability per lot
    - Household rainwater retarders
    - Rainwater reuse
    - Civil Construction Waste Plans
    - Environmental Education
    - Pluviometric system monitoring systems

Source: El Litoral

Case Study - The Transfer of Construction Law



TOTAL GRANTED AREA: 525,725.35m².

Private Reserves: 152,119.95 sq. mts.

Parks: 373,605.40 m² (373,605.40 sq. m.)

Source: SMU, IPPUC

Case Study - Cachimba-sul

Source: IPPUC

Case Study - Cachimba-sul

Source: IPPUC

Case Study - Cachimba-sul

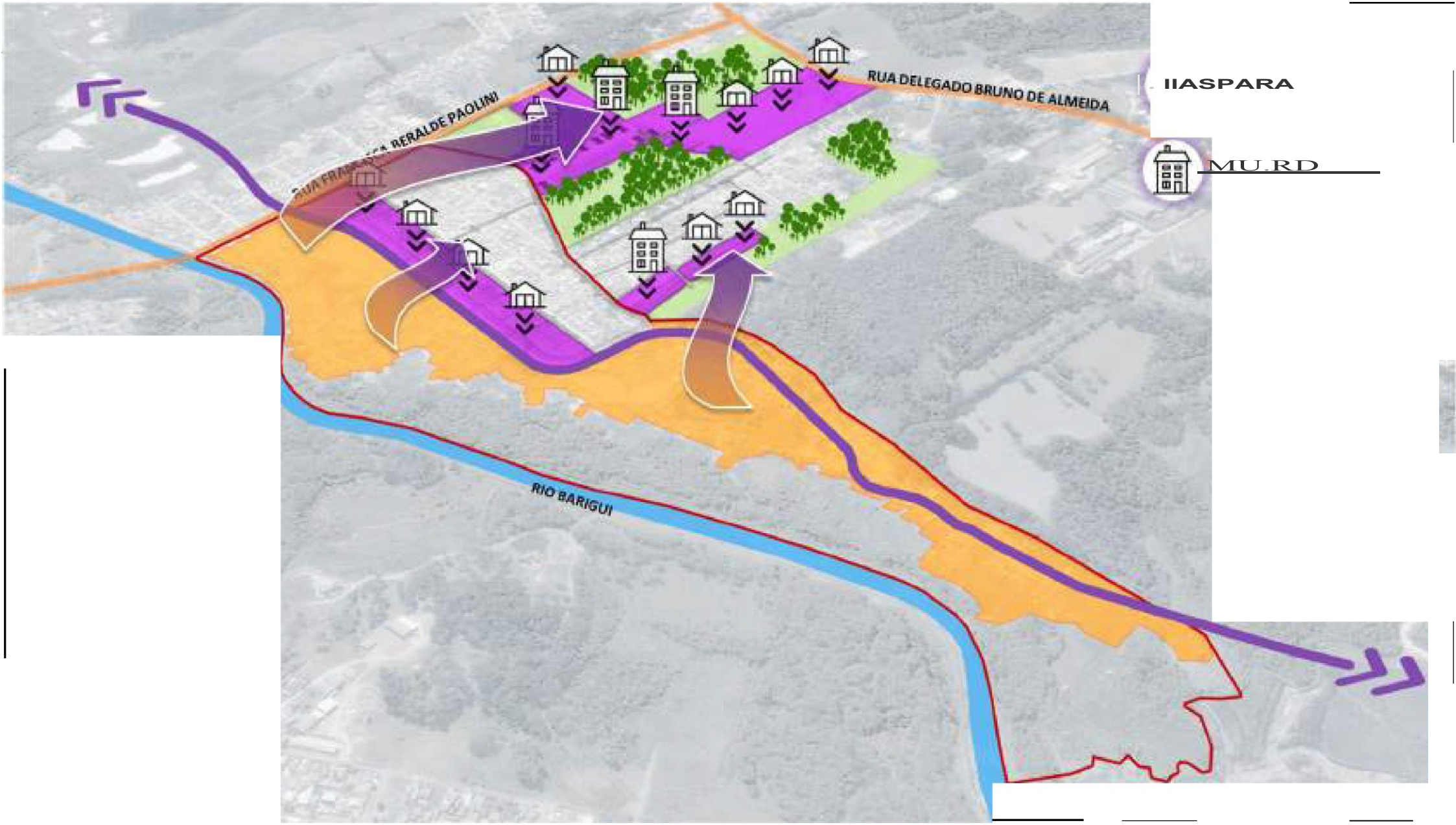
Source: IPPUC

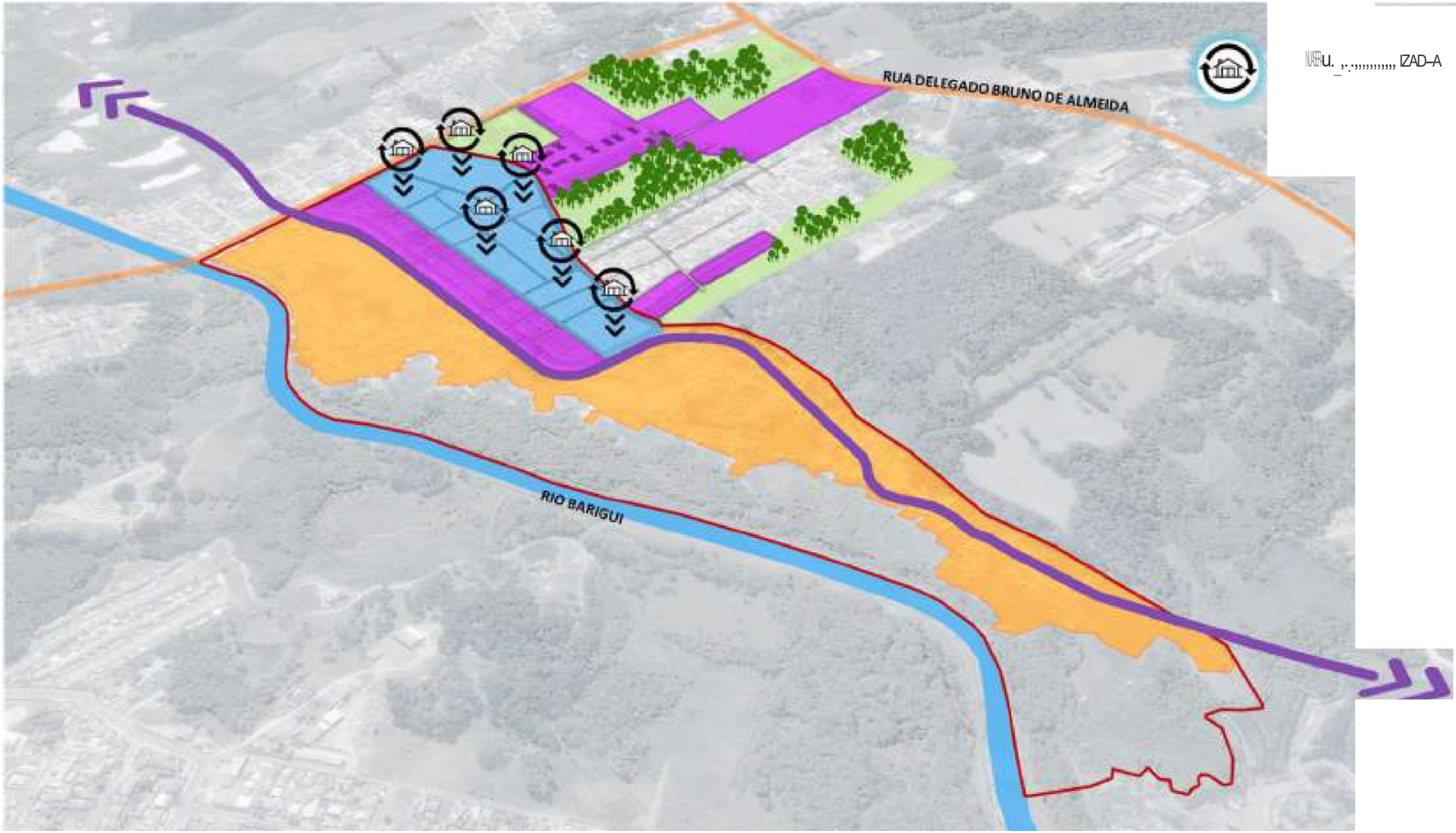
Case Study - Cachimba-sul

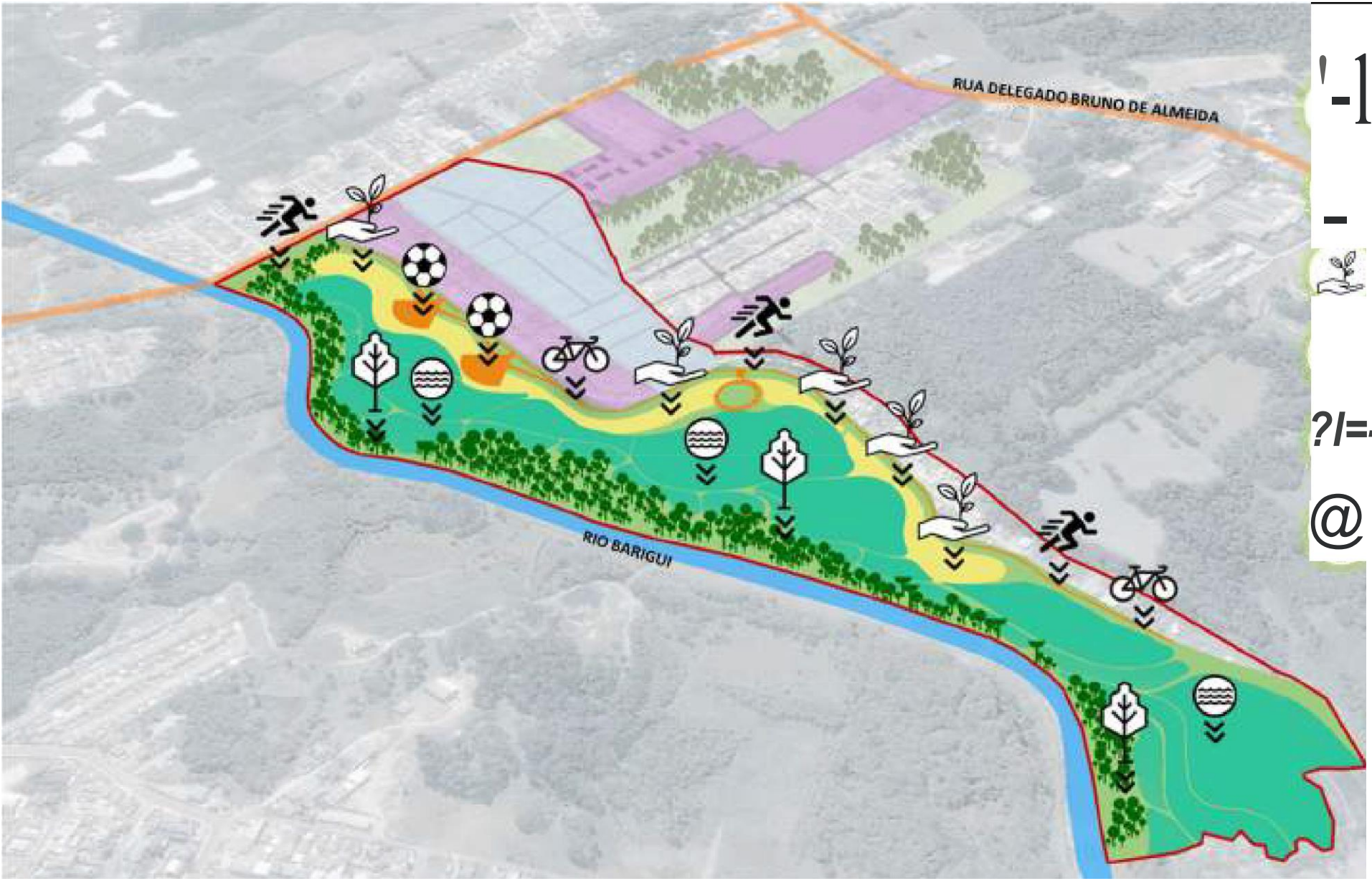
Source: IPPUC

Case Study - Cachimba-sul

Source: IPPUC


RUA DELEGADO BRUNO DE ALMEIDA
RERALDE PAOLINI
RIO BARIGUI


RUA DELEGADO BRUNO DE ALMEIDA
RIO BARIGUI



PAA.WHAT

'-l<Dl6em

BIIOAS'IJE –

PLANTIO

OCIOVM

?/=- [:OIIIHDA/OIII.... IIADA

@ MiEAESESJOR1lV.A

ÁREA A Área para macrodrenagem e recuperação ambiental (Área de Risco)	**Área A1**	Área não edificável para recuperação e melhoria ambiental. Cessão de propriedade da área atualmente ocupada do domínio público estadual para o municipal; Liberação da área atualmente ocupada e reassentamento; e Implantação de bacias de armazenamento e contenção e corredor ecológico.
	Área A2	Área não edificável para recuperação e melhoria ambiental. Cessão de propriedade da área atualmente ocupada do domínio público estadual para o municipal; Liberação da área atualmente ocupada e reassentamento; Implantação de diques para contenção de cheias; Implantação de canal de macrodrenagem; e implantação de parque linear.
ÁREA B Área para implantação de infraestrutura urbana	**Área B1**	Área edificável não consolidada. Readequação da área atualmente ocupada e reassentamento; Implantação de macrodrenagem; Implantação de pavimentação; e Implantação de paisagismo, iluminação e sinalização.
	Área B2	Área edificável consolidada. Implantação de macrodrenagem; Implantação de pavimentação; Implantação de paisagismo, iluminação e sinalização; e Ações para titulação de domicílios.
ÁREA C Área para implantação de infraestrutura urbana e implantação de infraestrutura social	**Áreas C1 a C5**	Áreas adjacentes à Vila 29 de Outubro. Desapropriações para a produção de unidades habitacionais e infraestrutura.
	Áreas C6 e C7	Áreas adjacentes à Vila 29 de Outubro. Desapropriações para equipamentos públicos; Construção de Unidade de Saúde; e Ampliação da Escola Municipal. Implantação do Centro de Referência de Assistência Social (CRAS).
	Área C8	Áreas adjacentes à Vila 29 de Outubro. Reforma do imóvel para implantação do Centro Municipal de Educação Infantil (CMEI).

Source: IPPUC

Case Study - Cachimba-sul

Source: IPPUC

Case Study - Cachimba-sul

Ciudades Sostenibles
Plan Nacional de Adaptación al Cambio Climático

- January, 2017 Project Start
- April, 2017 Interruption of the Atheros
- November, 2017 Socio-economic Diagnosis
- January, 2018 Occupancy study
- May, 2018 Urban standard
- July, 2018 Cleaning of the area
- August, 2018 Jovens Training
- October, 2018 AFD Funding
- September, 2018 Community meetings begin.
- March, 2019 Tender

Source: IPPUC

Source: IPPUC

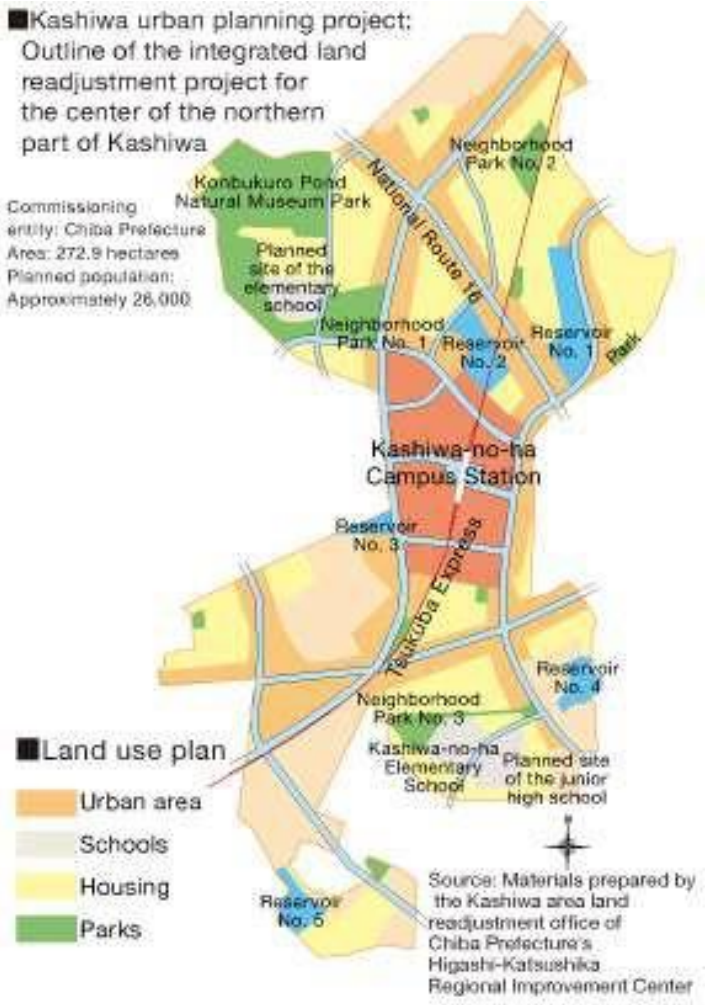
Source: IPPUC

Source: IPPUC

Source: IPPUC

In 2001, Kashiwa City began a Land Readjustment Project based on an urban planning project at the 273-hectare Kashiwa-no-ha area. In 2005, the Tsukuba Express began operating and the Kashiwa-no-ha Campus Station was built. The convenient access ushered in a new period for Kashiwa-no-ha. In 2008, Chiba Prefecture, Kashiwa City, the University of Tokyo, and Chiba University announced the Kashiwa-no-ha International Campus Town Initiative, spotlighting the area as a next- generation model city.

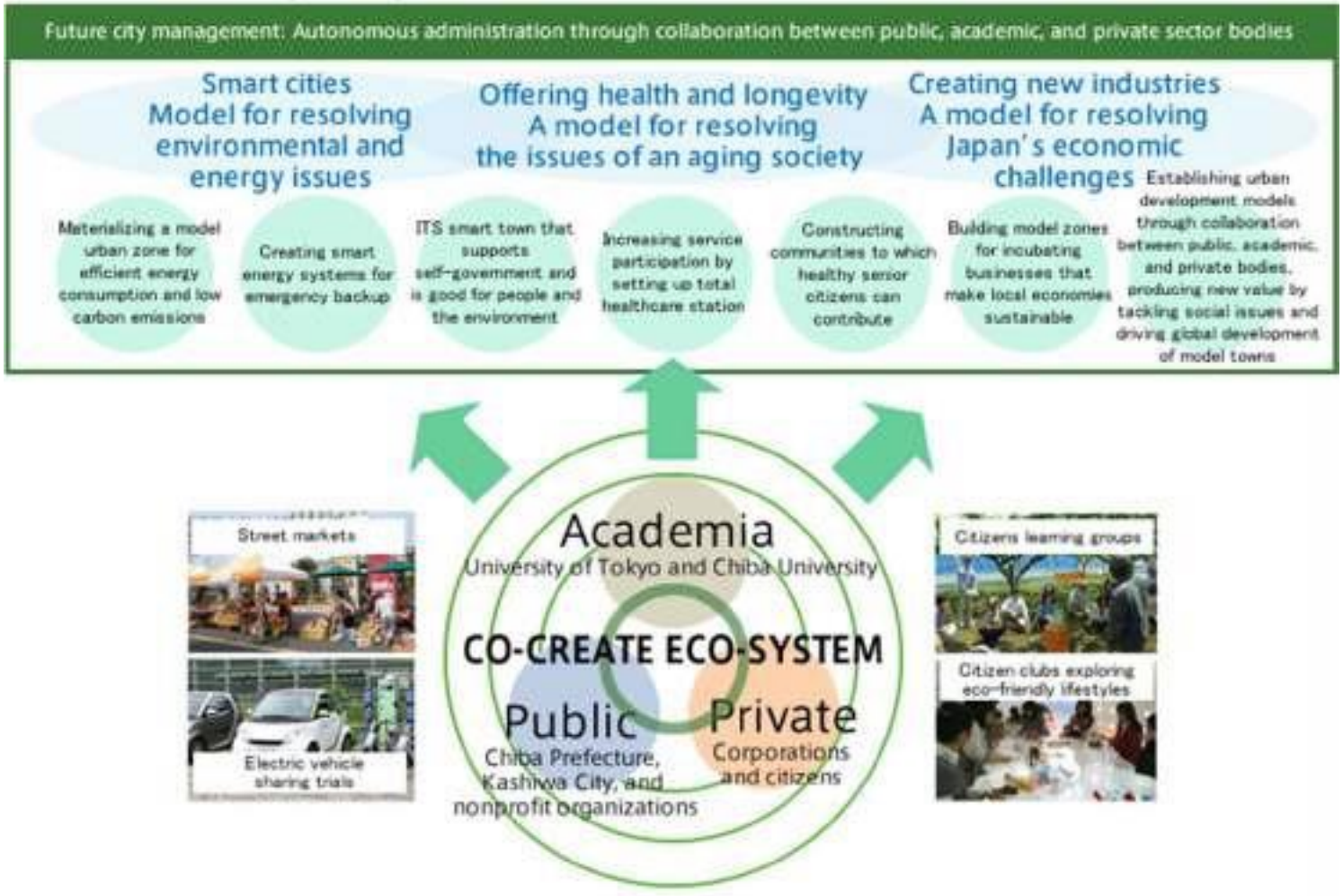
Source: Kashiwa-no-ha Smart City site. Available at <https://www.kashiwanoha-smartcity.com>



The goal of Kashiwa-no-ha, an academic and research city covering 273 hectares, is to become a model of urban development through the participation of public, private, and academic fields.

Source: Kashiwa-no-ha Smart City site. Available at <https://www.kashiwanoha-smartcity.com>

Kashiwa-no-ha Campus Proposals



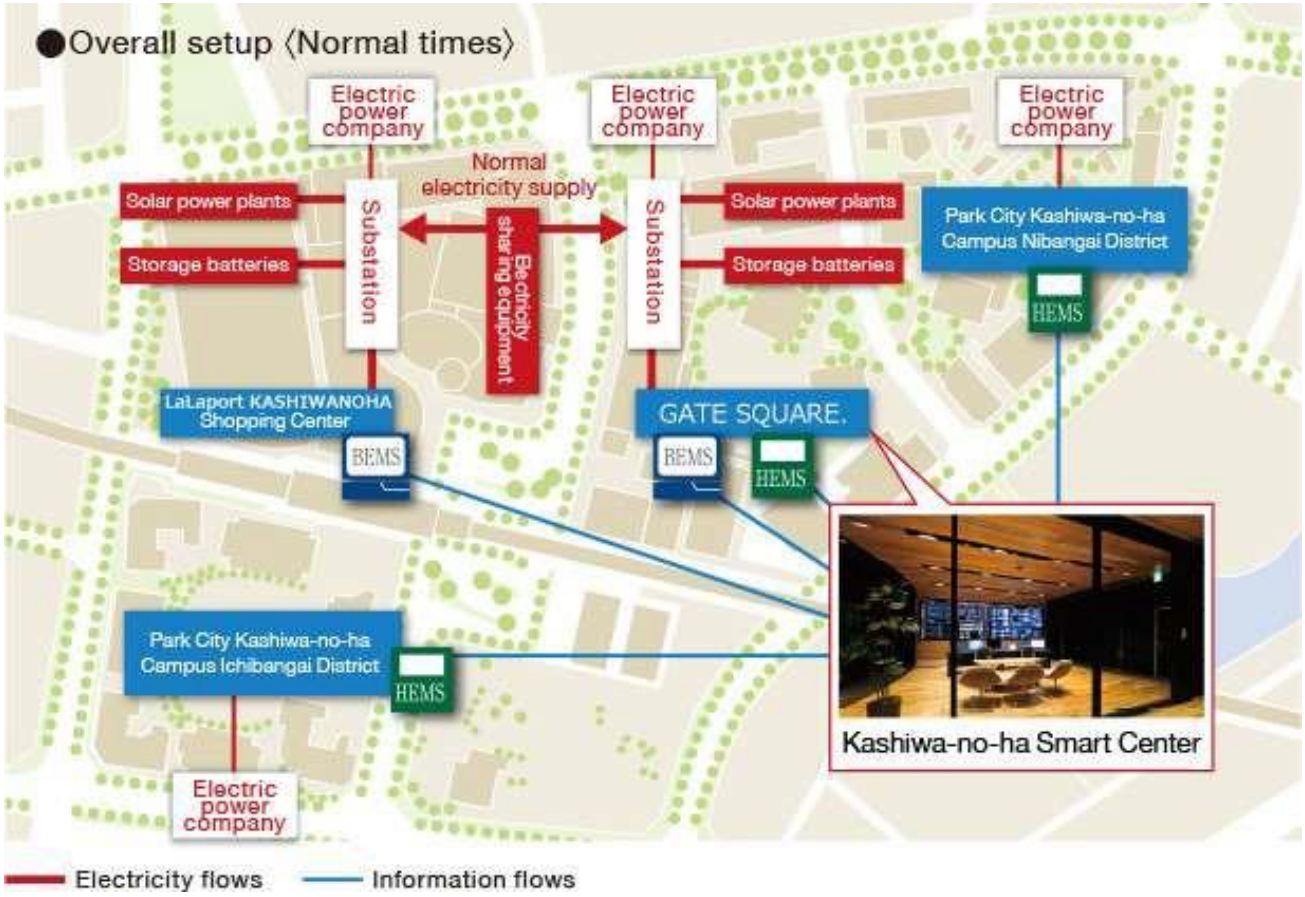
Source: Kashiwa-no-ha Smart City site.

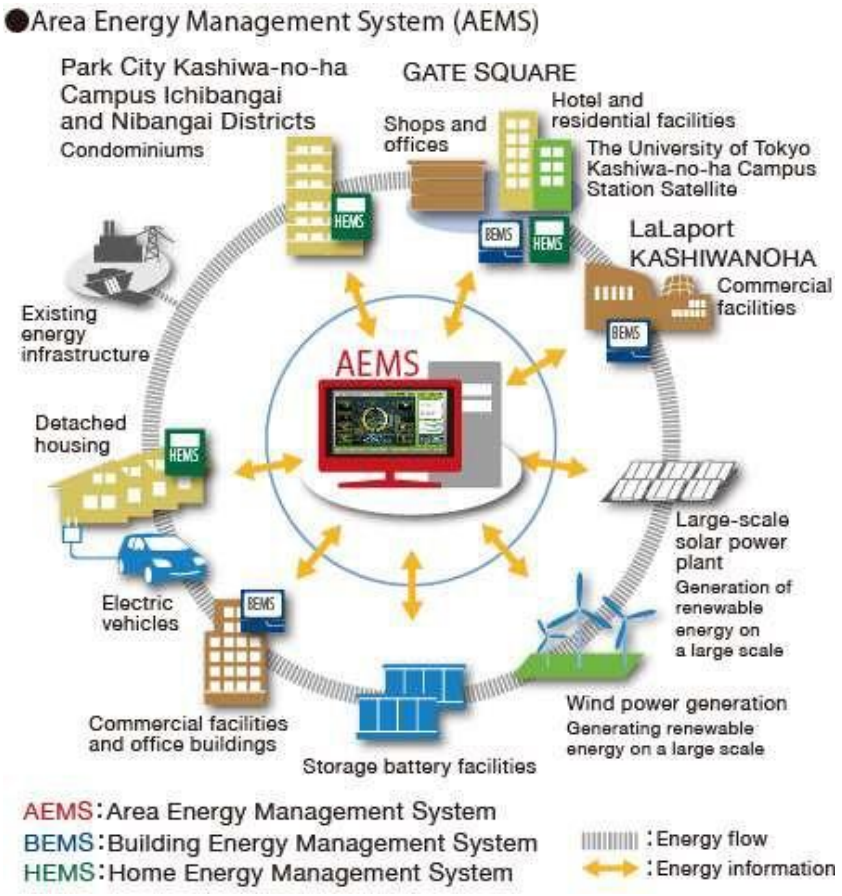
Creation of a garden city coexisting in harmony with the environment	Development of creative industrial and cultural space	Formation of international academic and educational space
Development of a sustainable transportation system	Eight Objectives	Creation of a Kashiwa-no-ha style throughout. the campus
Implementation of area management	Design of high-quality urban space	Development of a city that supports innovative fields

Source: Kashiwa-no-ha Smart City site. Available at <https://www.kashiwanoha-smartcity.com>

Case Study - Kashiwa-no-ha - Japan

1 - Most energy efficient city





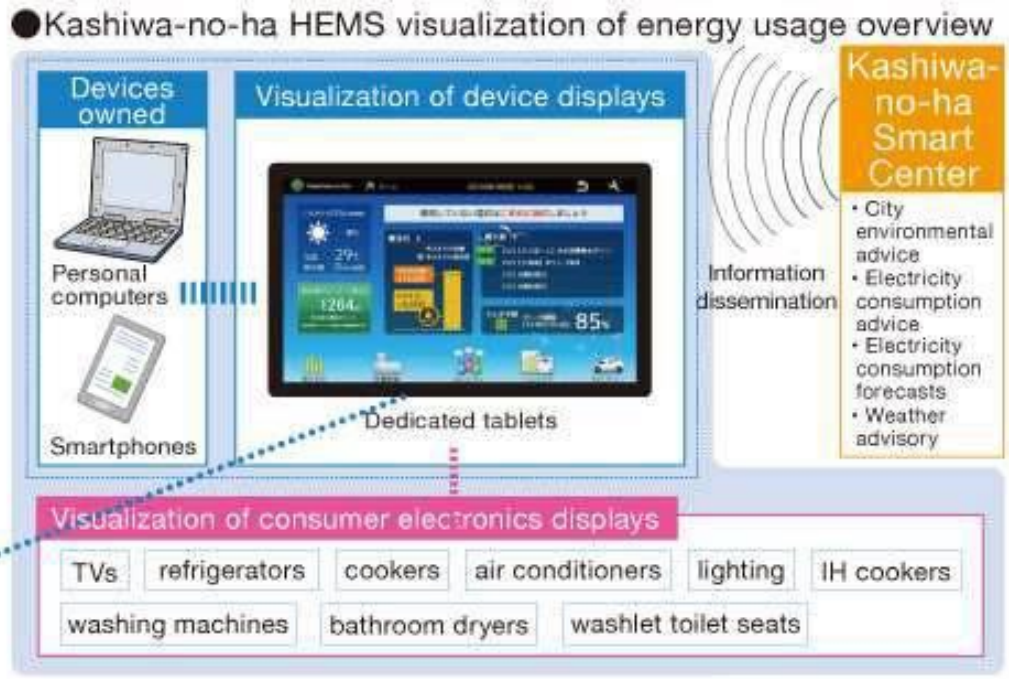
Optimization of energy use throughout the city by means of a central control of individual equipment that alerts the user of its consumption x production, and thus regulates even the operating time of economic activities. The maximum consumption of consumption by 26%, conserve energy and reduce carbon dioxide emissions. Smart grid sharing solar energy, cell storage, and other energy sources distributed among the districts.

Source: Kashiwa-no-ha Smart City site. Available at <https://www.kashiwanoha-smartcity.com>

2 - City Materializes Energy Conservation Lifestyle

●Kashiwa-no-ha HEMS/ Screen image

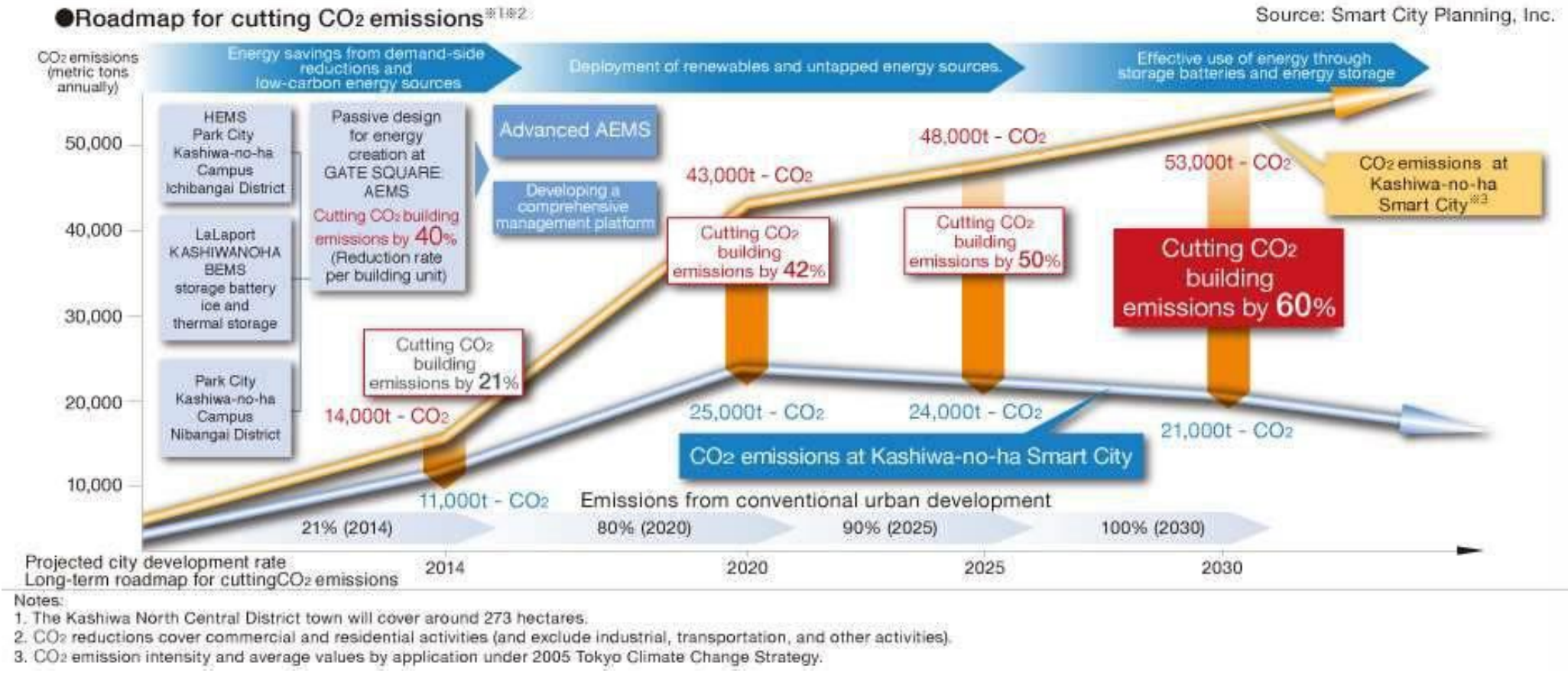
●Kashiwa-no-ha HEMS visualization of energy usage overview



HEMS showing residents' energy consumption can become more aware of its implications for energy conservation, separating environmentally friendly media from life forms.
They can be on tablets, personal computers, smartphones, and other devices demonstrating carbon dioxide (CO2) emissions from residences. This setup uses artificial intelligence for purposes such as advising on energy usage and comparing energy-saving efficiency. HEMS management management improvements through its responsive response feature, which prompt residents on energy usage during emergencies. Residents can control lighting and air-conditioning conditions while away from home. (GATE SQUARE. At Park Axis, Kashiwa-no-ha)

Source: Kashiwa-no-ha Smart City site. Available at <https://www.kashiwanoha-smartcity.com>

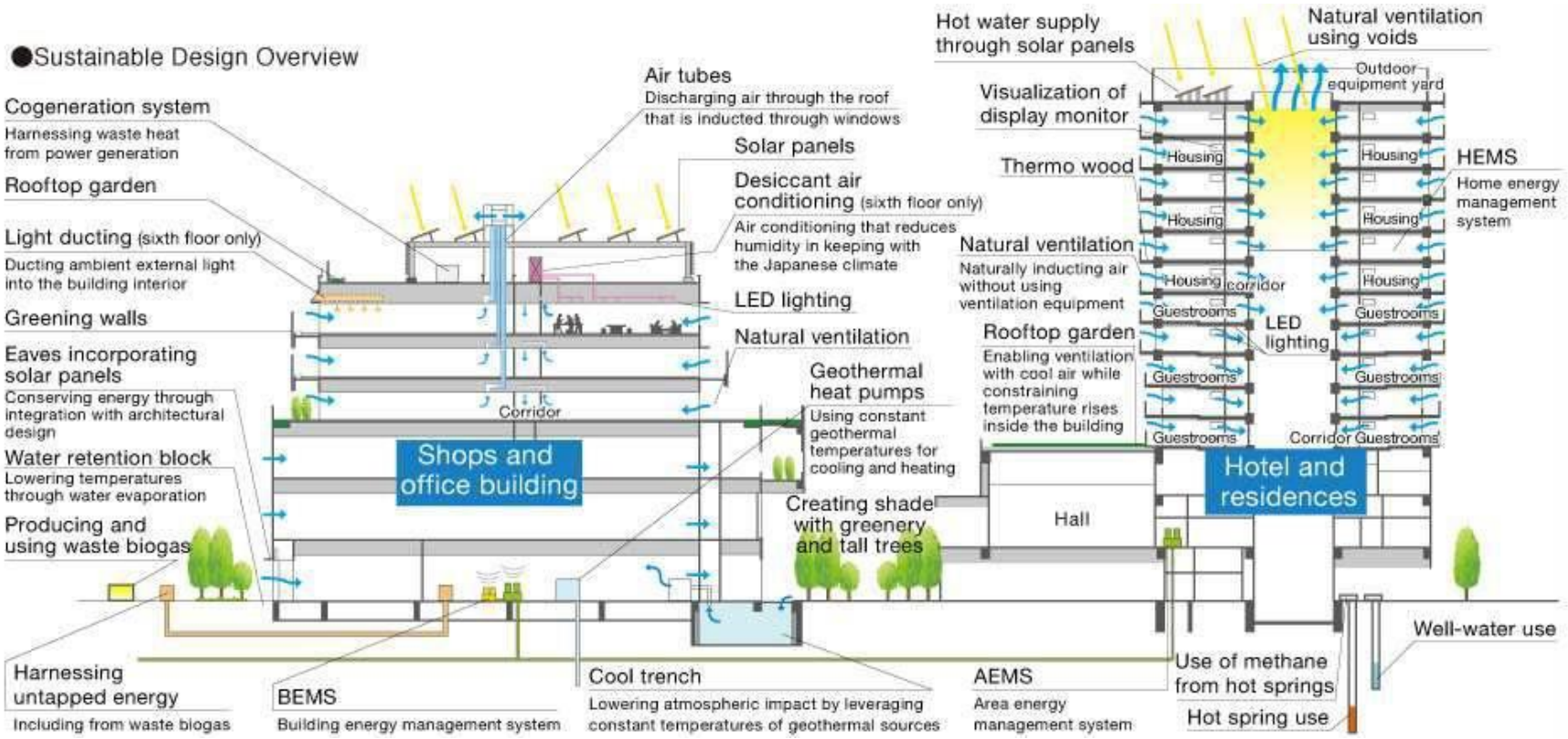
3 - CO2 reduction



Notes:
1. The Kashiwa North Central District town will cover around 273 hectares.
2. CO_2 reductions cover commercial and residential activities (and exclude industrial, transportation, and other activities).
3. CO_2 emission intensity and average values by application under 2005 Tokyo Climate Change Strategy.

Source: Kashiwa-no-ha Smart City site. Available at <https://www.kashiwanoha-smartcity.com>

4 - Sustainable *design*



Sustainable design reduces reliance on electricity and other artificial energy sources by using natural temperature and air to reduce ecological impact. The buildings encapsulate world-leading Japanese green building technology. By combining sustainable design and AEMS for each building in each quadra, there was a reduction of CO2 emissions from these two buildings by over **40%** to **50%**.

Source: Kashiwa-no-ha Smart City site. Available at <https://www.kashiwanoha-smartcity.com>

- Use of advanced technology to stabilize the availability of foodstuffs
- Chiba University is the largest of its kind in Japan, using technology in high-performance production.
- Mitsui Fudosan is collaborating in Mirai agribusiness university for commercialization.

Source: Kashiwa-no-ha Smart City site. Available at <https://www.kashiwanoha-smartcity.com>

千葉大学 柏の葉
カレッジリンク・プログラム

Chiba University Kashiwa-no-ha College Link Program

A place for learning how to resolve local issues through community and university collaboration

Kashiwa-no-ha Eco-City Promotion Council

Promotes environmental community activities that include environmental home economics and a project to visualize CO_2 emissions

Kashiwa-no-ha Eco Club

Where residents engage in lifestyles that are fun and sustainable

Kashiwa-no-ha Honey Club

Kashiwa-no-ha Honey Club

A new combination of apiculture and agriculture in an urban setting

さあ、街に出よう!
エコ・デザインの種を探しに。
柏の葉エコデザインツアー

Kashiwa-no-ha Eco Design Tour

Presents ecological design initiatives and advanced studies at each facility

柏北部東地区
農あるまちづくり
千葉県柏市柏たなか駅

Town planning embracing agriculture

Initiative to harness urban farmland

Source: Kashiwa-no-ha Smart City site. Available at <https://www.kashiwanoha-smartcity.com>

Conclusion and Recommendations

In the urban planet there are many resources of every nature and it is possible to every The city can set them in motion in the desired direction, using planning, governance, management, stimulating the formation of new markets, taxation, urban planning instruments or establishing obligations.

To bring the guidelines down to reality requires instruments that may or may not be structural, but it is necessary to be clear about where to go, even if we always review where to go, and to be absolutely consistent with the capacity of the territory and its local population, to make the decision and act through planning, projects, financing and management.

The examples presented indicate that it is necessary to think about a qualification The results in cities are achieved through the accumulation of good policies, programs and projects, so we must be resilient, persistent and change course only when necessary.

~~Thank you!~~

Architect Emanoele Leal

emleal@ippuc.org.br