### Systemic Perspectives on Low-Carbon Cities in Colombia

An Integrated Urban Modeling approach to Policy Analysis

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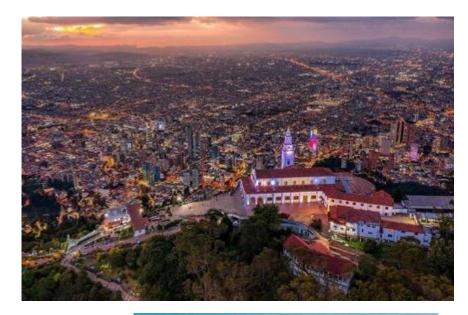
### We come from...

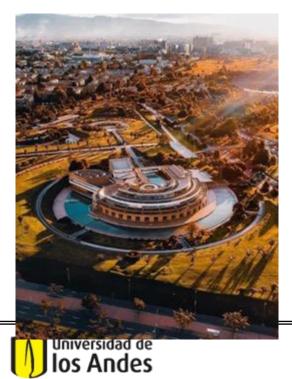




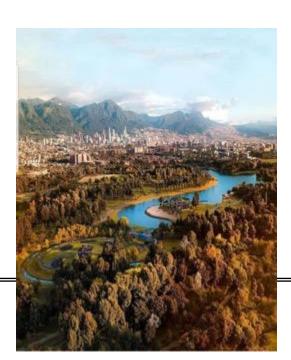








Facultad de Ingeniería







INTRODUCTION

### Objective

Provide an approach, technical criteria, tools (set of indicators and models) and policy and regulatory recommendations for sustainable urban developments in Colombia (climate change mitigation synergies between sectors, urban adaptation goals, and SDGs)

1. Objetivos de Desarrollo Sostenible





INTRODUCTION

### Approach

- Develop a vision for planning and operating a city or urban project
- Apply a set of indicators (adaptable) to evaluate an urban project and its evolution towards an expected situation
- Build inventories and baselines
- Apply a set of models to evaluate options for mitigation, adaptation and improvement of living conditions
- Develop a tool to integrate the recommended options

#### **DEPLOYMENT SCENARIOS**

- Analyze mitigation scenarios and options for increasing resilience and improving conditions for two case studies:
- 1 Macro project in operation phase.

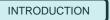
(Ciudad Verde en Soacha)

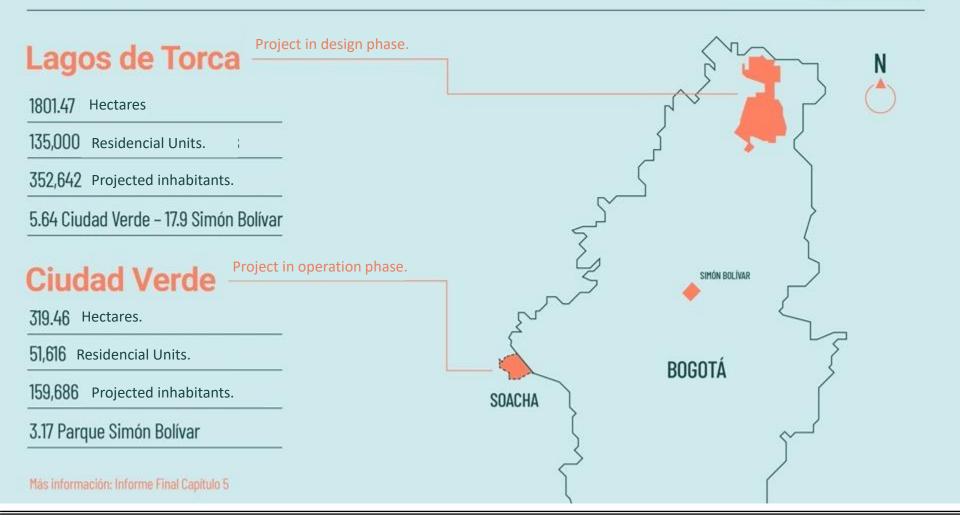
Project in design phase.(inicialmente Ciudad Norte, ahora Lagos de Torca)





### **CASE STUDY**

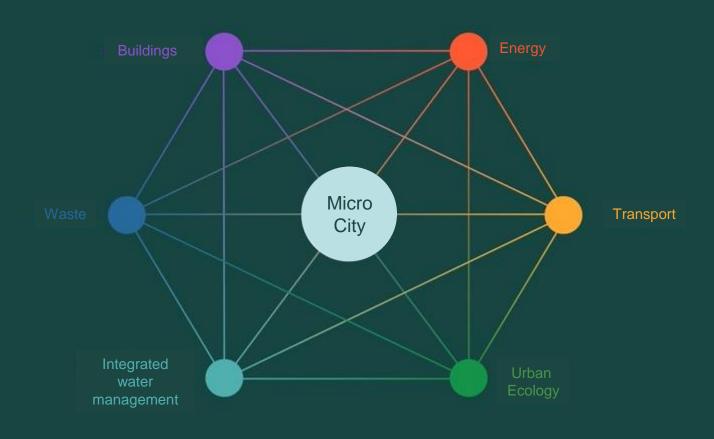








INTRODUCTION







#### PLANNING FRAMEWORK

METHODOLOGY

### **OBJECTIV**

FS

**GOOD USE** OF THE LAND

**MAXIMIZATI** ON OF **ECOSYSTEM** 

**EFFICIENT AND SUSTAINABLE** MANAGEMENT OF **RESOURCES AND** 

**SUPPLY OF PUBLIC GOODS FOR** WELFARE

INNOVATION, **CONNECTIVITY AND ECONOMY** 

**OUTPUTS** 

Support Axis					
Urban Ecology	Integrated water management	Energy	Waste	Transport	Buildings
Natural Ecosystems	Preservation of the hydrological cycle	Resilient infrastructure	No final disposition. Preferably use.	Balanced mix of uses/activities	Urban form and built environment
Corridor green blue	Provision of ecosystem services through SUDS	Distributed energy resources		Pollution reduction	Carbon footprint reduction
Provision, regulation, culture and support	Demand management and resource recovery	Cost to revenue ratio	Circular economy + life cycle analysis	Transportation affordability	Cost to revenue ratio
Useful and accessible green areas	Reliable and affordable water services	Reliable energy services	Rational waste management	Quality public transport / accessible	Housing, facilities, public space
Carbon sinks	Decentralized management	Clean energy and electric mobility	Decentralized waste management	Reduction of travel times and costs	Design, construction and operation

MITIGATION, ADAPTATION AND HABITABILITY

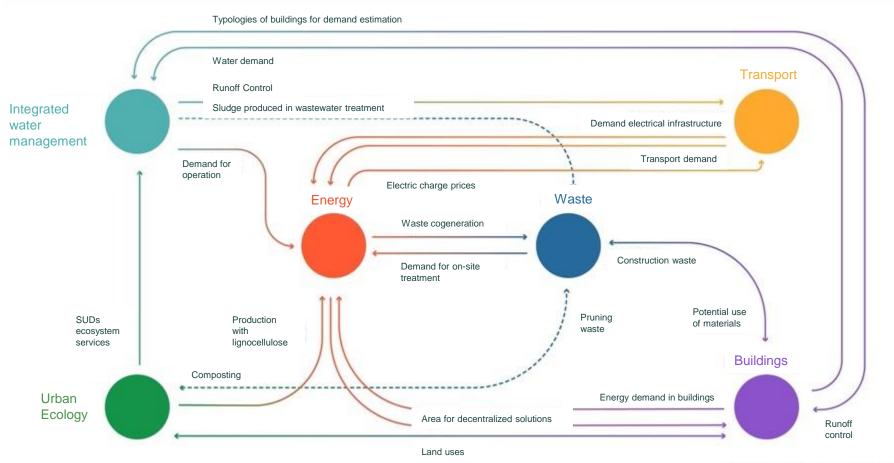
Más información: Informe Final Capítulo 1





#### SECTOR MODELING AND RELATIONSHIPS





Más información: Informe Final Capitulo 3





METHODOLOGY

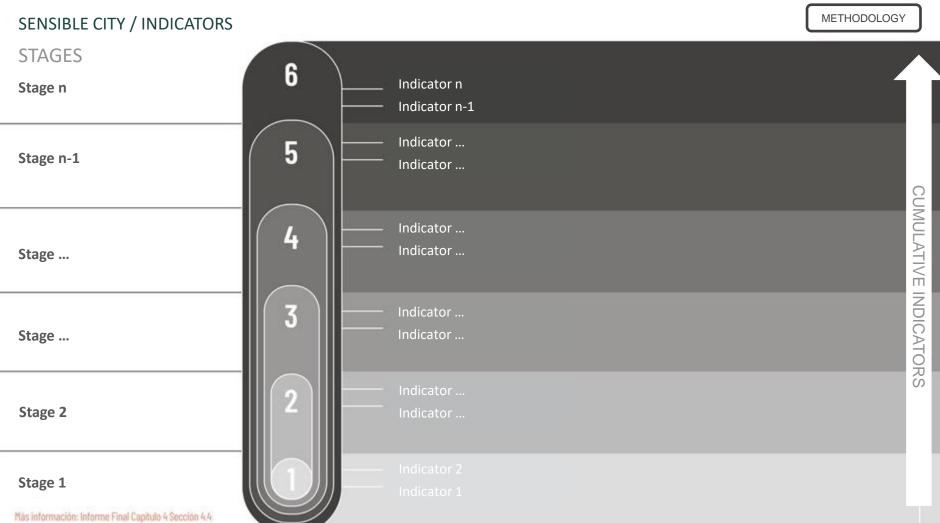
### **Sensitive city**

The methodology used considers different stages to go through in each sector to move from an initial situation represented by a minimum state of sustainability to a final situation represented by the achievement of a sensitive city in sustainability in that sector.

Más información: Informe Final Capítulo 1, Capítulo 4 Sección 4.4







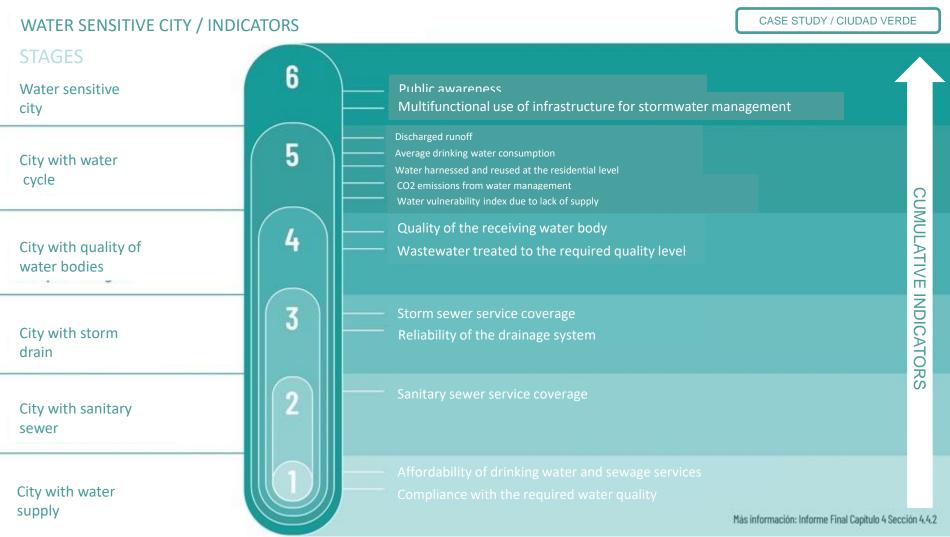




### **ECOSYSTEM-SENSITIVE CITY / INDICATORS** CASE STUDY / CIUDAD VERDE **STAGES** 6 City sensitive to CO2 capture and storage climate change Local climate regulation Social accessibility City with social and ecological **Ecological connectivity** functionality Neutrality (vegetable cover/BD) **CUMULATIVE INDICATORS** Public spaces green área infrastructure per inhabitant. City with integral ecological Private green space area structure Protected green área (EEP) City with main ecological structure Public green area per inhabitant City with Green public space City with public space Más información: Informe Final Capitulo 4 Sección 4.4.1











### CASE STUDY / CIUDAD VERDE **ENERGY SENSITIVE CITY / INDICATORS STAGES** City with clean, efficient and reliable supply Percentage of smart energy management systems in prosumers City with DERs and Interconnectivity of energy systems energy districts Interoperability **CUMULATIVE INDICATORS** Self-sufficiency of electrical energy through DERs City with participatory Self-sufficiency of thermal energy through DERs demand (demand management) Accessibility to smart metering City with participatory Degree of adoption of smart metering by users demand Local policies aimed at energy efficiency programs and demand management City with reliable and quality Average length of interruptions in electricity service energy supply City with electricity and gas supply by network Más información: Informe Final Capítulo 4 Sección 4.4.3





### SENSITIVE TO COMPREHENSIVE WASTE MANAGEMENT CITY / INDICATORS

CASE STUDY / CIUDAD VERDE

### **STAGES**

City sensitive to comprehensive waste management

City that minimizes its generation of waste and promotes reuse or exploitation from the design of the products

City with correct separation at the source and differentiated waste collection

City with proper final disposal

City with full trash coverage







### SUSTAINABLE MOBILITY CITY / INDICATORS

CASE STUDY / CIUDAD VERDE

### **STAGES**

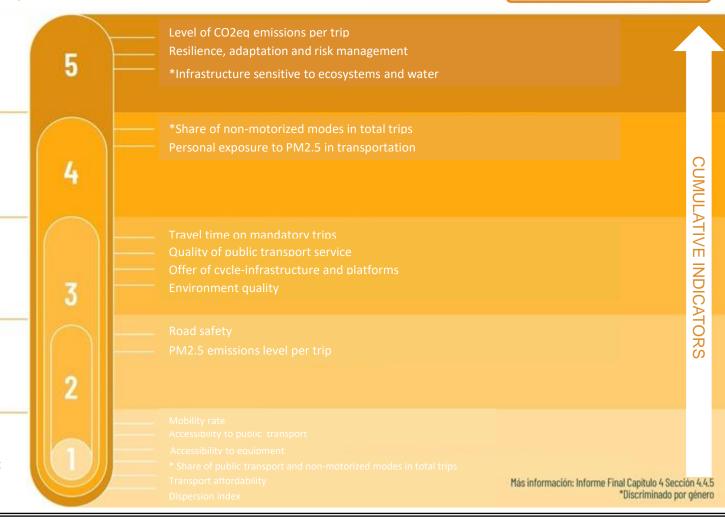
Consistent transportation with mitigation and adaptation to climate change

Quality of life as a priority (Health and active transport)

Good quality transport offer

Zero vision planning (zero deaths due to accidents and emissions)

Universal access to services offered by the city and to public transport







### CITIES WITH SUSTAINABLE BUILT ENVIRONMENTS/ INDICATORS

CASE STUDY / CIUDAD VERDE

### STAGES

City with sustainable built environments

City with conscious use of natural resources

City with efficient use of energy (demand management)

City with access to urban infrastructure

City with healthy housing

City with formal housing



Embodied carbon residential buildings

Embedded carbon urban infrastructure

Waste generated during the construction of residential buildings

Percentage of RAP used in pavements

Electricity consumption in residential buildings operation (upper bound)

Electricity consumption in residential buildings operation (lower bound)

Gas consumption in residential buildings operation (upper bound)

Gas consumption in residential buildings operation (lower bound)

Accessibility to service buildings (education)

Accessibility to service buildings (health)

Accessibility to service buildings (safety)

Accessibility to service buildings (shopping centers)

Coverage of educational services

Percentage of time in comfort conditions of residential buildings

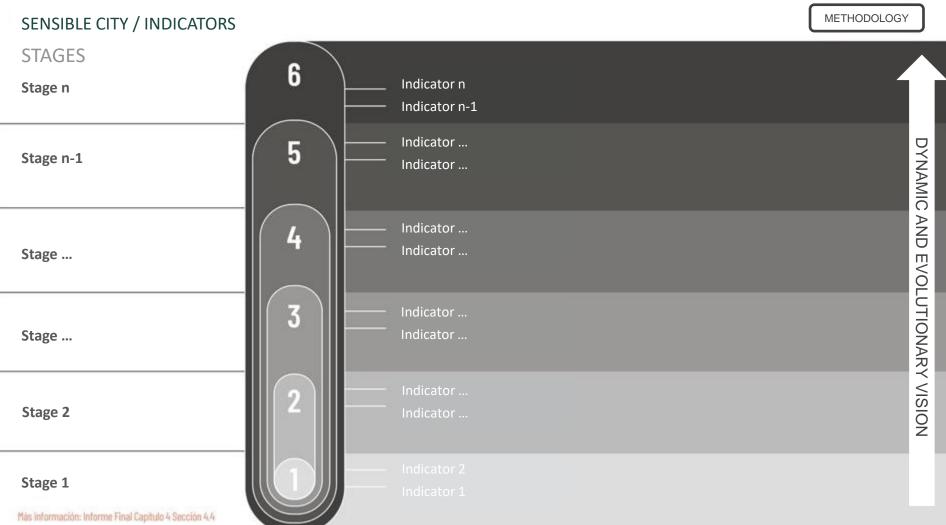
Percentage of dwellings with a formal development character

Más información: Informe Final Capítulo 4 Sección 4.4.6



**CUMULATIVE INDICATORS** 









METHODOLOGY

### Indicators

The indicators as a tool for planning and management, have as main objectives to generate useful information for monitoring, evaluation and decision making, as well as to monitor compliance with the objectives set. The most relevant characteristics of the indicators are:

0

Universality

2

Objectivity and clarity

3

Ease of collection



Representativeness

Más información: Informe Final Capítulo 2 Sección 2.3





METHODOLOGY

# **Fuzzy Comprehensive Assessment Methodology**

1

It allows to obtain a description of the current situation of the case study and to determine the stages and indicators that require priority attention.

2

They must take action or improvement measures and establish a time interval to monitor the evolution of the stages and indicators.

3

It allows an objective and comprehensive evaluation that involves linguistic terms in its description, facilitating its interpretation for decision making.

Más información: Informe Final Capítulo 2 Sección 2.6

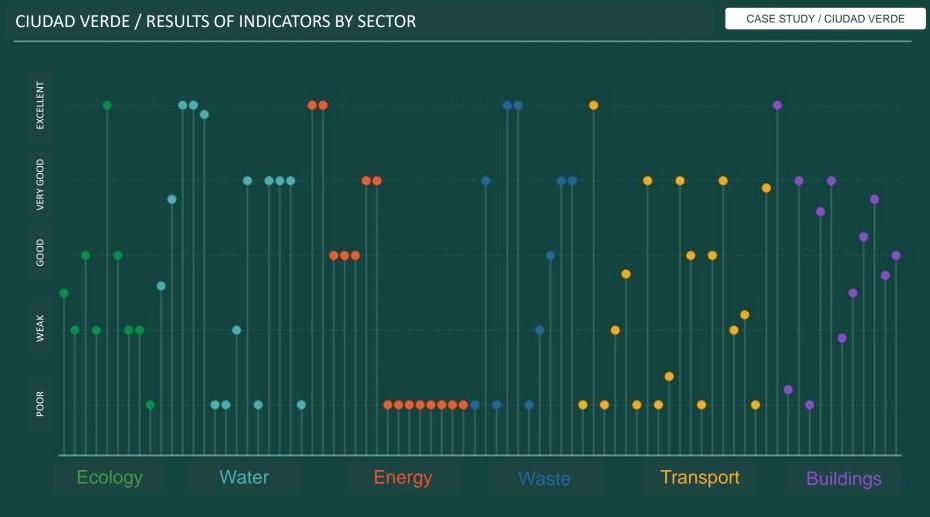


































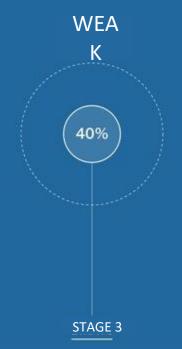
### CITY SENSITIVE TO COMPREHENSIVE WASTE MANAGEMENT/ RESULTS STAGES

CASE STUDY / CIUDAD VERDE

### Results by stage







City with correct separation at the source and differentiated collection of waste - City with reuse, material and energy use of its waste



City that minimizes its waste generation and promotes reuse













CASE STUDY / CIUDAD VERDE







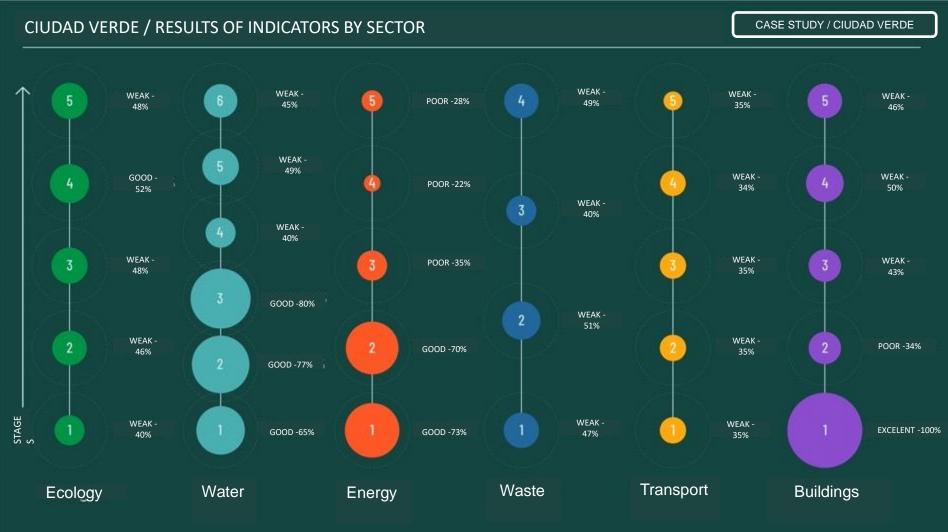
### CIUDAD VERDE / RESULTS OF INDICATORS BY SECTOR

CASE STUDY / CIUDAD VERDE











## Conclusions





### RESULTS AND LESSONS LEARNED



RESULTS MIGHTBE
COMPLEX,
CONSIDERING...

- · Methdology
- · Application of indicators
- · Evaluation of Mitigation Measurements



Different Developments

FOR ALL CASE STUDIES

OF BIG INTEREST DUE TO THEIR DIMENSIONS AND URBAN IMPLICATIONS

**BOTH CASE STUDIES ARE** 

#### Ciudad Verde en Soacha

ciddad verde en 30acha

- Final Phase
- Social Macroproject
- 1 Plan

Lagos de Torca en el Distrito Capital

- · Long-term 30 years
- · Different type of inhabitants

3 IDENTIFIED OPPORTUINTIES

Más información: Informe Final Capítulo 8

- CO2 FOOTPRINT REDUCTION
- ACTIONS TO FACE CLIMATE CHANGE
- BETTER CONDITIONS FOR HABITABILITY



Can be conceived while planning Improved and monitored during operation





### RECOMMENDATIONS/ MITIGATION MEASUREMENTS





Consider Phase of the Project



Consider new practices to use and handle water, energy, and waste



Promote decentralized systems with low footprint

- Distributed generation, district heatings, AMIs.
- SUDS.
- · Scheduling waste recollection



Different options to improve mobility and public transportation



Consider Nature-based Solutions



Different materials in the construction



Involve community and make it aware of the commitments achieved



Regulations and politics for the use of new technologies that involve everyone in the process.





### **RECOMMENDATIONS/ ADAPTATION**





Nature should be the most important factor



Green areas should be used to allow social distancing



Reconsider the effective green area indicator



Increase infrastructure modularity for the use of resources (e.g., water, energy)



Provide regenerative services



Review regulatory processes





CONCLUSIONS

### RECOMMENDATIONS/ HABITABILITY



#### **Urban Configuration:**

- Interactions between buildings/
- Connect habitats with commerce and jobs.



For lower income inhabitants it is usually difficult to have access to public services.



#### Architectonic Configuration:

- · Comfort (e.g., light(
- Flexibility in terms of spaces for different type of activities.
- · Materials used to improve habitability and comfort.
- Use technology in public areas and consider sustainability.



Guarantee connection between elements (e.g., water) and planning





### **FINAL CONSIDERATIONS**



• FOCUS OF THE STUDY

RECOGNIZE THAT THE URBAN PROJECTS ARE DYNAMICAL AND SHOULD ADVANCE TO THE DESCARBONIZATION BY Good soil use

Maximize ecosystem services

Efficient use of resources and waste

Sustainable infrastructure and mobilitys

2 USING INDICATORS DIVIDING
THE WHOLE PROBLEM IN STAGES
AND THE EVALUATION FOR
MITIGATION, ADAPTATION AND
IMPROVEMENT REQUIRE

Being considered from the beginning

Monitoring implementation



- DECREASE FOOTPRINT
- BETTER RESILIENCE
- BETTER CONDITIONS HABITABILITY



# Gracias







