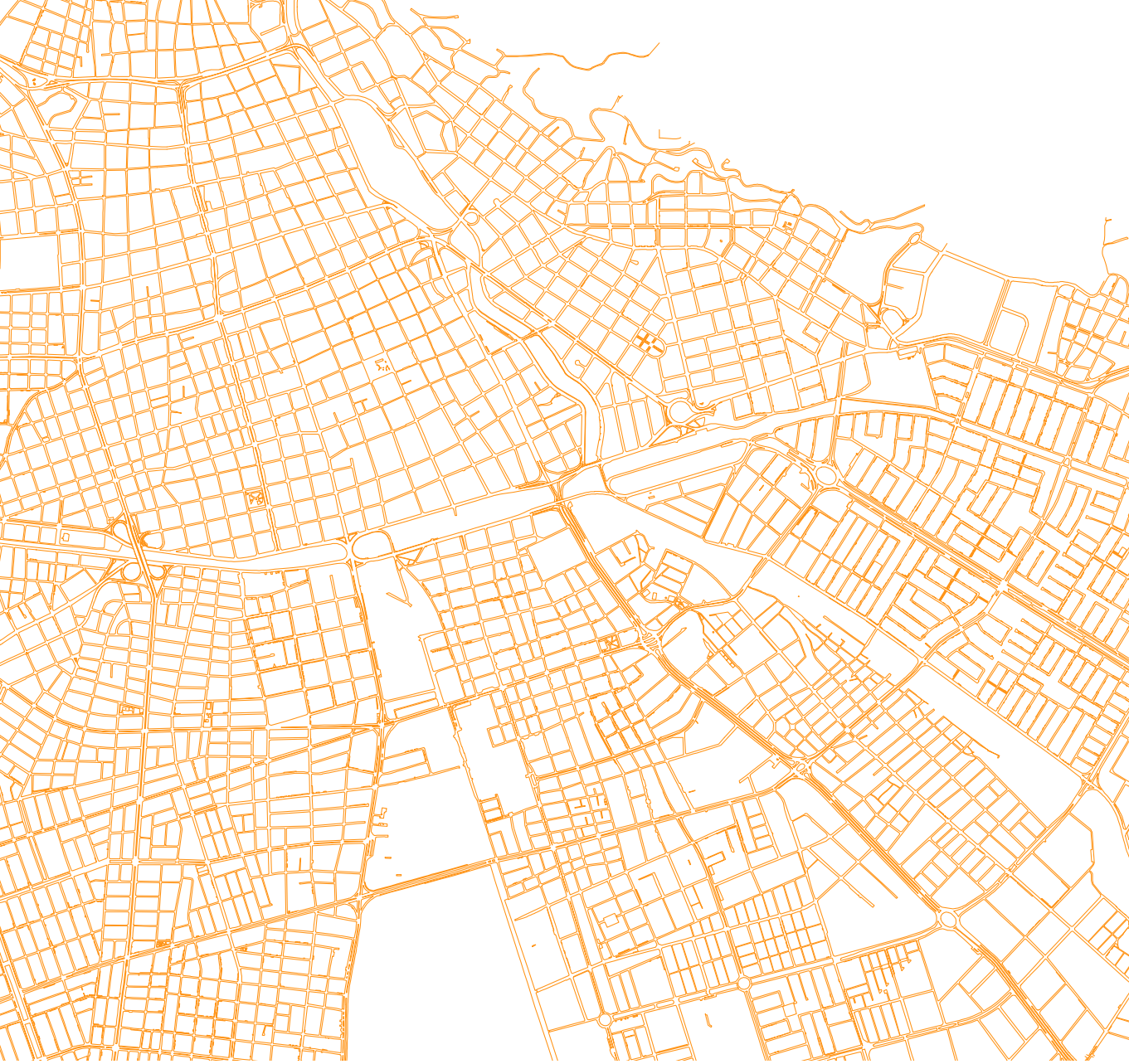

Evaluations for sustainable policies in Latin-American countries

A Sustainability Measurement Framework For Cali, Colombia

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Evaluations for sustainable policies in Latin-American countries

A SUSTAINABILITY MEASUREMENT FRAMEWORK FOR CALI, COLOMBIA

MASTER THESIS

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Abstract

A rapid process of urbanization occurring in the world is generating several negative impacts, especially in Latin-America, whose cities have a growth rate that is increasing rapidly and according to the UN an 81% of the population lives in cities and is expected to increase within the next 15 years. Some of the consequences to the formation of this mega-cities are the deterioration of the natural environment, inequality of income and access to basic needs and decline of the population's quality of life.

Multiple authors suggest that it's the time to take action to convert the cities into resilient environments that can eventually develop its full human and economic potential; creating scenarios of dialogue and analysis of the problematics and presenting an effective mechanism for the application of sustainable projects and ideas.

The aim of this thesis is to design a framework to measure sustainability in the city of Cali, Colombia; as the first step for the development of an assessment system of the progress of sustainability achieved in the city and the suggestion of an application of the framework in the current planning tools and projects of the city. The methodology to develop the framework consists at first with a comparison of existing internationally recognized assessment tools BREEAM Communities and LEED for Neighbourhood Development, followed by a process of filtering the resultant indicators using as a criteria the Sustainable Development Goal # 11 for the purpose of focusing the result framework to specific targets; lastly a contextualization of the framework supported by the ICES methodology.

The result of the methodology is a framework consistent of 23 indicators to measure sustainability regarding the Sustainable Development Goal # 11. The scope of the analysis is limited to the assessment of dynamics and elements in an urban scale, as normatively is the scale that allows the implementation of an evaluation framework and the modification of urbanistic regulations and policies.

The implementation is proposed within the evaluation and adjustment done to the land-plan use every three years as a system of indicators that not only can measure sustainability but the progress in the city. Is expected in further developments the implementation of a system of sustainability measurement indicators that contains all the dimensions of sustainable development.

Keywords: Indicators, Sustainability Goal 11, Assessment tools.

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1 INTRODUCTION

1.1 Background

Urbanization is constituted as one of the most important change processes in landscapes. In most countries, especially in Latin America, the majority of the inhabitants live in cities and villages, conditions that are increasing each year. According to data provided by the UN, currently 55% of the world's population lives in cities and is estimated to reach 68% by 2050; In Latin America, the situation is more drastic, in 2018 the 81% of the population lives in urban settlements (UN, 2018). Therefore, what sociologists call "urban society" (Lefebvre, 2014), constitute a major concern for planning professionals and institutions because the concentration of people that a city implies and to a large extent because is where political decisions are taken and directly influences the rural environment.

Figure 1. Map of emergent and megacities in Latin America. Source: Adapted from: ***Guia metodologica para ciudades emergentes ysostenibles ICES***

Cities, and how they are formed, constitutes one of the biggest challenges in the XXI century, thus it's dispersion leads to a series of problems such as the loss of biodiversity and grand landscape values, materials and energy consumption, greater emissions, amongst others (RRDCS, 2007); though it also represents the acquisition of positive economic and social conditions to the inhabitants.

In order to take steps in the right direction as a society, it is important to know and assess its current situation and to define which aspects are affecting it positively and which are negative. In other words, cities are faced with the problem of trade-offs among economic, environmental and social aspects (Mori and Christodoulou, 2012). Often economic progress, understood as development is taken as the ultimate goal; however, appropriate environmental conditions must be maintained for future generations: sustainability. Some authors consider this concept as a synonym of Sustainable Development (Mori and Christodoulou, 2012). The intrinsic nature of sustainable development is to meet the needs of people but saving the life support system of the Earth for future generations (Kates et al., 2001; Mori and Christodoulou, 2012). So, the Sustainable development goals (SDGs), 17 in total, were adopted by The United Nations in 2015 for the next 15 years. They are the blueprints to achieve a better and more sustainable future for all (UN, 2018).

Costanza et al. (2016) in their paper, make an attempt at investigating alternative methods to relate the Sustainable development goals to measurements of sustainable wellbeing and said that it can motivate and guide the process of global societal change.

There are several concepts that contribute to sustainability or that are considered as a measurable dimension of "sustainable development", such as wellbeing. Bakar et al. (2015), considers sustainability as a future goal, whereas wellbeing is the present measurable condition of sustainability. Therefore an index to measure sustainability is divided into three dimensions: Human wellbeing, which according to Prescott-Allen (2001) is a requirement for sustainability, along with the environmental wellbeing and economic wellbeing.

According to this, all the authors agree that wellbeing is a concept that should be considered as a guideline to indicate levels of success and progress since focuses in people's vision of their current situation based on their opportunities, development in the community, financial capacity and relation with the environment. Even though it is a concept that is still recent, being studied and used as a measure of standard development, every methodology has presented strong and cohesive strategies to take into account when assessing an overall situation of the population; also from these methodologies, all the researchers coincide that wellbeing is intangible and have inclined to define the term identifying its dimensions rather than giving it a precise and one-dimensional definition (Dodge et al., 2012).

A "sustainable" future that ensures wellbeing in all its dimensions is desirable for all, but is necessary to also agree on which processes and measurements to work towards. "The SDGs (UN's Sustainable Development Goals) represent an important step in building global consensus on what kind of world is desirable, and sustainability in the sense of longevity is certainly one of the characteristics of a desirable world, but it can only be predicted, not measured directly" (Costanza et al., 2016). They suggest that the SDGs are very detailed, but is essential to have a general goal to make progress towards, and define methodologies to measure it; what the authors call "overarching goal". The 17 goals are considered as sub-goals generating the need for a principal aspect that is later specified by different studies and that is also measurable. To measure the progress towards sustainable development Costanza et al., (2016) proposed a method to relate the SDG to sustainable development through an index called the Sustainable wellbeing index. "*Linking the SDGs and our SWI to a comprehensive, non-linear, systems dynamics model that can track both flows and stocks of built, human, social, and natural capital and make projections into the future under different policy scenarios.*"

In current policies and assessments of countries, development is commonly based only in economic evaluations and measurements such as the GDP[1] (Gross domestic product) and is accepted worldwide mainly because is linked to the System of National Accounts (The internationally agreed standard on how to compile measurements on economic activity. (United Nations Statistics Division, n.d.). Also, Huppert and So (2013), developed a framework to define and measure wellbeing, stating that governments are starting to recognize the measurement of subjective wellbeing as an indicator of progress in society and using it as a guideline for policymaking.

The issue that exists with this measure is that the GDP is based only on economic data that excludes other dynamic factors that affect directly people's quality of life and wellbeing.

This thesis aims to develop a preliminary construct regarding sustainability indicators to measure progress in the city of Cali, Colombia based on the proposals and tools available in the municipal planning instruments.

It is developed through the analysis of assessment frameworks that have relevance at a global context such as LEED and BREEAM, taking this frameworks into a Latin-American context, with the objective of creating a link between the sustainable development goals and the planning of the city, and establishing at a final moment a series of indicators that should help prioritize interventions.

The biggest transformations in urban space are no longer being developed in the major metropolis, but in intermediate cities that are through large migration and thus urbanization processes and are called "emergent cities". Characterized for having an average of 2 million inhabitants and having the possibility to modify the urban morphology are commonly found in Latin-America and the Caribbean.

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1. Gross value added is the difference between output and intermediate consumption. GDP is the sum of gross value added of all resident producer units plus that part (possibly the total) of taxes on products, less subsidies on products, that is not included in the valuation of output.

Next, GDP is also equal to the sum of the final uses of goods and services (all uses except intermediate consumption) measured at purchasers' prices, less the value of imports of goods and services (United Nations Statistics Division, n.d.)

As most of the Latin-American cities present similar characteristics and dynamics, they can be analyzed under the same criteria and a general strategy to guide urban planning and the formulation of plans in pro of sustainability can be formulated similarly.

What are the challenges that "emergent cities" face? What is the biggest challenge to route them towards sustainability?

Giving a general overview, as Terraza, et al. (2016) established, all cities present problems of an urban, social and environmental nature, such as disorganized urban sprawl, lack of definition between urban and rural soil; low density and presence of urban voids, high percentage of unused soil which unchains at the same time a number of urban problematics such as the deficit of public transport and inequitable distribution of public space and green areas; strong socio-spatial segregation; proliferation of informal settlements in vulnerable unoccupied areas of the city; and present a high risk of being affected by natural disasters caused by climate change.

A "sustainable city" is one that according to Terraza, et al. (2016) is: compact, meaning that has clear limits between urban and rural occupation, is socially cohesive, offer spaces for social interaction, presents a good index of public spaces and green areas, is resilient towards naturals disasters, encourages social activities and allows the community to develop. The arguments leading to the conclusion that most Latin-American cities present the same problems thus will share possible causes and solutions was the analysis made by the IDB (*International Development Bank BID*.); in which data was compared side to side and situated cities considering similarities. Three scenarios are exposed as a result of the analysis, the optimum, the trend, and halfway. The basic criteria are oriented to improve the quality of life of the inhabitants, in which every intervention is thought to increase the values of the indicators towards sustainable values. However, these territories are also considered as new cores of investment and opportunities, what makes them prone and ideal to develop new models of expansion and control of the urban print, taking advantage of their privileged localization and resources, guiding social processes towards sustainability as the concept is new to the governments.

The biggest challenge is to start opening effective urban planning spaces that allow the proposal and execution of not only short-term projects but also the correct execution and evaluation of long-term projects, the articulation between scales of intervention and the continuity of the same despite the change of government.

1.1.1 Measuring Sustainability

Several researchers have proposed diverse methodologies to measure the wellbeing and sustainability of communities and ecosystems, although they all coincide with starting by defining indices (Cutaia 2016). As part of wellbeing, local governments are interested in measuring the quality of life has grown, especially in dense urban areas where a lot of urban problematics are present, due to urban overcrowding and poor environmental conditions; not only as an instrument for policy-making and social planning but also to have a valid framework for monitoring the progress (Verma and Raghubanshi 2018).

Assessment tools often present issues divided in criteria which are characteristics judged by failure or success, whereas indicators could be contained in multiple criteria simultaneously and are quantitative, qualitative or descriptive meaning that could be measured (Haapio 2012), because sustainability cannot be measured directly (Costanza et al. 2016).

A method to measure wellbeing and sustainability may be through the assessment of quality of life. Quality of life is a broad concept, which encompasses the many dimensions of the relationship between a person and the environment.

The search of indicators is the starting point in developing new methods of measuring quality of life, not excluding the current use of an economic index such as Gross Domestic Product, but is fundamental to understand the aspects and compliment them with indicators that manifest a more real panorama. Bakar et al. (2015) for example, suggests as an alternative the Sustainable Society Index (SSI) introduced by the Sustainable Society Foundation, that is designed to complement economic growth, but does not include indicators of economic growth like the GPI (Gross Produce Index); Its aim is to exclusively measure social progress.

Costanza et al. (2016); Wagner (2006); Pupphachai and Zuidema (2017); agree on the statement that creating new indices based on a common attainable goal, such as to improve sustainability and consequently human wellbeing, facilitates achieving that goal when is measurable. The sustainable development goals give a general vision on what we need to work towards in the future, but should be classified into more general goals since policies or measures can affect more than one simultaneously, in order to develop a methodology for defining indicators.

Even though there are a series of challenges associated with the implementation of sustainable measurements, the actual method for measuring and comparison of results is still the greatest challenge (Pupphachai and Zuidema, 2017).

Sustainability indicators are originated from policy goals and also concretise and model the policies. Developing indicators cannot be only a technical or scientific process, but must be a communication canal with policy makers (Bakar et al. 2015). In Bakar's methodology, an index that is simple and directionally clear is developed. Simple, meaning to have a limited amount of indicators and that the method to calculate them must be transparent; directionally clear, it should have indicators that are relevant in terms of importance for sustainability and the ability to signal progress or absence of progress. Both objective and subjective indicators are measured.

The Sustainable development goals can be prioritized and arranged for each nation according to their scale and conditions, although the targets were aimed to be universal they are not applicable to every context (Verma and Raghubanshi 2018). The indicators must adapt to the way of living in each area of study even in the same country as the indicators could lose relevancy depending on the city; thus to assess the sustainability of different cities, with the main objective of identifying strategies to solve social problems with adequate procedures and measurements of progress is necessary to have an understanding of the context.

1.2 Problem Statement

The concept of sustainability is fairly recent globally, considering the SDG's are considered a benchmark for development of most countries all around the world, were only presented in 2015; is safe to say that the progress made towards achieving these goals or at least improving people's quality of life is very little or is still in an early stage. In Latin-America the situation is even more complicated when compared to, for example, a European country since the priorities and interests are others politically and as a society.

For governments is already evident that generating changes in the government and development strategies and the policies that regulate and sustain them is necessary, considering sustainable development as well as achieving equality of conditions and opportunities, as the rates of inequality in Latin-America are significantly high. In Colombia, the first steps are already done, integrating the UN's development goals with the national and local development plans in urban planning and national environmental policies. There is still a lack in articulating the goals in different scales since every scale contributes to one another and defining the studies that support the relevance of the sustainable goals, prioritize strategies and monitoring the same.

The rapid and effective development of an evaluation framework and measurement of the efficiency of the realization of strategic projects in the government's plan to establish which need to be executed first is a need considering the growth rate of the cities; the impact that a project can generate positive or negative and which projects should be a priority in the next government development plans; also having a support instrument to the land-use plan.

1.3 Research Questions and objectives

In order to respond with a cohesive development of research that can help Cali, the case study, to consider implementing sustainable strategies into the new urban developments and policies; moreover, include a system to measure sustainability in order to do changes in short-term policies if a development is generating a negative impact to the city.

The objectives of the thesis are the following:

- Initiate the process of articulation between development plans and Land-use Plans over time establishing standard indicators for the future assessment of progress.
- Propose a framework to complement the current evaluation system of the Land Use Plan (POT) that is focused on sustainability assessment.

Considering the aim of the thesis and the resources that exist in the city and its background the thesis presents three questions that are going to be addressed in the results:

Which is the first step to initiate the focus towards sustainable development in Cali, Colombia considering the current planning tools?

How can the assessment of sustainability be included into the existent planning tools, developments, and projects being executed at present?

Under which criteria can be established the coherence between scales and planning tools regarding urban development in the interest of sustainable development?

1.4 Proposed Methodology

The methodology to generate an initial index of sustainability measurement indicators consist in an analysis of sustainability frameworks developed in three steps:

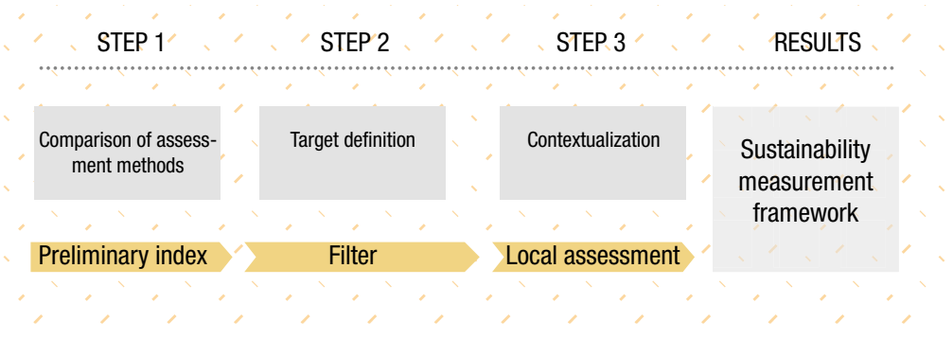

Figure 2. Summarizing scheme of the methodological development of the thesis.

- **Step 1:** Analyze the current sustainability indicators from the existing assessment tools LEED for Neighborhood Development and BREEAM Communities to evaluate and establish the relationship with the SDG's goal 11.
- **Step 2:** Make a comparison between the assessment tools mentioned above of sustainability frameworks and establish the relevance of the indicators in a Latin-American context.
- **Step 3:** Analyze and propose indicators that can help improve the revision and adjustment of the *Plan de Ordenamiento Territorial* (Land use Plan - POT) towards sustainable development in Cali, Colombia and assess the components of future projects that are related to the SDG's Goal 11 and the commitments assumed by Colombia in sustainable development.

1.5 Thesis Outline

The thesis presents the research and development of a framework to measure sustainability specifically applied in the case study, the city of Cali, Colombia. The document consists of four chapters that are: Introduction, Methodology, Results and discussion, and Conclusions.

Chapter 1: The Introduction mentions the importance nowadays of considering the assessment and adjustment of globalization strategies towards sustainability, to focus in the vulnerable population in order to ensure quality of life and progress in societies without affecting negatively the environment. The first step which would be to create awareness and commit to the global sustainability standards has already been made, but the challenge is to adapt the studies and procedures to every scale until it arrives at the household. The introduction also gives an insight into the current assessment methodologies to evaluate sustainability from different points of view.

The problem of the thesis, the objectives and proposed methodology are presented to conform the foundation of the thesis.

Chapter 2: The Methodology describes the process of generating a list of sustainability assessment indicators, starting from the description and analysis of existing measurement frameworks and taking the elements that are considered pertinent in the context of the case study. A summary of the proposed methodology is mentioned above.

The case study is presented, which is the city of Cali, Colombia a middle-sized Latin-American city that has not developed its full economic, industrial and human potential and is needed as most of Latin cities of a guide to evaluate and propose sustainable alternatives to the exponential urban growth that is occurring. The main tool to proceed with the realization of urban development projects is called POT *Plan de Ordenamiento Territorial* which is the Land-Use plan and the tool that is used as a starting point for the proposal of indicators to measure progress in the city.

The steps of the methodology consist of an analysis of LEED and BREEAM, which leads to a list of indicators classified in categories and described in detail that are common to both methodologies and constitute mandatory criteria to one or another methodology; to filter the selection of indicators the criteria used is that the indicators must be related to the United Nations' sustainable development goal # 11: Sustainable cities and communities; then, the indicators are contextualized in Latin-America, based on a methodology for sustainability measurement and prioritizing of projects called ICES (*Iniciativa para Ciudades Emergentes y Sostenibles* for its Spanish initials) that make emphasis in common Latin problematics and measurements for sustainable progress. The end result is a list of indicators that are related only to goal #11 and to the context, to compare to the current indicators from the revision and evaluation of the POT.

Chapter 3: Consist in the exposition of the result of the development of the methodology which consists of a table of indicators that measure sustainability and are related to the UN's SDG # 11 Sustainable cities and communities. Also makes a final comparison with the existing indicators of the urban development policies tool in Cali, showing which aspects have a notion of the assessment of sustainability and which indicators are already being measured, which need to be measured and which could be calculated from the analysis of others.

Chapter 4: Is the last chapter and contains the conclusion of the thesis and suggestions for future developments or researches.

In the appendix are the complete lists of indicators that are used in the development of the methodology and the analysis of the results.

2 METHODOLOGY

The methodology, as mentioned before, aims to develop a framework to assess sustainability considering as the main factor the context in which is going to be applied. The solution to the need of generating a framework of measurement of sustainability had to be accurate and simple to develop. Accordingly, a review of different approaches to sustainability measurement in multiple scales is made in order to understand how the influence of the factors in the context and the scale of evaluation, orientate the selection of a certain methodology or indicators in a framework.

Further on, the existent frameworks selected to develop the methodology in creating a new one, are explained in more detail in order to have a deeper understanding of the reasoning behind the proposed framework.

2.1 Theoretical approach

Costanza et al. (2016), suggest the evolution of the GDP as a quality of life as a measuring index would be to create a series of hybrid approaches that minimize the negative aspects and incorporate most of the positive aspects. For this reason, they consider a more sustainable alternative measuring the GPI (Genuine Progress Index), which weighs personal consumption by income distribution, add some positive economic elements left out on GDP, and subtracts a range of costs that should not be counted as benefits. Although the current measure of GPI doesn't include the positive contributions of natural and social capital.

Ameen and Mourshed (2019), mentions that considering the local context for sustainability assessment is fundamental in order to identify the needs and priorities of the place. In their work, they develop the final part of a sustainability assessment framework in Iraq, using already relevant indicators and determining the appropriate weighting and hierarchy, using the analytic hierarchy process. The result shows which indicators should be mandatory in the context of the case study and develops a more appropriate weighting and rating scores for the assessment. Stakeholders and decision-makers have a determining role in the definition of the weighting as the assessment is aimed at building consensus.

Macedo et al. (2017), analyse the flexibility in sustainability assessment methods and propose an approach that focuses on mobility, as they consider that indicators in some methodologies need to have a more balanced distribution among sustainability dimensions to contribute to the impact of sustainability at an urban scale. The analysis is made from comparing a series of sustainability tools focusing on the indicators. In conclusion, the work showed that is fundamental to develop an assessment tool that corresponds cohesively with the local context, and for the case study which takes place in Portugal, the weighting of the new framework showed that mobility was a priority.

Yan et al. (2018), emphasize that sustainability should not only consider natural resources and the environment, but also in human wellbeing and resident happiness. Thus, the result of the paper is a sustainable assessment index and a methodology to determine sustainable development efficiency based on the natural resources limitations and human welfare needs. The efficiency measures the capacity in which cities can minimize natural resources consumption and environmental loss. The natural

system is based on the basic resource consumption meaning water, energy, and land whereas the human welfare system is based on safety, health, social relationships and freedom of choice and action.

Pakzad and Salari (2018), assess sustainability in urban blocks, relying on their morphology, because they mention that contemporary urban form has shown to generate environmental, social and economic problems in the city. The methods used in the analysis are scientific, quantitative and empirical for the study of the urban form and urban design; also they argument that for focusing in this scale is that sustainable development is more effective when applied in the micro-scale.

The goals and targets of the framework look for reducing energy consumption and achieving a liveable environment, which leads to a proposal in three different parts: size/length, configuration/grain and orientation of the urban block.

Yigitcanlar et al. (2015), propose a multi-scalar urban sustainability approach as the result of linking two existing assessment methodologies; in the micro-scale, they use Urban-ecosystem Sustainability Index (MUSIX) and Neighbourhood-level Integrated Land-use and transport Indexing model (ILTIM).

The model evaluates primarily the environmental dimension of sustainability in multiple scales, leaving room to apply the same methodology to develop afterward a model that measures as well the social and economic dimension as well as leaving room to evaluate different alternatives of sustainable development plans.

The choice of the certifications considered in the development of the methodology is made considering as a reference the procedure of the FASUDIR (Friendly affordable sustainable urban district retrofitting) selection of what Zukowska et al., (2014), call the Key Performance Indicators. They develop a framework in which indicators are selected from the certifications mentioned above (LEED-ND, BREEAM, HQE, DGNB) to create a methodology that can combine the common aspects of the most recognized assessment methodologies. A brief description of the methodologies mentioned before was done by Haapio (2012), in order to understand the multiple variables that lead to the construction of a measurement framework and the focus of each one, however at the moment to make a detailed analysis the final choice of frameworks was between BREEAM Communities and LEED-ND, considering one was developed in Europe and another in America, with the objective of establishing common elements between two of the most recognized sustainability certifications

worldwide.

DGNB is one of the newest certification systems and the first one from Germany which makes this certification one of the most relevant according to Zeinal and Huber (2011) because Germany, is the most active in constructing and developing sustainable cities. Consists of a Life Cycle Assessment method that focuses on the cohesion between the sustainable development aspects, social, economic and environmental where each criterion is weighted differently.

All the HQE certification schemes are based on two components: SMO (Operations Management Systems) and QEB (Environmental Building Quality). SMO incorporates all the organizational processes oriented towards construction procedures that allows the compilation of the requirements to complete the profile for QEB, which is based in 14 targets and 159 indicators divided into 4 categories: construction, management, comfort, and health. Unlike the other certifications, HQE does not weight each category, but certifies them individually in 3 levels: basic, good and very good rating; for a building to be considered environmentally efficient, at least 3 targets should pass the mark (Ebert et al., 2011).

Methodologies well known worldwide such as BREEAM (Building research establishment's environmental assessment method), LEED (Leadership in Energy & Environmental Design), DGNB (German Sustainable Building Certificate) and HQE (Haute Qualité Environmentale) that assess and certificate the sustainable performance of buildings, have created an indicator system that can evaluate sustainability in a district or urban level. Each tool is developed in a different country, therefore, each one has a different approach when measuring environmental performance, focusing mainly on diverse aspects of the building or district to evaluate. As most of them highly recognized worldwide, the indicators correspond to criteria derived from the problems and priorities from the region, meaning that whereas in a Latin-American context satisfying basic needs such as water and energy coverage or housing deficits in European countries' assessments they face with elements such as energy performance, reducing emissions and the application of smart cities/building technologies. However, confronting indicators from methodologies that have advanced further into the study of sustainability assessment to the ones used in Latin-America, support the relevance of measuring certain variables.

BREEAM, was established in the UK and was the first commercially available environmental assessment tool; it is focused on mitigating the overall impact of develo-

pment projects within the built environment and for the assessment of larger scales, they created a methodology called BREEAM Communities. In this methodology, the categories of infrastructure and transport are the most emphasized; consists of 51 criteria in which all are weighted equally. (BREEAM Communities, s.f.)

The aims of BREEAM are to provide social and economic benefits whilst mitigating the environmental impacts of the built environment and promote sustainable development by stimulating sustainability's benefits. To achieve the aims of the certification and be able to generate and evaluation, BREEAM measures sustainable values in a series of categories that are energy, health & wellbeing, innovation, land-use, materials, management, pollution, transport, waste, and water; the categories are consequently sub-divided into assessment issues and each one has its own benchmarks, target and aim and are given a score in points.

The framework for sustainability assessment is called by BREEAM the Code for a Sustainable Built Environment and contains strategic principles and requirements to guide the design, construction, management, evaluation and certification of the impacts within three pillars of sustainability across the full cycle of the built environment and is interpreted through a technical standard that maximises resource efficiency; health, wellbeing, comfort, safety & security; social and cultural value; opportunities for effective and efficient use of facilities; direct and indirect economic benefits.

BREEAM Communities considers the issues and opportunities that affect sustainability in the earliest stages of the design process where the site selection is not done yet.

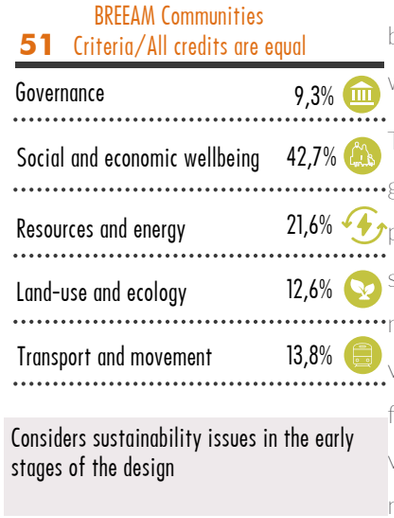

Figure 3. Table of BREEAM Communities categories and weights.

The assessment is made at the masterplan stage and involves three steps: Establishment the principle of development which involves the strategy at a community scale, step 2 determining the layout of the development which involves a more physical design and layout, the final step is the design of the details which involve specifications on the landscape and drainage solutions for example. Also, the evaluation considers the success of the development in a long-term, with economic issues and impact or effects in the improvement of the community's wellbeing.

The issues are grouped into 5 categories that are considered through criteria in steps 1 to 3. The categories are: governance, social and economic wellbeing, resources and energy, land use and ecology & transport and movement; a sixth category seeks to promote innovative sustainable solutions. (See Figure 2.)

BREEAM communities simplifies the assessment process using the studies that meet legislative requirements in the EU and UK to achieve credits in the certification, ensuring that the requirements go beyond the minimum requirements from international regulations and policies. For example, the land use ecology and ecology assessment issues are evidenced in the Environmental Impact Assessment.

The performance of a development is determined by a combination of different elements that are: the mandatory standards, the assessment issues and credits, awarded credits for innovation, the issues weighting, the BRREAM rating level benchmarks. The benchmarks start from passing with a 30% score until an outstanding performance with a score of 85% or above (BREEAM Communities Technical Manual SD202, 2017).

LEED (Leadership in energy & environmental design), is a rating system developed by the United States Green Building Council and base their assessment mainly in site selection, design and construction elements, LEED for Neighbourhood development; they evaluate with a rating system that weights each category differently that could reach a total of 100 points.

The premise to create LEED for neighbourhood development was to take the knowledge and technological development that serve to LEED at a building scale to help confront issues that affect the planet and make a significant advance towards the worlds sustainability, as they consider that the neighbourhood scale is key for urban change and innovation and are the catalysts opportunities for suggesting new sustainable solutions.

LEED aims to optimize the use of natural resources, promote regenerative and restorative strategies to minimize the negative impacts in the environment and human health due to the effects of the construction industry and to provide high-quality indoor environments for building occupants. To achieve the aim, LEED has set seven goals: to reverse the contribution to global climate change; to enhance individual human health and wellbeing; to protect and restore water resources; to protect; en-

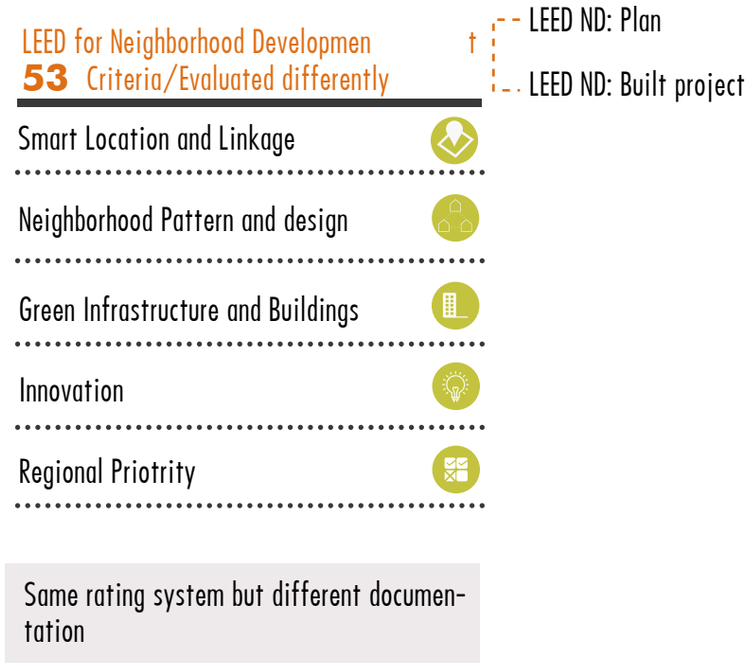

Figure 4. Table of LEED for Neighbourhood development's categories.

hance and restore biodiversity and ecosystem services; to promote sustainable and regenerative material resources cycles; to build a greener economy & to enhance social equity, environmental justice, community health and quality of life. (See Figure 3.)

The goals are the base of the pre-requisites and credits that as mentioned above are rated differently, categorized as Smart location and linkage, Neighbourhood pattern and design and Green infrastructure and buildings. Each credit is weighted according to its contribution to the goals. The certification is given at four levels: Certified, silver, gold and platinum to incentivize higher achievement and faster progress towards the goal.

The benefits of LEED-ND according to the methodology's guidelines are the consideration of the scale, the comprehension of the dynamics in a neighbourhood scale and the capacity to create opportunities and benefits out of the strategies and the longevity described as the passing of sustainable development to future generations considering the green design an investment. The LEED-ND have two options of certifications to choose: LEED ND: Plan and LEED ND: Built Project which imply different options to the rating system. To apply to a certification the candidate must apply to a specific certification system.

The development of the project throughout time is a major aspect of the rating of the certification. Some criteria or as is called by the Green Council credits, need to be understood and fulfilled within a period of time or for others in perpetuity, from the planning of the project, the construction until the end of the life cycle of the built environment. Some of the criteria that have to be met during the planning phase and until the 50% of the occupation are related to land-use, for example solar orientation, transportation demand management, smart location, local food production, neighbourhood schools, etc. Other criteria such as housing types, waterbody conservation, transportation demand management and site design for habitat conservation need to be met and fulfilled until 2and 3 years after the occupancy of the project which means that not only the planning, design, and construction but also the management during the occupation and use of the project. The criteria that are required to be met with perpetual commitments are for example light pollution reduction, agricultural land protection, ecological community's conservation, walkable streets, local food production among others.

The Green Council also has created an alternative guide when the projects are going to be assessed outside the U.S, where they show the equivalencies to non U.S standards, as well as advice in the measuring of each credit.

The scoring system of LEED works with a basic required criterion that have to be met in order to certify a project, and the rest of the credits can give additional points to the total score to rate the certification. Unlike BREEAM that gives a weight to each category in connection with the other credits, LEED defines a series of criteria that is mandatory in order to classify the project as certified and also some more criteria that the project can or cannot fulfill. The definition of the points in each criterion is made according to the relevance and positive effect that generates in the project and its environment. (Getting to know LEED: Neighborhood Development, s.f.)

The United Nation's Sustainable Development Goals are an update of the expired Development Millennium Goals which were a compromise by several nations to act against extreme poverty, hunger and illiteracy up until 2015. In 2016 there was a new agreement, the launch of the 2030 agenda, called the sustainable development goals. The agenda calls countries to achieve 17 sustainable development goals for the next 15 years. The goals promote the ending of poverty and inequality in the world, simultaneously building economic growth and fighting climate change. The SDG's are presented as a guide for countries to develop policies in order to collabo-

rate with the global commitments, but is finally left to each government the development of plans, policies and programmes. (See Figure 5.)

Figure 5. The United Nations' Sustainable Development Goals.

There is an ongoing discussion about the efficacy and reach of the SDG's, Spangenberg (2016), argues that we should analyse further into the targets of the SDG, since they are missing in addressing the causes of unsustainability and are focusing on changing unsustainable states and impacts. The strategies for the achievement of the targets are left unclear by the UN as is left to each government to implement legally binding standards to ensure the compliance of national policies that can favour sustainability. Also, create an economic environment that promotes rewards for institutions that contribute to sustainable development.

Hajer et al. (2015) state as well that SDG cannot be achieved in charge of intergovernmental organizations, but be mobilized by new agents such as business, cities and civil society. Concluding that SGD can be a tool to guide governments into a vision that promotes sustainable development, and be applied introducing effective policies that represent an advantage to work towards sustainable development.

Depending on why a place establishes necessary to measure and assess its sustainability, is mandatory to select a methodology capable of evaluating relevant criteria for the context; which is why a framework that has been developed in Latin-America effectively is chosen.

In this specific case, the methodology analysed is called ICES (*Iniciativa Ciudades Emergentes y Sostenibles*), because is an evaluation executed in multiple Latin-American cities to establish general critical criteria that have to be prioritized to improve living conditions in the city and develop strategies towards sustainable development.

The Methodologic guide ICES is a fast application methodology and diagnosis to help emergent cities to formulate and applicate an action plan that structure interventions to achieve their sustainability goals in a short, medium and long-term period developed by the Ibero-American Development Bank (BID). (*Guía Metodológica Iniciativa Ciudades emergentes y sostenibles n.d.*)

The guide was designed specifically to be applied in middle-sized Latin-American cities that present similar characteristics of extension, population, and development, prioritizing problematics such as managing vulnerable areas towards natural disasters and the adaptation and mitigation of climate change confronting the city from multiple dimensions such as governability, environmental, social and urban development. The aims of the guide are: to reform the dimension of fiscal sustainability and governability and to amplify the pillar of local economic development and sustainability among the dimension of urban development through the management of local agendas as intermediate LA[1] cities have governmental autonomy and little support from the nation to execute strategic public projects.

Conceptually the dimensions of sustainability for the ICES guide are the following, in which the entire process is framed.

i. Environmental and Climate change

ii. Urban

iii. Fiscal and governability

The methodologic process to identify the sustainability challenges of a city starts with a quick diagnosis; a quantitative analysis using 130 indicators, then a technical qualitative analysis and last, generating the base studies that consist of: natural disaster vulnerability; climate change effects; urban growth analysis; fiscal manage-

1 .Latin-American cities.

ment and public safety; transport, competitiveness, water, and sanitation.

The preliminary diagnosis, as a result, delivers the baseline indicators that subsequently are compared to the standard ICES indicators.

The process of developing the action plan consists of 6 phases, from the preparation to the monitoring the application of results. The first four, consist in the preparation, diagnose and making of the action plan; the following two consist of the investment and finally the constant monitoring and adjustment. (See Figure 5.)

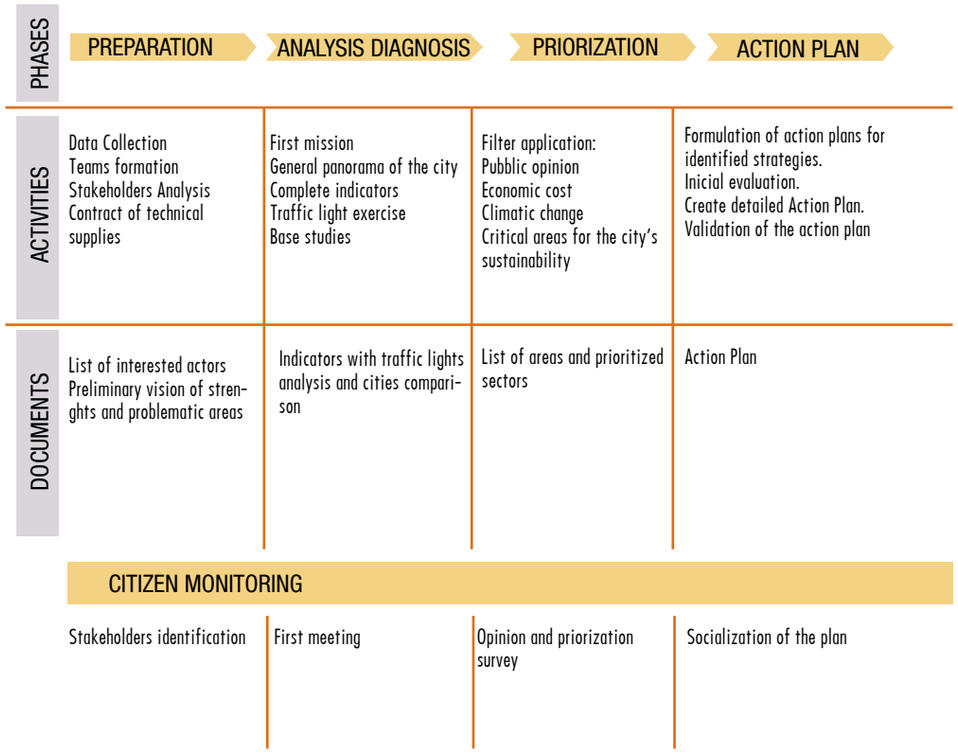

Figure 6. Scheme of functions and phases of the ICES Methodology. Source: *Guía Metodológica Iniciativa ciudades emergentes y sostenibles*

The preparation, called phase 0 by the guide, consists in the conformation of the team, recompilation of information to select the indicators through secondary sources, identifying the main actors in the city and defining the general vision of the city. The final document completed in this phase is a prioritizing process in which the critical aspects are determined, a sectorization process is made in order to locate each problem in a physical space, a first review of existing projects and strategies and preliminary proposal.

The following phase #1 consist of the analysis and diagnosis of the city. In this phase the process of identification of the problematics is started through the meetings between the community and the stakeholders, such as local officials, local entities like universities or NGO's who are in charge of organizing and analysing the recollected data, from the result of 130 indicators that cover the three dimensions of sustainability: climate change and environment, urban development, fiscal and governability. Classified in 11 pillars, 30 topics, and 67 sub-topics.

These indicators are a practical tool developed by the Ibero-American Bank of Development (BID) that help identify easily the critical problematics in LA cities. *See Anex A.

The results obtained from the 130 indicators can define the current situation of the city in each category when compared to standard values or benchmarks taken from other countries or cities. The indicators have three ranges: a green one if the result is adequate or good, a yellow one if the topic presents difficulties and red if the management of the topic is deficient. For this reason, the procedure of assigning a color to each indicator is referenced as the "traffic light" process. Benchmarking in the ICES methodology helps to determine which aspects of the city have more critic problematics and is the starting point to the definition of a process of prioritization through: an early diagnose of the city and the determination of the entities that have influence over the sector with the problematics; a description of current initiatives and projects that could solve or partially improve the problematics.

Phase 2 consists basically in the prioritization of the areas that in phase 1 resulted as critical for the development of sustainability in the city. The prioritization uses the base studies presented in phase 0 and 1 and by the survey of public opinion and is filtered by four filters or criteria: public opinion; economic impact, evaluating the economic benefits that solving certain problem would bring; climate change and risk vulnerability; multi-sectoriality, the relation between sectors when an intervention

is done. To each filter is given a score from 1 to 5, meaning that the ones with the higher score are a priority and those themes are analysed in more detail.

The aim of this phase is to leave clear which topics are the most critical to the city and need to be strategic projects in the action plan that is developed in the following steps. Some of the topics could require additional studies to the ones in phase 1, therefore the moment to define if they are needed or not is this phase.

Phase 3 comprehends the identification and development of strategies and actions for the prioritized areas identified in the previous phases. The methodology provides a step by step on how to elaborate the action plan.

The action plan includes the opportunities and risks of every project that is proposed as well as feasibility studies, schedules, pre-investment, and investment costs and possible financing fonts. The plan should consider the short and medium term regarding budget, management, execution, and monitoring. The plan could be considered the guide of the city towards sustainability.

The following phases constitute the execution stage, where the investment and monitoring of the development of the action plan take place. Phase 4 constitutes the studies of pre-investment which depends on which type of interventions were prioritized previously besides preparing every aspect regarding the terms of the recruitment.

Phase 5 consists in the proposal of a monitoring system not only of the implementation of the action plan but the measurement of progress solving the prioritized problems and the improvement of the sustainability of the city, through a data collection of the core indicators measured at the beginning.

In multiple LA countries the initiative has is being implemented in emergent cities, as entities are interested in replicating the methodology as a tool to prioritize public investment projects; for financing the implementation in each country exists different programs between experts and the BID to finance territorial entities be able to apply the methodology.

The indicators specifically are a major in the identification of the topics that mean a greater challenge in the achievement of sustainability. However, they do not help to recognize specific problems within the topics or to generate solutions. The role of the indicators is also to help to evaluate the progress of the city when implementing sustainability strategies.

The methodology has established a baseline of 60 indicators which are the ones that define the situation of a city when the data is collected. According to ICES, the indicators should meet the following criteria: representativeness, meaning that the indicators are able to represent fundamental aspects of urban sustainability and also can be easily translated into performance goals which favor monitoring; universality, the indicators search for the measuring of common elements that exist in most of the cities in the region; easiness of data collection, meaning that can be easily measured by data collection in order to simplify the step of analysis; and finally objectivity, the indicators are precise, easy to understand and can show verifiable facts.

2.2 Methodology Development

The general steps of the methodology are listed down below:

Step 1: Make a comparison between sustainability assessment methodologies (LEED & BREEAM)

Step 2: Select indicators targeted towards Sustainable Development Goal 11: Sustainable cities and communities.

Step 3:

- Compare indicators with ICES methodology.
- Define the categories, criteria, and indicators of the proposed index.

Results: Introduce the index in the context of the POT and urban development projects and assessment.

Future development: Ask for expert's opinions on the relevance of the proposed indicators and the correct instrument where to implement the developed framework.

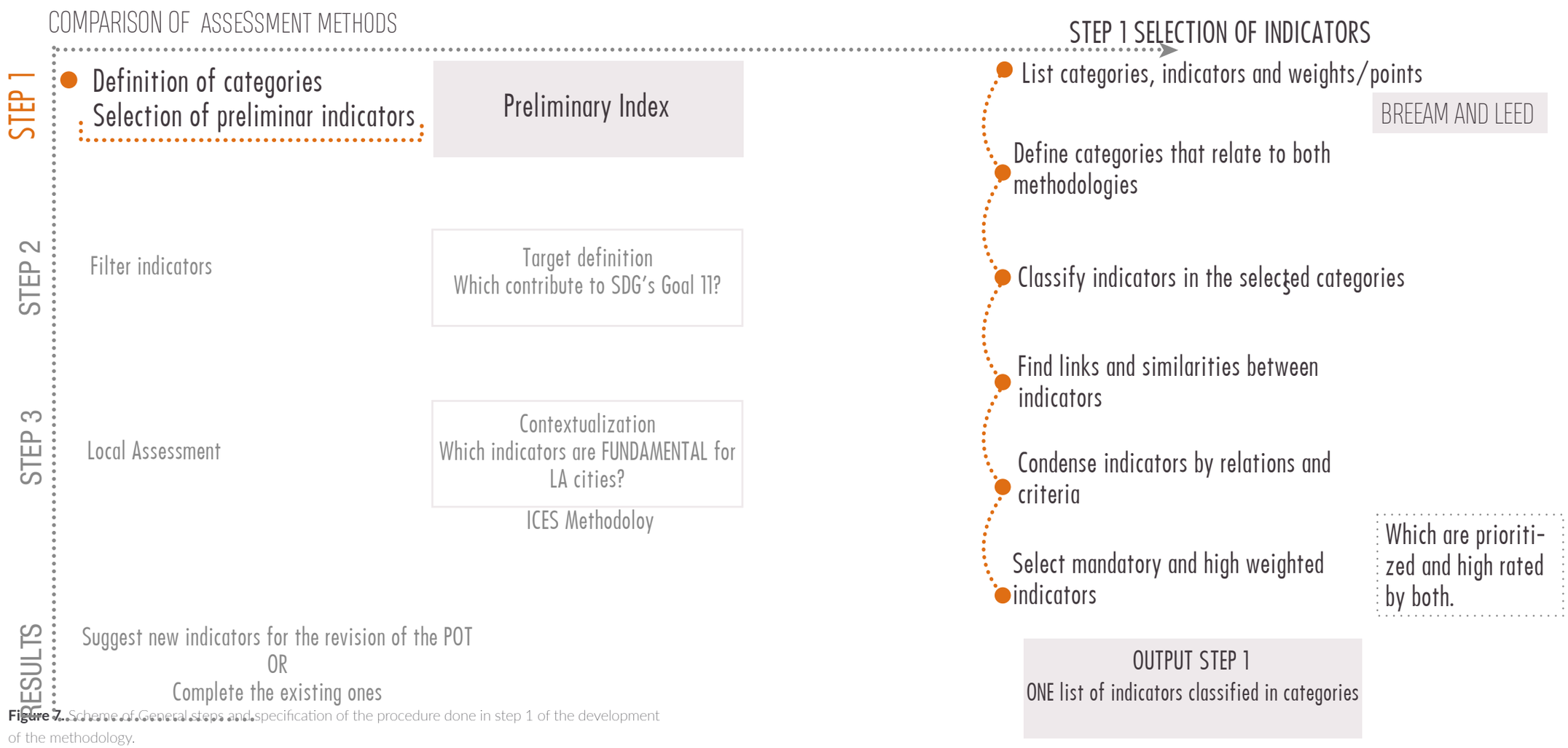

Figure 7. Scheme of General steps and specification of the procedure done in step 1 of the development of the methodology.

To achieve the purpose of this thesis, the proposed methodological approach consists of three analytical phases followed with consulting the opinion of experts about the final proposed index in order to validate the investigation and analysis. The result will be an index of indicators classified in categories and criteria that works as a compliment of the municipal expedient[1] which is the evaluation instrument of the POT. The main idea is to take as reference existing sustainability measurement frameworks to create one that can be adapted to the context of Cali, the city of study, considering the fact that no progress has been made regarding the orientation of urban projects towards sustainability outside its environmental dimension.

The comparison is made at a building level and a district/urban level, as the interest is to assess the progress of a city towards sustainability only the indicators at a district level will be taken into consideration. The indicators are divided into three categories that correspond to the three pillars of sustainability: environmental, economic and social.

As mentioned before, the frameworks chosen were LEED for Neighbourhood Development and BREEAM Communities, as are two of the most recognized and developed tools for sustainability measurement and also considering the scale of evaluation, an aspect that is also considered with selecting and comparing individual indicators and criteria. Is fundamental to understand the reasoning behind the

1 . *Expediente Municipal de Cali*. Is a system of urban information that comprehends documents, maps, data and georeferenced information that is used as an evaluation tool of the Land Use Plan (POT). (Alcaldia de Santiago de Cali- Expediente municipal, n.d.)

creation of an evaluation method for sustainability also considering that is a recent concept and has not been objectively defined, but for practicality is more efficient to adapt existing methodologies.

The methodology framework is divided into three main steps. Step # 1 consists in the comparison of the selected sustainable assessment methods LEED and BREEAM and the result of this first step, is a list of indicators that are common to both methodologies.

The use of indicators is supported by researchers as Verma and Raghubanshi, (2018) who say that indicators are a tool to measure progress towards achieving a goal, in this specific case defining targets for sustainability and help to inform the authorities that create policies to get a more real overview to the current state of the place, orientate development using the advantages that a place can provide as well as identifying weaknesses.

The comparison is made listing and analyzing every indicator in both methodologies (Is important to mention that each methodology has a different categorization and the indicators do not respond to the same definition, therefore not only what the methodologies name as indicators are considered, but also the criteria that the measurement has to fulfill.)

Shen et al. 2011, say indicators have to measure performance and that is important to include indicators in the process of urban sustainability assessment.

To achieve an objective comparison, was fundamental to find a classification that could respond to the criteria and indicators from both methodologies to avoid confusing what each methodology names differently to the other. The selection of the categories was considered the ICES methodology that is used in step 3 of the development of the thesis methodology to allow a more efficient organization from the beginning in correspondence with the last filter. The categories are Environmental sustainability and climate change, Urban Sustainability and Fiscal sustainability and governability. Within the first one are the topics; water, sanitation, waste management, energy, air quality, climate change, noise and risk vulnerability; in the second one, urban sustainability are included: land-use, Inequality, mobility, human capital, internationalization, productivity, business, innovation and employment and in the last one the topics are: financial sector, fiscal environment, business environment, connectivity, education, security, health, public management, participative public

BREEAM Communities

Indicator	Sub-Indicator	Mandatory	Weight
Governance			9,3%
	Consultation Plan	1-3	2,3%
	Consultation and engagement	1-3	3,5%
	Design review		2,3%
	Communiy Management of facilities		1,2%
Social and Economic wellbeing			42,7%
Local economy	Economic Impact	1	8,9%
	Training and skills		5,9%
Social Wellbeing	Demographic needs and priorities	1-2	2,7%
	Flood risk Assessment	1-3	1,8%
	Noise Pollution	1	1,8%
	Housing provision		2,7%
	Delivery of services, facilities and amenities		2,7%
	Public realm		2,7%
	Microclimate		1,8%
	Utilities		0,9%
	Adapting to climate change		2,7%
	Green Infrastructure		1,8%
	Local Parking		1,8%
	Flood risk Management		1,8%
	Local vernacular		
	Inclusive design		
	Light pollution		0,9%
Resources and energy			21,6%
	Energy Strategy	1	4,1%
	Existing buildings and infrastructure	1-2	2,7%
	Water strategy	1-2	2,7%
	Suitable Buildings		4,1%
	Low Impact Materials		2,7%
	Resource efficiency		2,7%
	Transport carbon emissions		2,7%
Land use and ecology			12,6%
	Ecology strategy	1-6	3,2%
	Land use	1-2	2,1%
	Water pollution		1,1%
	Enhancement of ecological value		3,2%
	Landscape		2,1%
	Rainwater harvesting		1,1%
Transport and Movement			13,8%
	Transport assessment	1-3	3,2%
	Safe and appealing streets		3,2%
	Cycling network		2,1%
	Access to public transport		2,1%
	Clycling facilities		1,1%
	Public transport facilities		2,1%

Table 1. List of indicators from BREEAM for Communities. Source: BREEAM Communities Technical Manual.

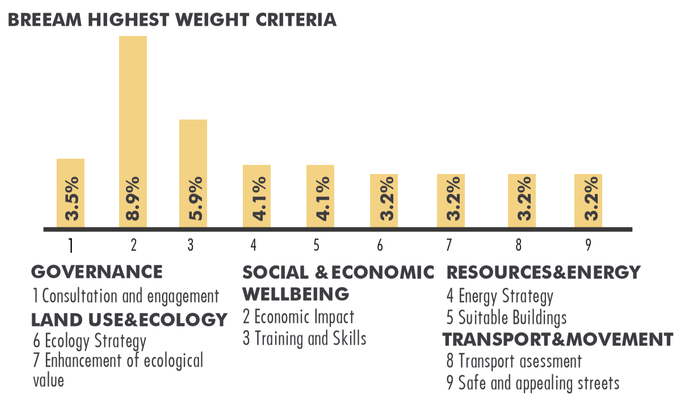

Figure 8. Bar graph indicating the highest weighted criteria from BREEAM Communities.

LEED for ND Indicator	Sub-Indicator	Required	Points
Smart Location and Linkage	Smart Location	X	
	Imperiled Species and Ecological Communities Conservation	X	
	Wetland and Water body conservation	X	
	Agricultural Land Conservation	X	
	Floodplain Avoidance	X	
	Preferred Locations		10
	Brownfield Remediation		2
	Access to Quality Transit		7
	Bicycle Facilities		1
	Housing and jobs Proximity		3
	Steep Slope Protection		1
	Conservation		1
	Restoration of Habitat or Wetlands and Waterbodies		1
	Long-Term Conservation Management of Habitat or Wetlands and Waterbodies		1
Neighborhood Pattern and Design	Walkable streets	X	12
	Compact development	X	
	Connected and Open Community	X	
	Walkable streets		
	Compact development		6
	Mixed-Use Neighborhoods		4
	Housing types and Affordability		7
	Reduced Parking footprint		1
	Connected and Open Community		2
	Transit Facilities		1
	Transportation Demand Management		2
	Access to Civic and Public Space		1
	Access to Recreation Facilities		1
	Visitability and Universal Design		1
	Community Outreach and Involvement		2
	Local Food Production		1
	Tree-Lined and Shaded Streetscaes		2
	Neighborhood Schools		1
Green Infrastructure and Buildings	Certified Green Building	X	5
	Minimun Building Energy Performance	X	
	Indoor Water Use Reduction	X	
	Construction Actitivy Pollution Prevention	X	
	Certified Green Building		
	Optimize Building energy performance		2
	Indoor Water Use Reduction		1
	Outdoor Water use reduction		1
	Building reuse		1
	Historic Resource Preservation and Adaptavite Reuse		1
	Minimized Site Disturbance		1
	Rainwater management		4
	Heat Island Reduction		1
	Solar orientation		1
	Renewable Energy production		3
	District heating and cooling		2
	Infrastructure Energy Efficiency		1
	Wastewater Management		2
	Recycled and reused Infrastructure		1
	Solid Waste Management		1
	Light Pollution Reduction		1

Table 2. List of indicators from LEED for ND. Source: Reference guide for neighbourhood development (USGBC).

management, taxes and financial autonomy, public expenditure management and fiscal sustainability.

The 51 criteria from LEED-ND and the 53 from BREEAM are divided into five categories that respond to different topics, therefore the first thing to do in step 1 is to find the links between the indicators between both methodologies, as some of the

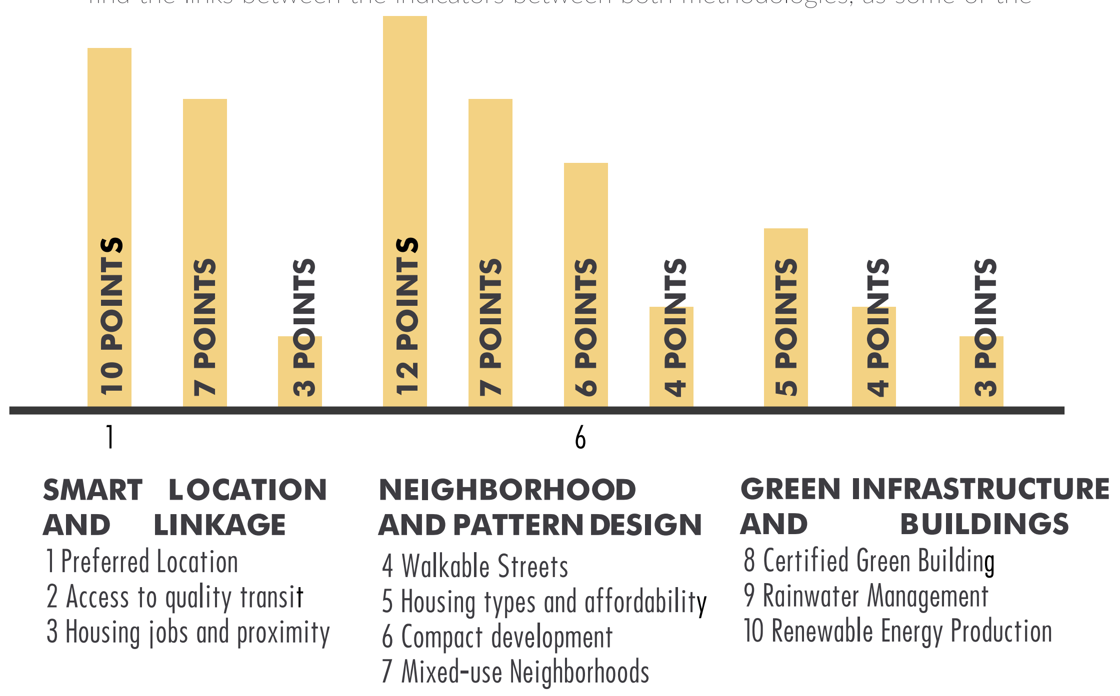

Figure 9. Bar graph indicating the highest rated criteria from LEED ND.

indicators from one methodology could replace several from the other, for example, water strategy an indicator in BREEAM can contain according to its requirements four indicators from LEED such as indoor water use reduction, outdoor water use reduction, site design for habitat or wetland and waterbody conservation. Which are related at the same time to the topic water in ICES.

The objective of grouping the indicators is to try and narrow the list as much as possible and using the indicators included in others as sub-indicators for the following steps. The categories that present the same situation as water are: land-use, mobility, energy and waste management.

One of the limitations of the investigation is the scale for which the indicators were designed, being for both cases neighbourhood/urban small developments; since the resulted framework is to be applied in a city scale.

To confront this issue, some of the indicators such as the BREEAM indicators local

Figure 10. LEED for ND mandatory criteria.

vernacular, which refers to a new development that maintains the identity of the place, with the use of colors materials, height and architectural style; low impact materials which is a criteria applicable for buildings or small compounds; and LEED indicators such as smart location, which refers to choosing the most adequate and served location for a new development; floodplain avoidance which refers to avoiding locating the project in a risk area; and preferred location.

However, some indicators that are created to be applied to a smaller scale still have coherence and can be developed on a larger scale such as energy strategy, land use and access to public space. The criteria advised from these indicators can be applied to the urban scale since the strategies for their development can be the same, what changes in this case are the parameters of evaluation and the benchmarks, which are going to be modified and taken further on in the development of the methodology by measurements that are applied in cities.

Figure 11. Circles diagram that explains which indicators from BREEAM and LEED are contained within others, to consider as a single indicator with multiple criteria.

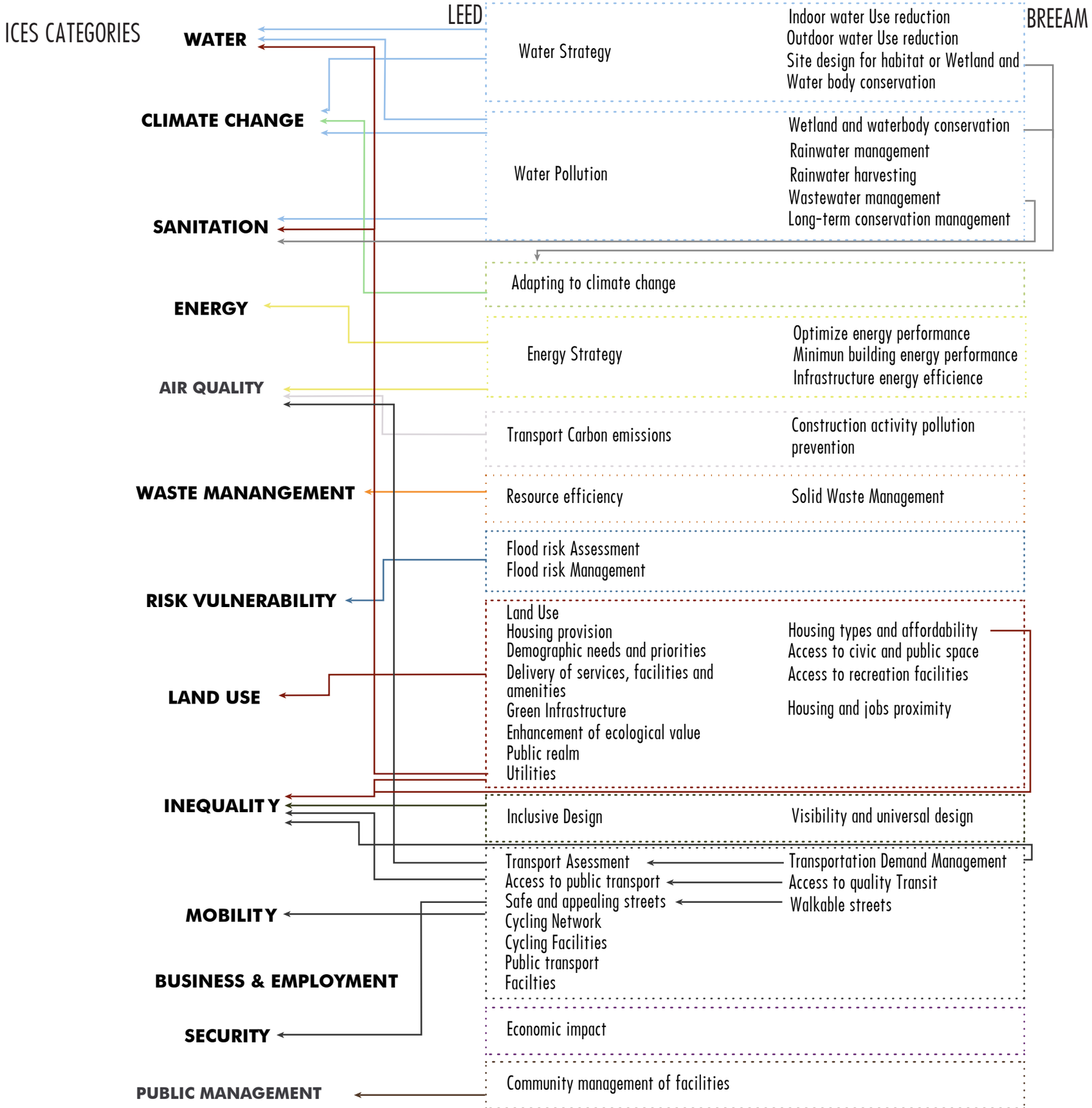

Figure 12. Scheme of links between the proposed categories and indicators from LEED & BREEAM.

This hepls the selection of the final categories.

Multiple indicators relate to different categories from ICES as shown in the graph above (See Figure 11), but what is considered for the final classification as a priority is the indicator that contains multiple from the other category, for example the BREEAM indicator Safe and appealing streets relates to security but is contained in the mobility and transport category from LEED, for the classification is going into mobility and the same criteria applies for the rest of the indicators. (See Figure 10)

After having clear the relations between the indicators from both methodologies, still, the list of indicators results too extent for the purpose of the thesis, therefore for narrowing the number of indicators the mandatory criteria are taken in consideration, that in most cases are indicators that correspond to both methodologies.

In the case of BREEAM, that the indicators are weighed within each category the criteria for choosing the highest weights is looking each category and selecting the highest scores that are slightly below and above the mean of percentage. For example the category social and economic wellbeing weights 42,7% making the mean percentage 2,8%, the first choice is the percentages above the mean being the indicators economic impact and training and skills, but as that would reduce the number of indicators heavily, is decided to also include the indicators that are the closest above the mean, being the ones that weight 2,7%: demographic needs and priorities, housing provision, delivery of services facilities and amenities and adapting to climate change.

In the LEED methodology the rating is different because they use required criteria

and additional credited criteria rather than weighting each indicator with a percentage of the total; therefore the strategy to choose the indicators from this methodology is to take the required criteria and the indicators that provide the most points.

To achieve the result table of indicators, was necessary to evaluate closer all the criteria from the indicators that include a series of more specific criteria and could be named differently. In the category water, for example, the indicator water strategy from BREEAM is too broad and multiple indicators from LEED are contained in it. The mandatory criteria from BREEAM are appropriate water consumption, and appropriate coverage of the water demand that could correspond to indoor and outdoor water use reduction. For this reason, the indicator was renamed as water supply and water pollution. Likewise, with the energy category, the indicator name instead of being energy strategy is changed into energy supply containing the sub-indicators energy supply-demand and energy consumption efficiency. (See Table 3)

The resulting categories from this step are apart from water and energy; waste, risk vulnerability, land-use, mobility and business, and employment. (See Table 4)

*Based on ICES Methodology

	Category	Topic	LEED Indicators	Required	BREEAM	Mandatory
Environmental	Environmental sustainability and Climate Change	Water	Wetland and Water body conservation	X	Water strategy	X
			Site Design for Habitat or wetland and Water body Conservation		Water pollution	
			Restorarion of Habitat or Wetlands and Waterbodies			
			Long-Term Conservation Management of Habitat or Wetlands and Waterbodies			
			Indoor Water Use Reduction	X		
			Outdoor Water use reduction			
			Rainwater management		Rainwater harvesting	
		Sanitation	Wastewater Management			
		Waste Management	Solid Waste Management		Resource efficiency	
		Energy	Infrastructure Energy Efficiency		Energy Strategy	X
			Minimun Building Energy Performance			
			Optimize Building energy performance			
		Air Quality	Construction Actitivy Pollution Prevention	X	Transport carbon emissions	
		Climate Change			Adapting to climate change	
		Noise			Noise Pollution	X
		Risk Vulnerability			Flood risk Assessment	
					Flood risk Management	
Socio-economic	Urban Sustainability	Land-Use	Compact development	X	Land use	X
			Housing types and Affordability		Housing provision	
			Mixed-Use Neighborhoods		Demographic needs and priorities	X
			Access to Civic and Public Space		Delivery of services, facilities and amenities	
			Access to Recreation Facilities		Green Infrastructure	
			Housing and jobs Proximity		Enhancement of ecological value	
					Public realm	
					Utilities	
		Inequality	Visitability and Universal Design		Inclusive design	
		Mobility	Transit Facilities		Transport assessment	X
			Transportation Demand Management		Access to public transport	
			Walkable streets	X	Safe and appealing streets	
			Access to Quality Transit		Cycling network	
					Cycling facilities	
					Public transport facilities	
		Human Capital				
		Internationalization				
		Productivity				
		Bussiness			Economic Impact	X
		Innovation				
		Employment				
Economic	Gobernability	Financial Sector				
		Fiscal environment				
		Bussiness Environment				
		Connectivity				
		Education				
		Security				
		Health				
		Public management			Communiy Management of facilities	
		Participative public management				
		Taxes and Financial Autonomy				
		Public expenditure management				
		Fiscal sustainability				

Table 3. Classification of indicators in the proposed categories.
The highlighted indicators make reference to the highest rated and selected.

CATEGORY	NEW INDICATOR	SUB-INDICATORS/CRITERIA
WATER	Water supply	Meet water demand
		Indoor and Outdoor water consumption reduction
		Wetland and waterbody conservation
		Rainwater use
	Water pollution	Drainage plan
		Conservation of wetland and waterbodies
ENERGY	Energy Supply	Meet energy demand
		Energy consumption efficiency
WASTE	Solid Waste Management	Meet waste disposal demand
		Reduce waste production from construction
RISK VULNERABILITY	Management of risks	Flood risk management and assessment
	Adaptation to climate change	
LAND-USE	Housing provision	Meet housing demand
		Housing affordability
	Demographic needs and priorities	Access to green suitable green spaces
		Access to suitable public spaces
		Jobs availability
		Delivery of services and facilities
		Ensure urban safety
		Inclusive design
	Land-use strategy	Compact development
		Mix-use neighborhoods
	Utilities	Meet public services demand
	Enhancement of ecological value	Protect existing natural habitats
MOBILITY	Transport assessment	Meet transport demand
		Access to public transport
		Public transport facilities
		Cycling network
		Cyclng facilities
	Access to quality transit	Transit facilities
	Walkable streets	Safe and appealing streets
BUSINESS AND EMPLOYMENT	Economic Impact	Development that generates jobs
		Complimenting existing economic activity
		Attract inwards investment

Categories taken from ICES methodology

Table 4. Result of Step 1 of the merhodology. A summarized table of the main indicators in LEED and BREEAM.

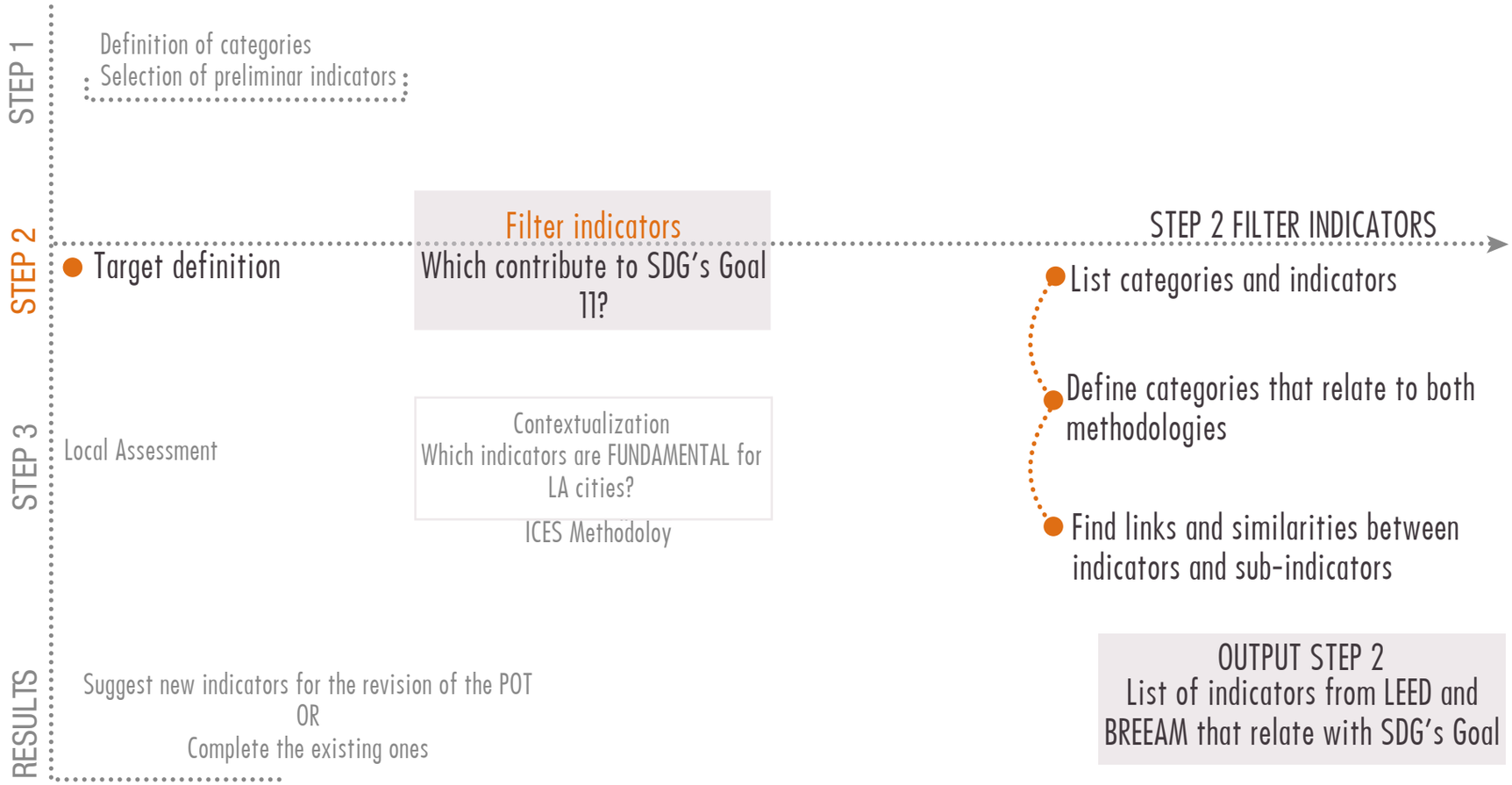

Figure 13. Scheme of General steps and specification of the procedure done in step 2 of the development of the methodology.

Step 2 consists in defining the target of the indicators selection and filtering the framework. For this thesis and according to the context of the case study, the target of the evaluation is to establish an effective measurement of sustainability in a city scale; due to this reason the UN sustainable goals are used as a reference and specifically the Goal number 11: Sustainable cities and communities. This goal establishes the importance of accommodating the growing population in affordable and quality housing, public spaces green areas and efficient public transport encouraging sustainable urban planning and management. Consequently, the filter to the indicators from step 1 the targets and indicators from the UN's development goals are used.

First, same as in step one a categorization of the indicators was made, corresponding the categories from the ICES methodology used before.

Goal 11 has eleven main targets each with an indicator and three additional indicators that were classified in the categories: housing, public transport, land-use, heritage, risk vulnerability or adapting to climate change, waste management, air quality, public space, and safety.

The objective of giving a category to each target is to select only the categories from step 1 that contribute with goal 11. The categories that are common between both tables are waste, risk vulnerability, land-use, and mobility; discarding water, energy and business and employment. (See Figure 13 and 14)

The indicators proposed by the United Nations are more specific than the ones presented by BREEAM and LEED, thus are used as a complement description and definition of the sub-indicators. For example, in the category waste, the criteria are meet waste disposal demand and the indicator that gives the definition of a measurable item which is the proportion between disposed waste and correctly discharged solid waste.

For multiple criteria from step 1, the indicators in this step apply the same procedure as with the waste indicator, which achieves a more complete table of assessment as presented below. (See Table 5)

BY 2030

Safe and affordable housing and basic services and upgrade slums.

HOUSING

BY 2030

Provide access to safe, affordable, accessible and sustainable transport systems for all.

MOBILITY

BY 2030

Enhance inclusive and sustainable urbanization and capacity for and sustainable human settlement planning and management.

URBAN PLANNING

BY 2020

Increase the number of cities that implement policies towards inclusion, resource efficiency and adaptation to climate change.

CLIMATE CHANGE

Strengthen efforts to protect and safeguard the world's cultural and natural heritage.

HERITAGE

BY 2030

Provide universal access to safe, inclusive and accessible, green and public space.

NATURAL DISASTERS

BY 2030

Reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management.

AIR QUALITY-WASTE

BY 2030

Provide universal access to safe, inclusive and accessible, green and public space.

PUBLIC SPACE

Support least developed countries, including through financial and technical assistance, in building sustainable and resilient buildings utilizing local materials.

BUILDING MATERIALS

Support positive economic, social and environmental links between urban, peri-urban and rural areas by strengthening national and regional development planning

URBAN PLANNING

Figure 14. Targets of SDG 11 with an assigned category

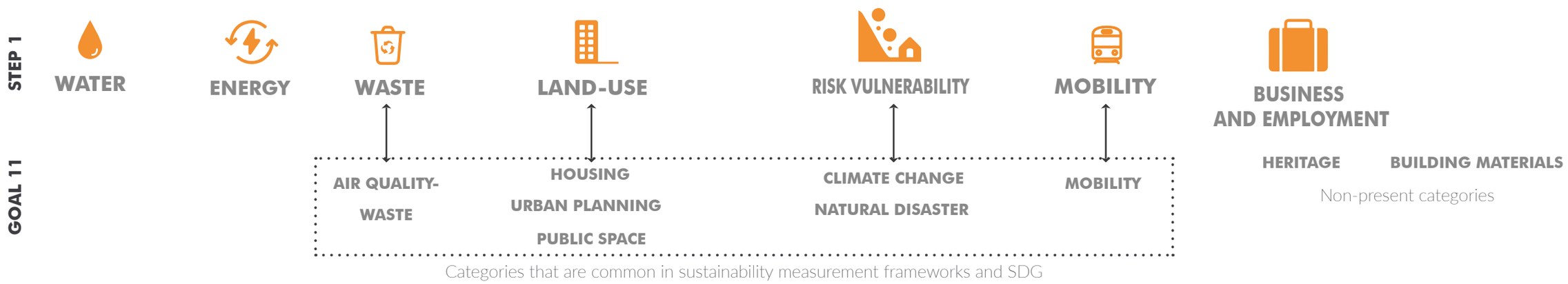

Figure 15. Scheme of the categories that are present in the resulted framework of step 1 and SDG 11.

SDG's GOAL 11 INDICATORS

AIR QUALITY- WASTE Annual mean levels of fine particulate matter (e.g. PM2.5 and PM10) in cities (population weighted).

Proportion of urban solid waste regularly collected and with adequate final discharge out of total urban solid waste generated, by cities.

HOUSING Proportion of urban population living in slums, informal settlements or inadequate housing.

URBAN PLANNING Proportion of cities with a direct participation structure of civil society in urban planning and management that operate regularly and democratically.

Ratio of land consumption rate to population growth rate.

11.a.1 Proportion of population living in cities that implement urban and regional development plans integrating population projections and resource needs, by size of city.

PUBLIC SPACE Average share of the built-up area of cities that is open space for public use for all, by sex, age and persons with disabilities.

CLIMATE CHANGE Proportion of financial support to the least developed countries that is allocated to the construction and retrofitting of sustainable, resilient and resource-efficient buildings utilizing local materials.

NATURAL DISASTERS Number of deaths, missing persons and persons affected by disaster per 100,000 people.

Direct disaster economic loss in relation to global GDP, including disaster damage to critical infrastructure and disruption of basic services.

Number of countries that adopt and implement national disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015–2030.

MOBILITY Proportion of population that has convenient access to public transport, by sex, age and persons with disabilities.

HERITAGE Total expenditure (public and private) per capita spent on the preservation, protection and conservation of all cultural and natural heritage, by type of heritage (cultural, natural, mixed and World Heritage (Centre designation), level of government (national, regional and local/municipal), type of expenditure (operating expenditure/investment) and type of private funding (donations in kind, private non-profit sector and sponsorship).

(Sustainable Development Goals Knowledge Platform.)

TOPIC	CATEGORY	NEW INDICATOR	GOAL 11 INDICATORS
WASTE	Solid Waste Managemen	eet waste disposal demand Reduce waste production from construction	Proportion of urban solid waste regularly collected and with adequate final discharge out of total urban solid waste generated, by cities.
RISK VULNERABILITY	Management of risk sF	lood risk management and assessmen t	Number of deaths, missing persons and persons affected by disaster per 100,000 people. Direct disaster economic loss in relation to global GDP, including disaster damage to critical infrastructure and disruption of basic services. Number of countries that adopt and implement national disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015–2030.
	Adaptation to climate change		
LAND-USE	Housing provision	Meet housing demand	Proportion of urban population living in slums, informal settlements or inadequate housing.
	Demographic needs and priorities	Housing affordability Access to green suitable green space s Access to suitable public spaces Jobs availabilit y	Average share of the built-up area of cities that is open space for public use for all, by sex, age and persons with disabilities.
		Delivery of services and facilities	
	Land-use strategy	Ensure urban safety Inclusive design Compact developmen t Mix-use neighborhoods	Proportion of cities with a direct participation structure of civil society in urban planning and management that operate regularly and democratically. Ratio of land consumption rate to population growth rate. Proportion of population living in cities that implement urban and regional development plans integrating population projections and resource needs, by size of city.
	Utilities	Meet public services deman d	
	Enhancement of ecological value	Protect existing natural habitats	
MOBILITY	Transport assessment	Meet transport demand Access to public transport Public transport facilities Cycling network Cycling facilities	Proportion of population that has convenient access to public transport, by sex, age and persons with disabilities.
	Access to quality transit	Transit facilities	
	Walkable streets	Safe and appealing streets	

Table 5. Resulted Table from step 2 of the methodology. Framework of specified indicators.

The result of step 2 shows a table of indicators that measure sustainability in a neighborhood or city scale and is related only to the UN's goal 11, but still lacks relation with the context of the case study, as mentioned before is important to increase the accuracy of the assessment. Step # 3 is the contextualization of the indicators in the city, based in the assessment framework ICES, completing the table of indicators resultant from step 2. (See Table 5.)

Figure 16. Scheme of the procedure in step 3 of the methodology.

As the categories from step one were selected to correspond with the ICES methodology, the first step was to confront the categories from the UN's global indicators and select only the categories and topics that relate to goal #11, in this case they are land-use, mobility, vulnerability towards natural threats regarding climate change, solid waste management, and air quality.

As the ICES methodology's indicators are aimed to evaluate and rate the progress of a city and prioritise the projects that should be executed are specific and focus on the fulfillment of people's basic needs to ensure the quality of life that the city and

local government should provide. Thus, the indicators work to define the focus of the measurements of the criteria from the steps before.

The result of this step is a table that still lacks definition in the categories that contain multiple criteria and the indicators are not included in the ICES methodology, therefore is completed with the indicators and criteria from each methodology from step 1. Also, as part of the contextualization with the case study, the indicators that exist already as an assessment of the progress of the city of Cali, present in the municipal expedient are added to the final table or are used to specify the definition of some of the indicators from the steps before.

To achieve a more feasible index of indicators the developed one was complemented with extra information to clarify the availability of data or how to collect it when is not available. The extra criteria were: Assessment method, Parameter for assessment and Type of calculation (Qualitative or Quantitative). (Refer to table 8.)

As well as with the development of the definitions of the indicators, that were taken either from the methodologies from step 1 and 2 or the UN's definitions, when an indicator corresponded with the listed criteria of another indicator even when it was not directly included in the final selection; in the addition of the extra criteria the same principle was applied.

For most of the cases the results of the indicators do exist in statistical platforms, or the data required to calculate a result are available, as data from the assessment of results from private companies that provide public services, for example: The water service, sewage system, and energy, the waste collection, internet, public transport are all provided by semi-private companies, thus manage their own database and analysis but are not included in the system of assessment of the land-use plan, which is the ideal urban development tool to include and implement sustainable strategies.

The tables --- show the final result of the framework of assessment of sustainability-focused in the SDG #11.

PILAR		#INDICATOR	INDICATOR	DEFINITION
LAND USE	Housing	43	Percentage of housing unist that don't satisfy the habitability national standards	Percentage of housing units in inferior conditions than the national standards
		44	Cuantitative housing deficit	(Quantity of homes - quantity of housing units) / Quantity of homes
MOBILITY	Planned and managed public transport	61	Planning and management transport system	This indicatior aims to establish if the city counts with an adequate planning and management system. According the anwer of three questions: 1. Is there a recent survey (2 years max of origin/destination covering the metropolitan area) 2.IS there a transportation masterplan published based on the survey or backup studies? 3.Has the city implemented a transport management system that include
	Affordable transport	62	Affordability index	(Amount of trips a month per person x Average cost of trip)/(Per capita income of the lowest earning quintile of the population)
LAND USE	Density	41	Annual rate of the urban print growth	Average of the annual growth rate within the official city limits
	Land use planning	47	Existence and applicability of a current land plan	The city has a land plan use that include zonification with environmental protection and preservation areas and is currently implemented
VULNERABILITY TOWARDS NATURAL THREATS REGARDING CLIMATE CHANGE	Vulnerability against risks of natural origin	39	Fundamental infrastructure in risk situation because of inadecuate construction or located ir a non mitigable risk area	Percentage of public fundamental infrastructure vulnerable to natural threats
		40	Percentage of homes in risk because of inadequate construction or located in a non mitigable risk area	Percentage of homes in risk due to insecure roofs or floors or because are located in a non mitigable risk area
SOLID WASTE MANEGEMENT	Adequate removal of solid waste	11	Percentage of solid waste spilled in landfills	
		12	Remaining life of the soil in which the landfill is located	
	Solid waste treatment	13	Percentage of solid waste in the city discarded in dumps, controlled waste lands, water bodies or burned	
		14	Percentage of solid waste in the city that are composed	
		15	Percentage of solid waste in the city sorted out and classified for recycling	
AIR QUALITY	Concentration of air pollutants	26	Air quality Index	Amount of noxious pollutants in the air measured by the air quality index
		27	Concentration of PM10	Particulate material in suspension with an inferior diameter to 10 µm, average of 24 hours (µg/m3)
LAND USE	Green and recreation areas	45	Green areas for every 100.000 inhabitants	Hectares of permanent green areas for 100.000 inhabitants
		46	Public spaces for every 100.000 inhabitants	Hectares of opened air and access public space for 100.000 inhabitants

Table 6. List of indicators from the ICES methodology related to goal 11. Source: *"Guía Metodológica: Iniciativa Ciudades Emergentes y Sostenibles."*

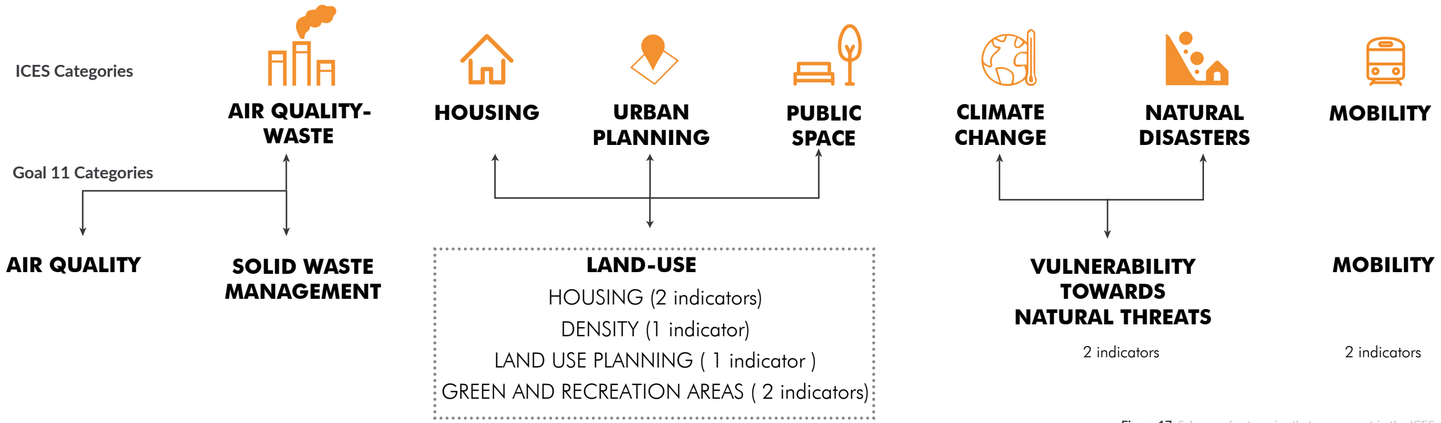

Figure 17. Scheme of categories that are present in the ICES methodology and SDG 11.

2.3 Case Study

The selection of the case study was based on the idea of developing a system that could help improve sustainable development in Latin-American communities, inspired in the application of the UN's Sustainable Development Goals.

The methodology is applied in Cali, Colombia considering that there has been from little to no progress regarding the compromises that were taken by the nation regarding sustainable development in 2016 and the articulation of existent policies with an updated framework that can be implemented with the current urban development policies.

Cali is an intermediate city and the third most populated of the country with 2'400.000 inh. Located in the southeast of Colombia. Officially named Special District and main city in a metropolitan area of more than 3million inhabitants.

Because of its strategic location and environmental richness, the development of the country has made it into one of the main economic centres in the country and the main one in the southeastern area of the country, being the main cultural, industrial

and agricultural pole.

For multiple reasons including the facility for industrial development and severe migration from the countryside to the city, Cali has been growing at an exponential rate in population and land occupation during the last fifty years. The dynamics occurred in the city and the country during this time, in which the city has not been able to adapt to the pace of growth, stalled the city as an economic and investment core in the country. Attempting to generate instant solutions in order to mitigate the upcoming problems, while starting a process of planning and organization of the city, the prioritization of solutions has been left behind.

Figure 18. Localization map of Cali, Colombia.

The challenge is to recover the city's relevance in a national and regional scale, with the objective of turning it into a focal point of new opportunities to its inhabitants. In addition, is mandatory to consider its potential as a metropolitan area, in order to generate articulated strategies and policies that benefit a common vision, the population and contribute to sustainability.

In Colombia, the concept of "sustainability" was introduced in the constitution of 1991, which gave Colombian law a modern perspective that considers human rights and obligations regarding the environment. But was only in 1993, as a response to the UN Conference in Rio de Janeiro about environment and development that

the Environment and sustainability ministry[1] , the Environmental National system (*SINA Sistema Nacional Ambiental*) and the National Environmental Council, which are the entities in charge of regulating and managing environmental matters in a National Scale, and are also in charge of dictating principles for land management. The hierarchy is headed by the ministry which is the public entity that manages the environment and renewable resources nationally, in order to promote sustainable development and consumption; the entity following is the SINA, orientates laws and legislation that allows the functioning of the environmental principles in the law throughout the entities in every scale that are entailed to the ministry; becoming one of the most important institutions in sustainable and environmental matters. Is

Figure 19. Panoramic view of Cali. Source: *Raúl Palacios / El Pais*

constituted by the ministry of environmental and sustainable development, the Regional autonomous corporations (*Corporaciones regionales autónomas*), Sustainable development corporations, Territorial entities and investigation institutions ascribed to the ministry.

1. In the law 99 of 1993, which created the ministry of environment was presented the concept of sustainability and goals of economic development.

"The Environmental national system and the National Department of planning have defined coordination and consultive instances to orientate the policies, normativity, and management of the environmental sector. In Colombia is highlighted that even when it does not exist a proper organism with the designation of 'National sustainable development council' there are organizations designated with the same functions: The Environmental national council and the National economic and social policies council (CONPES, the superior organ in charge of the planning the development of the country)" (Sanchez L 2013).

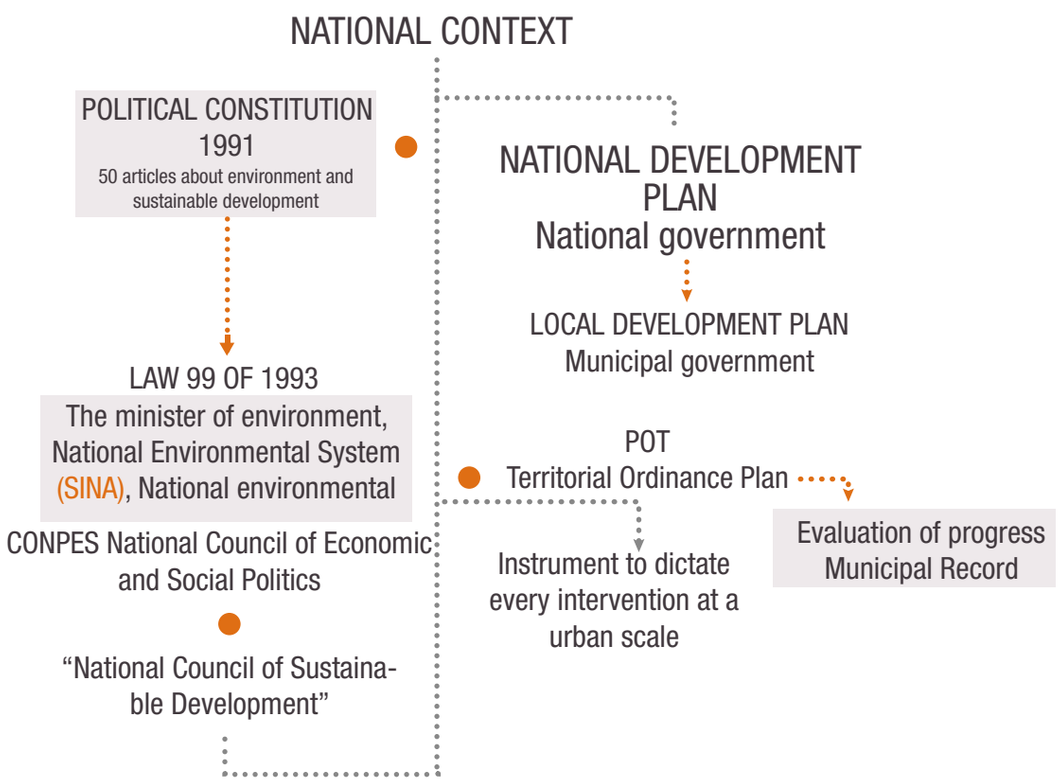

Figure 20. Scheme of the hierarchy of urban regulation instruments in Colombia. From the national scale to the city scale.

Sustainability being a concept so hard to define and specify is left to interpretation, and when is combined with development it's focus changes progressively to economic development rather than overall sustainability (Verma and Raghubanshi 2018). For this motive, the definition presented in Colombian law should be consequent with every policy related to sustainability.

Sustainable development in Colombia revolves around the idea of economic growth since the concept was introduced globally in the '80s, as it became evident that industrialization started damaging significantly natural resources and environments. Sustainable development was defined by the Law of 1993 art.3 as the leader to economic growth, elevation of quality of life, social wellbeing, without the exhaustion of renewable resources in which is grounded, nor the deterioration of the environment or as the right of future generations to use them to satisfy their own needs. (Germán 2002)

Even though the concept of sustainability was introduced in planning instruments and normativity since 1993, it was not until the 2000's that policies were officially introduced by CONPES .

A problematic with the correct functioning of this institutions is that following the procedures specified the articulation between the legislation in a national scale and those on a territorial scale are not clarified or verified, as the law is based mainly on the natural areas declared important to the conservation of the environment nationally, lacking criteria and guidance when establishing planning policies in the city scale, which is the most important for actual quality of life improvement and application of sustainable strategies. Additionally, as the ministry was evidently created to regulate the exploitation of renewable resources, neglects dimensions of sustainability related to land regulation, urban planning and development, and social-oriented projects.

The instrument to specify and update the planning and execution guidelines is dictated by each government in every scale is the development plan. Is mandatory to consider that the instrument strictly related to land-use policies is the territorial ordinance plan (POT), which is renovated every 12 years (Period that is still discussed if is pertinent, given that is where projects at medium and long-term are stipulated and could take an execution time of more than 15 years) consequently is just being developed in smaller scaled cities, with a lower amount of inhabitants. The development plans, called '*Plan de desarrollo municipal* (PDM)' are renovated with each

government, meaning every 4 years. According to the development plan's law[1] , these two instruments have to perform together when it comes to decision making among the territory. The flaw in this disposition is that is left to each government's discretion the transition between one plan and other and the cohesion with the national development plan.

The current POT in Cali was formulated and proposed in 2014 and is the updated version of the first one that was valid in the period 2000-2014. This new plan intends to solve the problems caused by the unplanned growth, faults and legal gaps that the old plan allowed; also proposes a new model of what the city should become by recognizing that every system in the city is dependent on the others

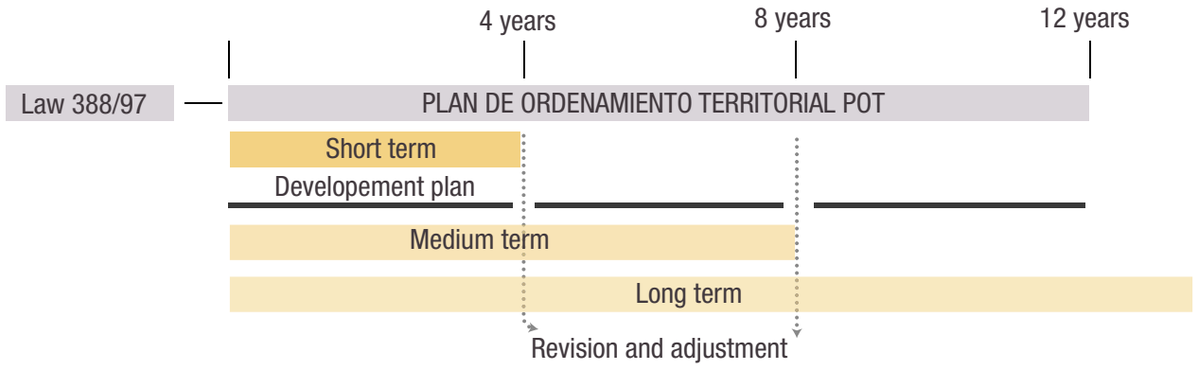

Figure 21. Scheme of the duration of the validity of planning tools in Colombia.

and understand the city as a network. Among the new proposals, the plan needed to include more sustainable options for environmental, construction, occupation and transport policies as well as the disposition to adopt urban projects that could help to improve urban sustainability.

The general vision of the POT is to order the territory strategically to enhance the quality that it already offers, throughout the articulation of the urban and rural components and the concertation of a regional development agenda. As well as creating an ideal scenario to achieve environmental sustainability, focusing on water resources and risk prevention.

Is structured in 6 titles, divided by general component, urban component, rural component, strategic projects, complementary planning, and management instruments and annexes. The component in which sustainability is mentioned and the plan makes a focus in it, is in the general component, regarding environmental management and quality and mitigation and adaptation towards climate change in the articles 102 and 103.

Article 103, talks specifically about sustainable construction and dictates to generate sustainability conditions in the territory and improve the quality of the habitat. Delegates the environmental and planning authorities to create the manual for sustainable construction, where strategies, action plan, and instruments to promote sustainable development in the city are listed. Using as resources: energy efficiency and the introduction of alternative fonts of energy, water saving and reuse, the use of recyclable materials in construction, adaptability to the climate and introduction of green coverage in construction.

> *"Article 102. Strategies of mitigation and adaptation to climate change. In the short term the Administrative Department of Environmental Management (DAGMA)[2] conjointly with the Autonomous Regional Corporation of the Valle del Cauca (CVC)[3] in the frame of their legislative powers will consolidate the strategies of adaptation to climate change based on the analysis and construction of climatic variability scenarios, through the formulation of the Municipal Action Plan of Mitigation and Adaptation to Climate Change, that includes he management of the Municipal Ecological Structure and the monitoring of gases emission that affect the urban quality"* (Plan De Ordenamiento Territorial Acuerdo 0373 de 2014, 2014)

An important aspect to emphasize from the POT is that has a series of what they call strategic projects, which are a set of actions focused in the fulfillment of the goals of the territorial ordinance; are considered high impact generators in the territorial structure and have significant positive transformers. A particularity about strategic projects is that they incorporate different dimensions of the territory meaning that

1 Ley 152 de 1994. Ley Orgánica del Plan de Desarrollo.

2 DAGMA *Departamento Administrativo y de Gestión del Medio Ambiente*, Is the entity in charge of managing the environment in Santiago de Cali and the highest authority inside the urban perimeter. (Alcaldía de Santiago de Cali DAGMA, n.d.)

3 CVC *Corporación Autónoma Regional del Valle del Cauca*, Is the entity in charge of managing the environment in a Regional scale and promote the integral development of the region. (CVC, n.d.)

they need different instances of management. Is relevant to mention that the strategic projects involve an urbanistic intervention of great scale that intervenes more than one urban component.

The strategic projects are *The Plan Jarillón*, the environmental corridors project, the creation of eco-parks, green corridor, aeropark Marco Fidel Suarez, regional park Pichincha, relocation of housing units located in risk areas, the consolidation of the system of protected areas and the well for the municipal water system supply. The Plan Jarillón, for example, consists of the relocation of housing units located in the riverbanks of the Cauca River because is classified as a non-mitigable risk area by flooding. The project considers the location and construction of new housing units, the creation of big public spaces areas in the risk areas including parks, bike paths, and pedestrian paths. Another project that is significantly relevant for the city is the green corridor which consist in the adaptation of many kilometers of public spaces, facilities, rehabilitation of roads and the implementation of new public transport corridors; considering the dimension of the project and its reach can be considered as the most important urban renovation project being developed in the city.

The POT also states and delegates the creation and management of sustainable policies to entities that are purely in charge of environmental faculties, which also happens with the regulations nationally when sustainability is understood as a term that concerns only the conservation of the environment, wildlife, and natural habitats. Article 103, also mentions a different tool yet to be created which is the "Manual for the Sustainable Construction" to be formulated by the DAGMA but this time in collaboration with the planning department. Although the Pot was formulated in 2014 until today there has not been any signal of progress regarding the policies that are proposed in the regulations, since the proposals are still vague and there is no entity in charge of supervising the progress.

The manual for sustainable construction was created by the housing ministry in 2015 and aims to educate in aspects of energy and water efficiency for the construction of new buildings in the entire country. It consists of a manual that gives guidelines and introduces the culture of sustainable construction in the country explaining the performance of the buildings depending on where is going to be developed, proposing passive or active systems to promote sustainable strategies in the design of new constructions, as well as exposing the economic advantages that sustainable construction generates. According to the agreement the use of the sustainable construction manual was mandatory for all the new edifications (public or private and of any use) since 2016, but thus far is not demanded to obtain construction permits.

As mentioned above the POT has a validity of 12 years (See Figure 19.), meaning that the current one will regulate every urban process in the city until 2026; considering the pace of growth of the city and the expectation of population and urbanization growth, the period of its validity result to be too long and only efficient considering the long term proposals but still is far from reality to consider the city as an object that is not dynamic and will not change during this period of time; which is why there is an instrument designated to assess the fulfillment and progress of the projects presented in the POT, called the "*Expediente Municipal*" (Municipal record), in this respect, the indicators designated to assess the progress and development of the city are registered there.

The procedure established to edit the POT during its validity is called revision and adjustment and it must be done every four years, corresponding with the formulation of the development plan. The aim is to evaluate the progress and make adjustments in the short term projects since is within the time to execute them, also to modify its content in case is not reflecting the model of territory that is proposed in the first place or in case additional studies show that is necessary to modify risk areas and determinations regarding their mitigation.

The Municipal record, mentioned above in multiple occasions is the tool that was created to evaluate the POT, to accomplish its aim is based on three axes: the evaluation of the territorial model, the evaluation of the progress of the projects in the

Figure 22. Categorization of the indicators contained in the Municipal Record

POT and the construction of key indicators of the municipal territory. The informa-

tion contained in the municipal record is the result of the analysis and classification of information of the territory provided by different entities of the municipality and external organism as well as other territorial dynamics. This process was established in 2013 with the revision of the first municipal's POT in order to have an appreciation of the flaws in the past land use plan. (*Alcaldia de Santiago de Cali- Expediente municipal*, n.d.)

The indicators published by the municipal records aim to show in a measurable form the complex dynamics in the occupation of the territory, display them in a way that is easy to comprehend and be useful to provide information about the tendencies of municipal development. The indicators are centralized in the site of the System of Social Indicators (SIS). The indicators are divided into three main groups: Social Development Dimensions, Commune Profiles, and other indicators.

In the social development category the topics are: Digital city, Culture and political participation, Education, Health, Economic environment and governance, Peace and safety, dignified life and Sustainability, where in the sustainability category there are 21 indicators classified in environment and solid waste management, mobility, population, housing, and public services.

*See Anex A

Considering the sustainability indicators included in the social development dimension, the scope falls short since is neglecting as dimensions of sustainability other aspects as safety, equality, and coverage in basic public services.

As mentioned before, all the indicators of the System of indicators are used to evaluate the progress of the city, but the ones that have an effect in the change and orientation of policies of urban development are the ones from the municipal record, which can be considered as an overview of all the indicators in the system. The issue is, in the municipal record do not exist indicators specifically for the measurement of sustainability as an urban standard, therefore is a priority to implement indicators focused in the assessment of sustainability considering also the strategic projects being developed in the city.

The dimensions in the classification of the municipal records are Heritage, which includes: goods of cultural interest, Special plans of management and protection, Notable trees; in the environmental dimension: Risk and threats, Environmental sustainability and ecological conservation, environmental quality; Functional system including mobility, public services, public space and facilities; and social-economic structure including real state module, partial plans[1] and uses.

The municipal record is structured in two titles: In the first one are presented the indicators that make reference to the population dynamics in the city of Cali, and in the second one are developed the indicators that regard territorial dynamics divided in Environment, Functional and social-economic.

Each indicator counts with the development of data analysis, maps for georeferentiation, which allows the understanding of each indicator in the physical space, also for its definition a baseline is established and the progress is monitored through time.

In the revision and adjustment which is the document resultant from the analysis provided by the municipal expedient, is named into the components and strategies of development of the city sustainable goals or developments, but as well as in the national plans or policies of territorial development in the country are referred only to environmental sustainability (conservation of the natural environment, reduce in the consumption of natural resources, delimitating protected natural environments

1 Partial plans are an urbanistic tool proposed by the POT that gives certain benefits in the development of an urban complex/area that considers things like urban linkage, public spaces and environmental linkage.

among other policies) but is not considered a clear strategy to develop the entirety of the municipal territory, as sustainability is a concept that involves multiple aspects. Although is mentioned in the revision and adjustment, the municipal expedient appears to have indicators that measure different dimensions and aspects of the city but lacks coherence when identifying a purpose of the measurements.

As proposed in the objectives of this thesis, the result should be a framework that has a defined objective for the interpretation of the measurement indicators as well as the selection.

The current development plan that is valid until 2019, has some initial indications relating the UN's sustainable development goals into the assessment of the progress of the city and the proposal of strategic projects to improve the city's sustainability and quality of life of its inhabitants. The sustainable development goals take place in the classification of what the development plan considers result and product indicators. The plan is based on the result indicators which measure the influence that the development plan has in the development of the strategic projects and the product indicators measure the progress of each strategic project. Result indicators depend on the product indicators and for this specific development plan, are related to the SDG indicating which entity is in charge of the development and evaluation of the project and to which development goal contributes. The result indicators that are related to Goal #11 are related mainly to mobility, public health issues, housing, and public space.

The current development plan expires in 2019 and each one is valid for a 4 years period, consequently even if is very well constructed would be effective only during the short term. The negative aspect about development plans is that is left to the major's discretion to adopt the previous development plan strategies, structure or projects which is why in spite of being an innovative proposal for the city's progress is not the ideal tool for the application of a sustainability assessment framework.

3. RESULTS AND DISCUSSION

The result of the methodology, as shown above, is a table that contains 23 indicators to measure sustainability regarding the Sustainable Development Goal #11.

The generated framework was thought to measure in a city scale, even though the aim of the assessment is to create an interaction between the scales of application of strategies of sustainable development the city scale is the focal point for the creation of policies, development of projects, more effective generation and distribution of economic resources and more efficient monitoring than evaluating a greater scale,

regional for example when is considered that the governing authorities have minimal influence in urban policies. The articulation of scales in this case is proposed as a modification of the model of territory that is proposed in the different instruments of urban development, considering the sustainable development goals as the guiding thread of the revision of the current regulations, proposal of new regulation documents and the center of discussion when the topic is which is the future of the city.

After the comparison of sustainability assessment frameworks, filtering of indicators and contextualization of the resulting framework in this case in Cali, Colombia the final table is divided into 5 topics: Waste, Risk vulnerability, Land-use, Mobility and Environment, where the topic that contains the most indicators is land-use meaning that the major influence in the framework is the design and management of the urban environment. However, the category that contains the least indicators is the environmental, which only measures the quality of the air which is directly affected by the mobility that is as a matter of fact an important topic in the final framework and could be related to the indicators of public transportation, cycling network, conservation of natural environments, the reduction of car use and the encouragement of walking.

The elements present in the framework are the 23 indicators classified in 5 topics and the indicators are divided at the same time in sub-indicators. The viability of the framework can be based on the following criteria:

- Type of Calculation: qualitative or quantitative
- Assessment method
- Difficulty of measurement

For multiple indicators the difficulty of measurement is easy since the measurements already exist in the database of indicators of the city, and when the data is considered to be hard to measure or calculate is due to a lack of information in vulnerable areas where the regulations are not fully considered and the authorities are not present, for example in the informal settlements where is hard to collect data and do not exist multiple urban regulations.

On the other hand there is data that is qualitative and due to the amount of time and resources that should be invested in the collection of this type of data is classified as hard to collect, for example indicators regarding the sense of safety of the citizens in the city, which also variates according to the localization.

TOPIC	CATEGORY	INDICATORS	DEFINITION	INDICATORS FROM THE MUNICIPAL RECORD	
WASTE	Solid Waste Management	Meet waste disposal demand	Proportion of urban solid waste regularly collected and with adequate final discharge out of total urban solid waste generated, in the city.	Solid Waste	Volume of solid waste generated by day Houses with the service of waste disposal
RISK VULNEARABILITY	Management of risks	Risk management and assessment	Percentage of homes in risk because of inadequate construction or located in a non mitigable risk area	Risk	Number of settlemets located in risk vulnerable areas
LAND-USE	Demographic needs and priorities	Access to suitable public spaces	Public spaces for every 100.000 inhabitants	Public Space	Effective public space Public space index per commune Coverage ratio of public space Concentration of m2 of public space Public space vs population density
		Delivery of services and facilities	Mixed-use neighborhoods	Economic activities	Number of economic activities by type Number of land-uses aproved by neighborhood Number of land-uses not aproved by neighbor-hood
LAND-USE	Land-use strategy	Compact development	Ratio of land consumption rate to population growth rate Annual rate of the urban print growth	Population density	
	Utilities	Meet public services demand	Percentage of houses with conection to the municipal water network Percentage of houses with conection to the municipal sewage system Percetage of houses with conection to municipal electric power	Public Services	Houses with connection to the water network Houses with connection to the municipal sewage system Houses with connection to municipal electric power Houses with connection to the natural gas network
	Enhancement of ecological value	Protect existing natural habitats	Ensure the protection of natural exhisting habitats and mitigate negative impacts	Ecosystemic conservation	Systemical conservation of the areas of natural protection Surface of the city declared as an environmen-tal protected area Surface of the city declared as a protected area Areas in the city that belong to the national protected environmental areas Strategic ecosystems declared as protected area Percentage of protected areas that count with a management plan

TOPIC	CATEGORY	INDICATORS	DEFINITION	INDICATORS FROM THE MUNICIPAL RECORD	
MOBILITY	Transport assessment	Meet transport demand	Planning and management transport system	Public Transport	Integrated transport system (SITM) Demand of public transport (Passengers/year)
		Cyclng facilities	Adequate provision of clyclist facilities (Storage, permits, manteinance)	Alternative transportation system: bicycle	Network of prioritary bike paths
ENVIRONMENTAL	Air quality	Concentration of air pollutants	Air quality Index Concentration of PM10	Air quality	Air quality index Concentration of PM10 Concentration of CO Concentration of SO2 Carbon print (Equivalent CO2) Levels of emisions by commune

Table 7. Table of indicators from the resulted framework and from the Municipal Record

Most of the indicators are assessed by calculation which means that most of the indicators can be obtained by the collection of data or analysis used with the data that exists from other statistical sources.

In step 3, when the filter of indicators was made, simultaneously the indicators from the municipal record were also filtered with the criteria of the indicators of SDG 11. The result of this filter was that only three indicators from the municipal record can measure sustainability supported on goal 11; those indicators were: Demand of public transport, settlements located in risk areas, volume of solid waste produced in the day, houses with access to the waste collection system, air quality index, concentration of PM10 and effective public space. This filter at this stage shows how important the contextualization of the framework because otherwise means that the municipal record has little to no relation to the sustainable development goals and does not have either enough information for an effective assessment of sustainability.

The same procedure was applied at this point to the ICES indicators that were related to goal 11 showing that there were indicators for all the categories in goal 11 except for measurement indicators related to heritage. The explanation is that the ICES methodology makes an assessment to identify priority aspects in Latin-American communities where their evaluation does not consider investing in heritage as the main aspect for urban development and sustainability. For the rest of the indicators, there was a correspondence with the SDG 11.

One of the most important aspects of the proposal of the framework was to incorporate it into the existent policies and assessment methodologies, to make it easier to implement and avoid creating the necessity of creating new entities.

The last step after the table of indicators was finished, a table showing which indicators from the municipal record can be used in the new framework. On this occasion the result was totally different from the one obtained before, the number of indicators that can be compared with the framework to measure sustainability increased 10 times, although is important to consider that some of the indicators can complement the framework and still be giving an accurate scope of the measurement of sustainability.

The indicators that coincide are concerning mostly environmental aspects, as mentioned before ecological conservation is the main goal in the urban development of the city considering its environmental potential, therefore the policies and measurements regarding this aspect are more structured and clear.

After the analysis of the case study and the revision of the results of the methodology, there is a lack of coherence and clarity between the models of development that is proposed by the multiple planning and management instruments as well as a clear manifestation of the importance of the consideration of sustainable strategies to adjust current projects and to edit the factor for future developments.

The first step to develop a sustainability strategy is to establish a common goal between municipal Land-use plans, regional and municipal development plans and

CATEGORY	INDICATORS	SUB - INDICATORS	DEFINITION	UNIT	QUANTITATIVE OR QUALITATIVE	PARAMETER	NOTES	DATA AVAILABILITY
WASTE	Solid Waste Management	Meet waste disposal demand	Proportion of urban solid waste regularly collected and with adequate final discharge out of total urban solid waste generated, in the city.	Percentage	Quantitative	Ratio of solid waste collected in the city by the amount correctly disposed	Discharged in landfill with an adequate treatment of leachate and gases	Easy
		Solid waste treatment	Solid waste in the city that are composed	Percentage	Quantitative	Ratio of solid waste discharged by SW composted		Hard
			Solid waste in the city sorted out and classified for recycling	Percentage	Quantitative	Ratio of solid waste discharged by SW recycled		Hard
		Reduce waste production from construction		N.°	Quantitative	Difference of amount of waste produced from construction		Hard
RISK VULNERABILITY	Management of risks	Risk management and assessment	Number of deaths, missing persons and persons affected by disaster per 100,000 people.	Deaths/100.inh	Quantitative	Number of deaths and missing people by every 100.000 inhabitants		Medium
			Direct disaster economic loss in relation to global GDP, including disaster damage to critical infrastructure and disruption of basic services.	Economic loss/Global GDP	Quantitative	Ratio of economic loss by the global GDP		Hard
			Percentage of homes in risk because of inadequate construction or located in a non mitigable risk area	Percentage	Quantitative	Ratio of homes in risk by the total homes	Homes in risk because of insecure roofs, floor or walls or located in a risk area	Hard
			Fundamental infrastructure in risk situation because of inadecuate construction or located in a non mitigable risk area	Percentage	Quantitative	Percentage of vulnerable public fundamental infrastructure to natural disasters		Medium
LAND-USE	Housing provision	Meet housing demand	Proportion of urban population living in slums, informal settlements or inadequate housing	Percentage	Quantitative	Percentage of houses in inferior conditions to the habitability standards lower than the ones established		Exists/Medium
			Quantitative housing deficit	Percentage	Quantitative	(Number of homes-Number of houses)/Number of homes		Exists/Medium
		Housing affordability	Proportion of new rental and/or for sale dwelling units for households with less than the median income	Percentage	Quantitative	Percentage of new rental or for sale houses priced for households earning more than the AMI (Area medium income)		Easy
	Demographic needs and priorities	Access to green suitable green spaces	Green areas for every 100.000 inhabitants	ha/ 100.000 inh	Quantitative	Hectares of green permanent space for every 100.00 inhabitants		Easy
		Access to suitable public spaces	Average share of the built-up area of cities that is open space for public use for all, by sex, age and persons with disabilities.	Percentage	Quantitative	Average proportion of the built area dedicated to open public spaces dissagregated by sex, age and people with disabillities		Medium
			Public spaces for every 100.000 inhabitants	ha/ 100.000 inh	Quantitative	Hectares of opened public space for every 100.000 inhabitants		Easy
		Jobs availability	Unenployment rate	Percentage	Quantitative	Total of unemployed people by the total of the workforce	Annual rate. The rate represents the percentage of people looking for a job	Medium
			Ratio of jobs by home	Ratio	Quantitative	Number of jobs opportunities	Data of employment (sectors, buissiness, income, unenployment)	Medium
		Delivery of services and facilities	Mixed-use neighborhoods		Qualitative	Ensure mixed-uses in the implementation of planning policies	The aim is to reduce vehicle distance traveled and automobile dependance	Hard
			Essential facilities are provided and located within walking distance distributed in the city		Quantitative	Ensure the existance of basic need facilities within walking distance in every neighborhood		Hard
		Ensure urban safety	Percentage of citizens that feel safe	Percentage	Qualitative	Percentage of inhabitants that feel safe or very safe		Hard
			Amount of thefts for every 100.000 inhabitants	Thefts/100.00 inh	Quantitative	Amount of thefts for every 100.000 inhabitants	Disregarded in violent and non violent	Medium
		Inclusive design	Number of sectors that have participation in which exists citizens participation in the formulation of public policies		Quantitative	Existence of a policy framework that supports and ensures public participation in urban planning and execution/evaluation of projects		Medium

CATEGORY	INDICATORS	SUB - INDICATORS	DEFINITION	UNIT	QUANTITATIVE OR QUALITATIVE		NOTES	DATA AVAILABILITY
		Inclusive design	Number of sectors that have participation in which exists citizens participation in the formulation of public policies		Quantitative	Existence of a policy framework that supports and ensures public participation in urban planning and execution/evaluation of projects		Medium
	Land-use strategy	Compact development	Ratio of land consumption rate to population growth rate.	Ratio	Quantitative	Ratio of the rate of land consumption and the rate of population growth		Medium
			Annual rate of the urban print growth	Percentage	Quantitative	Ratio of the annual rate of the growth of the urban print within the legal limits of the city		Medium
	Utilities	Meet public services demand	Percentage of houses with conection to the municipal water network	Percentage	Quantitative	Ratio of houses conneted to the municipal water network/Number of houses		Easy
			Percentage of houses with conection to the municipal sewage system	Percentage	Quantitative	Ratio of houses conneted to the municipal sewage system/Number of houses		Easy
			Percetage of houses with conection to municipal electric power	Percentage	Quantitative	Ratio of houses conneted to the municipal electric power/Number of houses		Easy
	Enhancement of ecological value	Protect existing natural habitats	Ensure the protection of natural exhisting habitats and mitigate negative impacts		Qualitative	Creation, protection and enchancement of wildlife corridors linking existent wildlife habitats		Easy
MOBILITY	Transport assessment	Meet transport demand	Planning and management transport system		Qualitative	Existence of a planning and management of a public transport system	Note 1	Easy
		Access to public transport	Proportion of population that has convenient access to public transport, by sex, age and persons with disabilities.	Percentage	Quantitative			Medium
			Affordability index	Percentage	Quantitative	(Amount of trips in the month by person x Average cost of the trip)/ Income of the lowest income quintile		Easy
		Public transport facilities	System of transport planning and management		Qualitative	Availability of facilities for the development of the management of public transport		Easy
		Cycling network	Connected, eficient and safe cycling network		Qualitative			Medium
			Kilometers of cycling roads for every 100.000 inhabitants	km	Quantitative	Total of linear kms of byclicle paths inside the city expresed as kms by every 100.000 inh		Easy
		Cyclng facilities	Adequate provision of clyclist facilities (Storage, permits, manteinance)		Qualitative	Promote cycling by the provision of cycling facilities	Parking and storage spaces	Medium
	Access to quality transit	Transit facilities	Reduce vehicle distance traveled		Quantitative	Encourage multimodal transportation developments and a well connected network		Hard
	Walkable streets	Safe and appealing streets	Kilometers of pavements and pedestrian paths for every 100.000 inhabitants	km	Quantitative	Total of linear kms of pedestrian paths inside the city expresed as kms by every 100.000 inh		Medium
ENVIRONMENTAL	Air Quality	Concentration of air pollutants	Air quality Index	N.°	Quantitative	I= Ihigh-Ilow/Chigh-Clow(C-Clow)+Ilow		Exists/easy
			Concentration of PM10	µg/m3 media in 24h	Quantitative	Concentration of particles in suspention with a diameter inferior to 10µm in an average of 24h		Exists/easy
				From Step 2				
				From ICES				

Table 8. Resulted framework for sustainability measurement in Cali

*This indicatior aims to establish if the city counts with an adequate planning and management system. According the anwer of three questions: 1. Is there a recent survey (2 years max of origin/destination covering the metropolitan area) 2.IS there a transportation masterplan published based on the survey or backup studies? 3.Has the city implemented a transport management system that include indicators to measure and monitore the system?

communication with the national plan. Even though they all suggest and tend to propose the same things such as: encouraging regional economic development, stimulate sustainable development, enforce and strengthen the policies that protect the environment and ensure peoples quality of life; revising the specific proposals there is an evident lack of a narrative thread that not only gives coherence to all the different tools, but also would be more efficient as the projects could solve multiple problematics at once. The proposal aims to establish a strategy based of sustainable development since Colombia has already set up sustainable goals to be fulfilled by 2030, however the legal tool to route the projects that are proposed in the POT is the revision and adjustment that is made in the short term.

As mentioned above the system to evaluate the progress made in the city and the tool to elaborate the revision and adjustment document is the municipal record, and for this reason, the approach of the thesis is to create a framework that can assess sustainability. With the intention of generating a new approach to the measurements provided by the system of indicators. For example in the system of indicators in the dimensions of social development there is a category of sustainability indicators, but consist only of 21 indicators that contain only environmental, mobility housing and basic population data, reducing the measurement of sustainability to a few aspects that even when analyzed could not give a real scope of the extent of the concept sustainability and the actions that have to be taken to be able to understand the direction in which the city is going or even if there is an improvement in this matter. To have an assessment of progress is important to have a benchmarking reference when the data is collected and is time to analyse the results, which can be chosen by the municipality in further developments or can be extracted from the experiences of other Latin American developments, for example the ICES methodology has defined a set of benchmarks for each indicator that work in what the methodology calls emergent cities and is used for the prioritizing of problems phase when to each result is classified into one of three reference levels: within expected parameters, lack, and critical situation. The benchmarks can be established by further developments designing marks that are applied only in the city, considering also the current measurements of the indicators considering public and stakeholders opinions.

The aim of doing the benchmarking process is to establish the categories and topics that are deficient and underdeveloped in the city in order to consider them a priority in the elaboration and fulfillment of policies, however is still necessary to include

every aspect in the policies for further development and consideration within the extent of the prioritized topics, as mentioned before, with the application of a solution for an identified problematic multiple indicators can be affected positively, therefore is important to not only consider the prioritized elements in the planning tools.

Finally, in the municipal system of indicators, the category of social indicators includes a dimension of sustainability indicators; this is where the proposed framework of indicators could be included, extending it to the rest of SDG in order to achieve a broader perspective on the dimensions of sustainability, even though when using the SDG as a reference for the proposal of measuring indicators, there are some that affect more than one objective at the same time since they can respond to multiple actions and solutions. Also, this framework should be applied to the municipal record with the intention of relating it with the adjustment of the POT.

4 CONCLUSION AND FUTURE DEVELOPMENTS

This thesis constitutes the analysis and proposal of a framework for the selection of indicators that measure sustainability focused on the SDG #11, applied in the case study Cali, Colombia.

The introduction mentions the importance of measuring and assessing the progress in sustainability in the current cities and countries as well as the role that the SDG's represent in the establishment of the main targets and problems to confront in the look for a more sustainable future. The challenge with the SDG's and the assessment of sustainability is the progression and application of policies between scales as presented in the problem statement.

The problems addressed in the thesis are finding how to begin the process of focusing the evaluation of sustainability considering the existing planning and policies tools in the case study and establishing a criteria that gives coherence to the transition of sustainability goals and assessment from the national to the local scale.

The methodology consists in the development of three steps that result in a final framework of assessment of sustainability based in SDG 11. The steps are the review of existing sustainability assessment tools like LEED ND, BREEAM for Communities and the ICES methodology in order to obtain as a result a list of indicators that is contextualized in concordance with the case study.

The case study is Cali, Colombia which is a middle sized Latin-American city with almost 3 million inhabitants characterized for its favorable geographic and natural conditions giving it a major advantage for it economic and industrial development which still needs a boost that favors equally investors, owners, clients and inhabitants; considering sustainable development proposals and policies the best alternative to develop the city and enhancing the natural values that possesses. The tools that can support and encourage the proposal and implementation of ideas for sustainable development are the POT which is the local land-use plan and the municipal record, where indicators are used to measure the effectiveness and accuracy of the projects presented in the POT.

The steps of the methodology consist of an analysis of LEED and BREEAM, leading to a list of indicators classified in categories and described in detail that are common to both methodologies and constitute mandatory criteria to one or another methodology; to filter the selection of indicators the criteria used is that the indicators must be related to the United Nations' sustainable development goal # 11: Sustainable cities and communities; then, the indicators are contextualized in Latin-America, based on a methodology for sustainability measurement and prioritizing of projects called ICES (Iniciativa para Ciudades Emergentes y Sostenibles for its Spanish initials) that make emphasis in common Latin problematics and measurements for sustainable progress. The end result is a list of indicators that are related only to goal #11 and to the context, to compare to the current indicators from the revision and evaluation of the POT.

The result of the methodology is a table that contains 23 indicators to measure sustainability regarding the Sustainable Development Goal #11 which is divided into 5 topics: Waste, Risk vulnerability, Land-use, Mobility and Environment, where the topic that contains the most indicators is land-use meaning that the major influence in the framework is the design and management of the urban environment.

From the methodology developed to obtain the final table of indicators, in which a comparison of existing sustainability assessment frameworks was done an aspect that was evident throughout each step of the methodology is that even if each methodology has a different aim, perspective or understanding of sustainability the end results have multiple elements in common when making a more detailed review of the indicators and the aspects that give extra credit to the assessments.

The variation between the tools is mainly in the distribution of weights and ratings of each assessment methods since in the mandatory or required criteria there is more coincidence.

The fact that there are several aspects that are related regarding sustainability measurement in the frameworks, makes more simple generating a synthesis with the most relevant elements in this case of the two methodologies in step 1. Likewise with the ICES methodology is used to give more specificity to the indicators, since in this methodology the indicators have already similar elements to those from the certification assessment tools, even though ICES is a tool that is focused on establishing critical aspects in the city instead of giving a positive evaluation to neighbourhoods/ smaller scale developments.

The result framework can be considered as a support and analysis tool to the development and progress of the planning of urban and sustainable development policies, whose purpose is to orientate the revision and adjustment of proposals of the POT being supported by the current tool of indicators (the municipal record), also with the objective of using the current measurements and measurement systems to avoid generating the need to implement systems that require a large budget.

Also, including sustainability measurement indicators can contribute with problematics that perhaps were not considered before in the evaluation of progress system in the city, since it only considers the progress made in the current proposals; and in some cases, the strategies being developed can solve those problems.

For further developments, the proposal is to encourage local authorities and entities to invest in proposals for urban planning that is focused on sustainable development. The first step to route policy-making towards sustainable proposals needs to be done and consider sustainability as a concern that affects all the dimensions in a city and not only the new construction of an individual building or residential compounds.

This thesis can be considered as a first step of the application of existing tools to develop a sustainability measurement tool considering as the main aspect the contextualization to the city, and the assessment of the progress of the current plans and projects being developed. Is left as an obligation of the urban planning authorities to apply and develop a complete assessment method and policies that can ensure the sustainable development of the city, therefore encouraging the city's economic development and improving people's quality of life, although the application of the SDG's as a guide for the establishment of a measurement framework is a limit considering that the goals are a very general perspective of the principles of sustainability and does not consider a real perspective of the scope of the problematics that a certain place presents or can face when developing sustainable strategies, like economic losses, difficulties in adaptation of the strategies or lack of budget for studies and application.

The next step for the city is to design and implement an assessment tool and method that includes all the dimensions of sustainability and urban dynamics, as part of the normative protocols to ensure the application of the measurement in all the planning and resource distribution instruments as a mandatory feature, relying in the sustainable development goals and an stakeholders analysis to define more precise aims of territorial development of the city and the actors responsible of the development, considering as an opportunity the encouragement of private investors to get involve actively in the renovation of policies process.

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Apendix

Anex A:

System of indicators of Santigo de Cali, Sustainability Indicators:

Environment and solid waste collection.

Emision of greenhouse gas emissions (tCO2e).

Average annual concentration of nitrogen dioxide (NO2) in the air.

Average annual concentration of sulphur dioxide (SO2) in the air.

Annual concentration of PM10

Tons of solid waste generated by inhabitant.

Percentage of waste water that receive primary treatment.

Average annual temperature.

Average annual precipitation.

Mobility.

Cars by every 100.000 inhabitants.

Transit accident average daily balance.

Annual number of trips in public transport by every 100.000 inhabitants.

Motorcycles by every 100.000 inhabitants.

Population.

Birth rate.

Pupulation growth rate.

Total population by sex and age group.

Total population by geographic area.

Total population.

Housing and public services.

Percentage of housing units with water service.

Percentage of housing units with authorized energy service.

Percentage of the population living in slums

Indicators for communes and townships of Cali.

Population : Total population

Indicators- Regional comparatives

Population

Total population by geographical area

Total population.