Mapping sustainability and circular economy in cities: Methodological framework from europe to the Spanish case

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A R T I C L E I N F O

A B S T R A C T

Life in cities is accelerating towards a future in which they must be sustainable, healthy and resilient and to which they must add the circular economy (CE) as a new paradigm of sustainability. There is great interest in the use of indicators to assess urban sustainability, but no common solution is recognized due to the diversity of approaches and opinions. This article addresses this problem by proposing a methodological framework based on official tools in use, such as the European Reference Framework for Sustainable Cities (RFSC), the Urban Agendas and the CE strategies adopted by each country in the EU. This framework is intended to homogenize and simplify the existing world of sustainability and CE indicators in cities and, at the same time, reflects the complexity of the multi-conceptual, multi-level, multi-scope and multi-scale nature of the subject under study. This framework is developed in three phases to study and select the reference sources to create a map with a holistic and simplified approach, supported by a previous phase in which the specific environment of each territory was explored. In turn, the multi-scope implementation is carried out for Europe and Spain as a case study for testing purposes, resulting in a sustainability and CE map for Spanish cities. The methodological framework has relevance for a diversity of geographical areas due to its replicability and its adaptation to each local case. This last quality allows the indicators to be contextualized and, thus, their implementation in cities, towns, or any human settlement in general.

1. Introduction

The current issues about sustainable human settlements such as well-being or quality of life are highlighted by the UN, in the Quito Declaration (United Nations, 2016) and in the 2030 Agenda for Sustainable Development with its 17 SDGs, specifically, through SDG11 (United Nations, 2015). In this sense, the Spanish Urban Agenda (AUE, using the Spanish acronym) is developed (Gobierno de España and Mitma, 2019), which together with the rest of European urban agendas (ASviS, 2017; The Scottish Government, 2016; Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, 2014) are considered noteworthy references (Pemán-Gavín, 2019).

Furthermore, the sustainability paradigm is currently supported by the concept of circular economy (CE), being considered as a "condition" to achieve sustainability (Geissdoerfer et al., 2017). This results in the emergence of strategic documents at the European Union level

(European Commission, 2014, 2015a; 2015b; 2018a; 2018b; 2018c; 2019; 2020a), as well as at the national, regional or local level. In the European environment, besides Spain with its Spanish Circular Economy Strategy (EEEC, in its Spanish acronym) (Gobierno de España et al., 2020), some Administrations at national level draft plans to boost the CE (Dutch Ministry of Environment, 2016; Sitra Studies 121, 2016; Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety, 2016; Ministry of Environment of Portugal, 2017; Ministry for the Environment, Land and Sea Ministry of Economic Development, 2017; The French Ministry of Ecological and Solidarity Transition, 2018; GOZ, 2020; Government of Ireland, 2020; Republic of Serbia, Ministry of Environmental Protection, 2020). In parallel, other initiatives are emerging at the autonomous, regional or local level, both in Spain (Junta de Extremadura, 2017; Gobierno de Aragón, 2020) and in the rest of Europe (Chemport Europe, 2020; Town of Riihimäki, 2019; Stad Leuven, 2020). Reference entities in the CE, such as the Ellen MacArthur

Table 1
Background.

References	Relevant topics		
	SI	CEI	City
Mitchell et al. (1995)	●		●[a]
Mitchell (1996)	●		●[a]
Gallopin (1997)	●		●[a]
Quiroga Martínez (2001)	●		●[a]
Antequera and González (2005)	●		
Reed et al. (2006)	●		●[a]
Aguado et al. (2008)	●		●[a]
Hernández Aja (2009)	●		
Ramos and Caeiro (2010)	●		
Bodini (2012)	●		●[a]
Turcu (2013)	●		●
Waas et al. (2014)	●		
Huang et al. (2015)	●		●
Kitchin et al. (2015)	●		●
Latawiec and Agol (2015)	●		●[a]
Vargas Yáñez (2015)	●		●
Cohen (2017)	●		●
Roman and Thiry (2017)	●		
Smol et al. (2017)		●	
González-García et al. (2018)	●		●
Kalmykova et al. (2018)		●	
Avdiushchenko and Zając (2019)		●	●[a]
Fusco Girard and Nocca (2019)		●	●
Gravagnuolo et al. (2019)		●	●
Haupt and Hellweg (2019)		●	
Hély and Antoni (2019)	●		●[a]
Moraga et al. (2019)		●	
Ngan et al. (2019)	●	●	●[a]
Saidani et al. (2019)		●	
Santagata et al. (2019)		●	●
Kristensen and Mosgaard (2020)		●	
Sánchez Levoso et al. (2020)		●	●
Steiniger et al. (2020)	●		●
Sharifi (2021)	●		●

[a] The topic is included but the research does not focus exclusively on it.

Foundation (2015), also promote its development by providing indicators.

Recent events brought about by the COVID-19 pandemic have only reinforced this picture of sustainability and CE. Thus, the UN stresses the need for cities and settlements to be healthy and provide wellbeing together with the certainty that "the COVID-19 crisis provides a spur to accelerate transformative change" (United Nations Environment Programme, 2021). In the same way, the European Union creates the Next Generation EU recovery funds (European Commission, n.d.-b), with which it wants to promote a "more sustainable, resilient and fairer Europe" and boost the CE (European Commission, 2020b). In the case of Spain, the Recovery, Transformation and Resilience Plan (Gobierno de España, Gobierno de España and Presidencia del Gobierno, 2020) is presented with forward-looking objectives such as healthy cities, the transition to the CE or adaptation and resilience in the face of climate change.

On this basis, since the late 1980s, measuring sustainability has become an academic and political focus (Turcu, 2013). From the beginning, no set of indicators with "universal appeal" was recognized (Mitchell, 1996) and questions continue to be raised today regarding the design and use of indicators (Steiniger et al., 2020). Not only is the indicator relevant, but so is the way it is articulated within the framework to which they belong (Roman and Thiry, 2017). Thus, various studies of frameworks are emerging worldwide, whether specific to an area or for global applications, either by sector or by organizational level (Ramos and Caeiro, 2010).

In this way, those indicators and frameworks referring to sustainability assessment in the field of cities are also recognized as very relevant (Sharifi, 2021). In this case, the levels of study are constituted as a system in which the city or urbanism is the macro level that encompasses

everything, followed by the middle level in which the building or architecture is found, and the micro level in which the constructive elements or construction are developed (Pomponi and Moncaster, 2017). Considering the above, the macro level is performed from indicator catalogs (Vargas Yáñez, 2015), deducing that it can contain the medium and micro levels at the same time according to the complexity and interconnection of the levels of study. In Spain, this fact has been translated into different sets of urban indicators developed by each city according to its context and needs, as stated in the White Paper on Sustainability in Spanish Urban Planning (Ministerio de Vivienda, 2010).

Studies such as Avdiushchenko and Zając (2019) point out that CE and sustainability are not only relevant in Europe but also in most countries in the world, including China. However, Avdiushchenko and Zając (2019) also caution that their experiences with CE cannot be directly applied in the European context since they do not share the same approaches and problems.

As a brief background, a search is performed from scientific literature databases such as ScienceDirect and Web of Science, and subsequently, the "snowball" technique (Wohlin, 2014) is applied to identify additional articles from the references of the previously selected articles. The objective is to obtain an overview of the existing approaches on the topic and, therefore, it starts from a general point of view towards the specific one at the macro level of study. As a result, a compendium of publications grouped chronologically is developed in order to know the trends together with their linkage to the relevant topics identified during the research: SI, CEI and city, which are not mutually exclusive (Table 1).

The results of this search highlight the topicality of the subject of study. However, since the first reference studied (Mitchell et al., 1995) the city is mentioned with SI although they do not focus on it exclusively. As examples, Hély and Antoni (2019) focus on regional settings but also encompass a city within their case study and Bodini (2012) presents the city as an example of the potential of systemic approaches as a general framework. The incorporation of CE into SI emerges as a more recent global topic (Moraga et al., 2019; Ngan et al., 2019) appearing, as such, in the work of Smol et al. (2017). However, although CE is part of sustainability, the study of indicators is often treated separately. Only in the case of Ngan et al. (2019) the CEIs are treated as part of SI and jointly. This new topic does not exclude the study of SI, which remains constant from Mitchell et al. (1995) to the present day with studies such as Steiniger et al. (2020). In addition to the issues mentioned above, knowledge of the literature has made it possible to identify the diversity of approaches, analyses, studies or methods proposed by the authors. A latent heterogeneity around the subject can be observed, perhaps due to its topicality, which suggests the need to use existing and in use official tools and frameworks. Works such as Marin and De Meulder (2018), in which a circularity framework for cities is designed, capture the complexity of this type of studies. So, Table 1 shows how the main topics are not always studied together, although the UN guidelines and the European Commission value this point (United Nations Environment Programme, 2021) (European Commission, 2020b). Therefore, a map of sustainability and CE in cities is also necessary because within the 2020–2030 decade the different spheres of sustainable development in cities must be addressed jointly and transversally, in line with what is proposed by the European Commission (2020b).

To resolve these issues, the present research is initiated with the purpose of filling the homogeneity gap and the need for widely used evaluative items (Cohen, 2017; Sánchez Levoso et al., 2020) that are easy to handle and to apply due to their simplicity (Steinmann et al., 2016; Avdiushchenko and Zając, 2019), and taking into account that this brief but complete set is understood as a challenge (Steiniger et al., 2020). This research focuses primarily on the European context by studying existing regulations, strategies and official frameworks or tools.

To this end, the main objective of this article is to propose a methodological framework to create a map of sustainability and CE in cities,
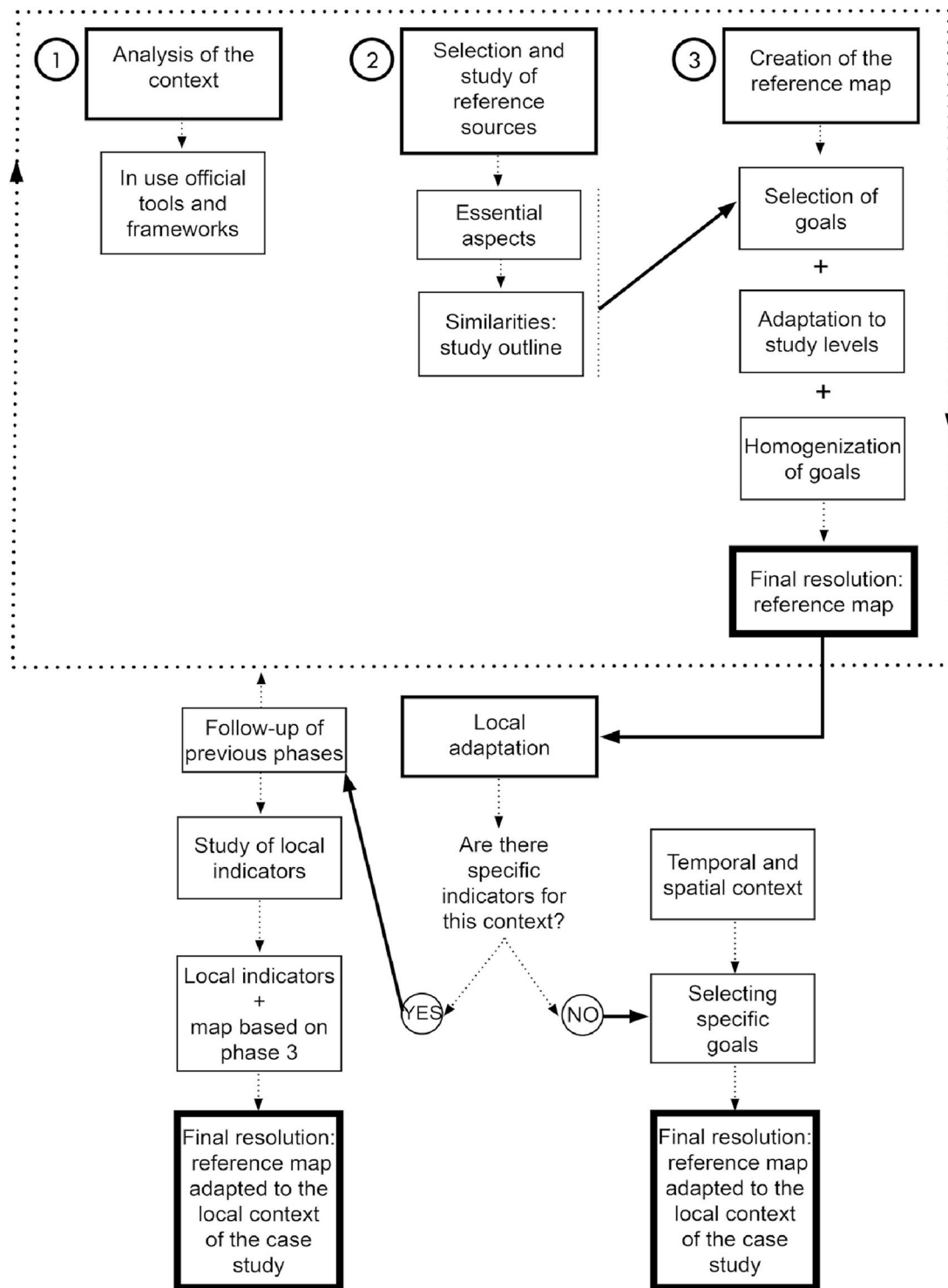
Fig. 1. RMap Methodological framework (created by the author).

linked to the macro, medium and micro levels of study within the official European, national and local scopes. This framework originates from the use of official frameworks or tools that are widespread and in use, taken as reference sources. Such a map assesses the status, and analyzes and measures the progress of different strategies or actions undertaken. It is conceived as an iterative process that generates an adaptable and flexible structure (Turcu, 2013) according to the spatial and temporal context together with the idiosyncrasies of each case study. It is important to know the structural relationship between levels and indicators in order to make an appropriate and specific selection, which is

why the study of the selected indicators becomes a significant part of this article. However, evaluation frameworks should be tested with empirical implementation studies (Cohen, 2017). Therefore, not only the methodological framework is proposed, but the Spanish state case is presented as a case study.

In addition, although sustainable development is considered a global objective, the CE projects that have already been developed and those that will be developed will be local or regional in scope (Korhonen et al., 2018). Local interventions are "crucial" to achieve the transition to CE in urban environments (Sánchez Levoso et al., 2020) and the need for

planners to understand the local context (Faraud, 2016) makes it essential to adapt the map to each particular context.

The article is structured starting from section 2 which presents the methodological framework to implement and discuss it in section 3, to the case study of Spain, in which the previous knowledge of the official frameworks and tools at the European and Spanish level is also developed. Section 4 concludes the article with an exposition of the implications of the framework and the map, the limitations of this research and the lines of work for future research.

2. RMap, methodological framework

This section is configured as a general scheme of the proposed original methodological framework, which is developed in depth through its implementation and discussion in a case study in section 3, following the suggestions of Cohen (2017).

The methodological framework or RMap (as a result of the acronym of the two key elements "reference sources" and "map") is applied through a three-phase process (Fig. 1):

- Phase 1. A preliminary analysis of the context of each case study is carried out in order to learn about the existing official frameworks and tools (section 3.1).
- Phase 2. The reference sources are selected and their essential aspects and similarities are studied in order to establish the study outline (section 3.2).
- Phase 3. The reference map is created by a selection of goals[1] of the reference sources according to their relationship with the levels of study, followed by a process of adaptation (applicable whenever necessary to ensure compatibility), and a subsequent homogenization to finally obtain the map (section 3.3). The map contains indicators from official sources, in use and contrasted and therefore available to be applied (Fig. 3, Table 6, Table B1 in the Appendix B).

RMap allows the process to be iterative, with the aim of being able to adapt the map to different areas of a case study. Iteration makes it possible to draw up European, national or territorial maps common to several case studies and, subsequently, to include frameworks or catalogs of indicators specific to each context, thus shaping the local scope of study. Thus, if there are specific indicators for this context, all the previous phases are followed with the study of local indicators and the creation of the designed map based on the one already created. If there are no specific local indicators, the creation of the local map is done only by selecting the specific indicators according to their temporal and spatial context.

3. Implementation of the methodological framework (RMap): Spain as a case study in the European and national multi-scope

The different phases of the RMap are developed and discussed below, taking Spain as a case study. This article covers the European and national levels, so that it can serve as a basis for creating a specific map for any Spanish territorial or local context. Therefore, in this implementation the iteration of the methodological framework will not be carried out.

3.1. Phase 1: Analysis of the context

3.1.1. European scope

The concept of sustainable cities emerged in the Charter of European Cities & Towns Towards Sustainability (European Conference on Sustainable Cities and Towns, 1994). Years later, through the Marseille Declaration (Council of Ministers (EU), 2008), what was theorized in Leipzig (Council of Ministers (EU), 2007), was put into practice on the basis of a "reference framework for sustainable cities in a spirit of solidarity", i.e., the Reference Framework for Sustainable Cities (RFSC)[2]. This is conceived as an online tool developed by the Member States of the European Union to "guide cities towards sustainable urban development" (RFSC, 2019).

At the UN level and with a decisive EU, as a consequence of the Millennium Development Goals (MDGs), a framework comprising the 17 SDGs was developed in 2015 through the 2030 Agenda for Sustainable Development (United Nations, 2015). Again, the city appears in this context as one of the protagonists in the struggle for sustainability reflected in SDG 11 on sustainable cities and communities. Shortly thereafter, the Pact of Amsterdam (Council of Ministers (EU), 2016) included in the urban dimension issues such as the CE, contributing to create the EU Urban Agenda. Similarly, in 2017 the United Nations published its New Urban Agenda representing a new urban framework based on SDG 11 (United Nations, 2017).

3.1.2. Spanish national scope

Subsequently, in the Spanish state context, the AUE emerges as a "policy lever" for the implementation of the 2030 Agenda (Gobierno de España and Mitma, 2019) in the Spanish territorial context, also aligned with the commitments of the New Urban Agenda and the Urban Agenda for the EU (European Commission, n.d.-a). Its framework of influence is that of SDG 11, which includes the necessary aspects to make "cities and human settlements inclusive, safe, resilient and sustainable" (United Nations, n.d.). In addition, the AUE brings to its objectives various national strategies and plans that affect the study levels with issues such as energy rehabilitation of buildings (Gobierno de España, Mitma, 2020a), mobility (Gobierno de España, Mitma, 2020b), green infrastructure (Gobierno de España, Miteco, 2020a) or adaptation to climate change (Gobierno de España, Miteco, 2020b).

As a last reference, based on previous initiatives on CE such as the "Call of cities for circular economy" launched in 2015 by the city of Paris (Mairie de Paris, 2015) or the "Seville Declaration: the cities commitment to a Circular Economy" (FEMP, 2017), the Local Circular Economic Strategy (ELEC abbreviated in Spanish) (FEMP, 2019) emerges. This is also directly aligned with both, the 2030 Agenda and the AUE, and mentions, within the reference context of the CE, the Circular Economy Package of the European Commission (2015a) and the EEEC.

Although the EEEC is not specifically applicable to urban environments, it is included in this section because of the unique coverage it poses to the construction and demolition sector, its relevance and the absence of other strategies addressing the CE,[3] which appears only in the ELEC. The EEEC appears in 2018 in draft form (Gobierno de España et al., 2018) but is finally approved in 2020 (Gobierno de España. Miteco *et al.*, 2020). It aims at the Spanish transition towards a CE through the implementation of different action plans, allowing to adapt them based on previous experience, since the overall vision of the EEEC is long-term. Its lines of action are defined taking as a reference the first EU action plan for the CE (European Commission, 2015b). It is also linked to other

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[1] The need to use a "common lexicon" to unify the existing literature (Cohen, 2017) leads us to apply the term "goal" as a term of homogeneous use among the different frameworks and catalogs studied. We define goal as any type of indicator, dimensions, objectives, axes and any other term referring to indicator frameworks, since, as we will see in section 3.2 various studies and authors differentiate between different types of them, also taking into account that each reference source uses different terminology (Table 2).

[2] However, the RFSC online tool (RFSC, n.d.), has subsequently been updated and incorporates other frameworks such as the SDGs, and ISO 37101 Sustainable development in communities (ISO, 2016).

[3] Subsequently (section 3.3.2), its selected goals will be adapted to form part of the map for application at the urban planning, architecture and construction study levels.

Table 2

Hierarchical structure of reference sources.

Reference sources	1st scale		2nd scale	3rd scale
RFSC	5 dimensions		30 objectives	167 indicators
AUE	10 strategic objectives		30 specific objectives	72 monitoring and evaluation indicators
EEEC				
PAEC 2018–2020	8 axes of action		70 measures	17 general indicators
				160 indicators
PAEC 2021–2023	8 axes/lines of action		112 measures	28 indicators for the axes or lines of action
				160 measurement indicators
ELEC	5 strategic axes	9 circular policies	29 measures	136 monitoring indicators

international policies such as the new CE Action Plan For a cleaner and more competitive Europe (European Commission, 2020a) or the 2030 Agenda for Sustainable Development and is recognized as a policy lever for the implementation of the 2030 Agenda.

3.2. Phase 2: Selection and study of reference sources

As a European reference source, only the RFSC is selected since the SDGs are applied and adapted to the Spanish territory and to our study levels in the AUE national strategy, which is included together with the EEEC and the ELEC as strategies that cover criteria of a CE nature.

In turn, the EEEC is materialized through successive Action Plans. The 2018 EEEC draft included its first Circular Economy Action Plan (PAEC, in its Spanish acronym), which covered the 2018–2020 annuities. The next PAEC corresponds to the period 2021–2023 and is available as a document for public information (Gobierno de España and Miteco, 2021).

During the study of the different reference sources selected, it was observed that the content and the application procedure in the different sources are similar, with a hierarchical structure organized in three scales (Table 2).

The first scale includes the general lines of action of each source, understood as "dimensions" in the case of RFSC, "strategic objectives" in the case of AUE, "axes of action" or "lines of action" in the case of EEEC and "strategic axes" in the case of ELEC. All the reference sources are structured around 5 or 10 general lines, reflecting their global nature. However, in the case of the ELEC, this scale is subdivided into an intermediate one in which "circular policies" are defined for almost all its "strategic axes", except in the case of "cross-cutting policies".

In the second scale, the general lines of action of most of the sources are specified and defined as "objectives'' according to RFSC, "specific objectives'' in the AUE, "measures" in the EEEC or "measures" in the ELEC. It is at this scale that actions are established and the most relevant stage of the implementation process is carried out. In most cases, they are developed as packages of 29 or 30 actions, although in the EEEC the number of actions rises to 70 in the PAEC 2018–2020 or 112 in the PAEC 2021–2023. In the case of the AUE, the lines of action, as such, are proposed as examples, so we do not consider them as part of the study framework.

The third and last scale corresponds to monitoring the lines of action of each reference source through their corresponding indicators, which are simply identified as "indicators'' in the RFSC, "monitoring and evaluation indicators" in the AUE, "indicators'' or "general indicators" in the EEEC's PAEC 2018–2020, "indicators for the axes or lines of action" together with "measurement indicators" in the EEEC's PAEC 2021–2023 or "monitoring indicators" in the ELEC. The AUE contains the lowest number of indicators, since it only specifies 72, while most of the reference sources contain more than 130, reaching up to 167 in the case of the RFSC.

Therefore, as the main aspects of the lines of action of each reference

source are concentrated in the 1st and 2nd scales,[4] these constitute the framework of study of this research. However, the adaptation and homogenization processes (section 3.3.2, and 3.3.3) are carried out only on the 2nd scale, because it constitutes the main body of the content of the reference sources.

At this point of the article, it is important to indicate that initial studies point out a distinction between different types of indicators, such as environmental indicators or sustainable development indicators pointed out by Quiroga Martínez (2001) or state or environmental indicators and SI defended by Higueras García (2009). It is in consideration of this issue together with the need for the use of a "common lexicon" (Cohen, 2017), when it is decided to point out the different elements of sources as a goal in general, simply understanding that "indicators are an essential component in the overall assessment of progress towards sustainable development" (Gallopin, 1997).

3.3. Phase 3: Creation of the reference map

The creation of such a map is carried out in a sequence of four steps (Fig. 1), which are specified and developed below.

3.3.1. Selection of goals

The selection of goals is based on the relationship between the reference sources and the levels of study, i.e., urban planning, architecture and construction. Obviously, the very urban nature of most of the sources and their original objective of creating sustainable cities and communities directly relates them to urban environments. In this research, this relationship is obtained through two aspects: the explicit link to SDG 11 on sustainable cities and communities and the use of keywords. For this purpose, an exhaustive search and analysis of the documents of each reference source is carried out.

To facilitate the presentation of the research data, we work from a numerical coding of the 1st and 2nd scale of the reference sources (Appendix A). The following paragraphs justify this relationship for each of the sources.

On the one hand, the specific relationship with SDG 11 (Table 3) has been obtained, in most cases, from the official documents of the reference sources. However, in RFSC case a simulation is also carried out in the RFSC online tool (RFSC, n.d.) to obtain its link to SDG 11, since it is not directly specified. This simulation compares the SDG framework with the RFSC, facilitating the link identification with SDG 11. In the case of the PAEC 2018–2020, this link could not be established because it is not specified anyway, nor directly or indirectly.

On the other hand, this study lets distinguish the keywords related to the field of study, which have been classified according to whether they belong to the macro, medium or micro dimension in Table 3. Any expert could clearly differentiate these keywords based on their meaning, therefore this identification is based in an assumed way on the authors' own knowledge (Avdiushchenko y Zając, 2019).

As seen in Table 3, in the case of both RFSC and AUE, the relationship

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[4] A complete list of the 1st and 2nd scales of each reference source can be found in Appendix A.

Table 3

Selection of goals.

Relationship between reference sources and urban planning, architecture and construction									Goals selected	
Reference sources	Specific relationship with SDG 11		Relationship based on keywords						1st scale	2nd scale
	1st scale	2nd scale	1st scale_key words			2nd scale_key words				
			Macro	Medium	Micro	Macro	Medium	Micro		
RFSC	1, 2	1.3, 1.4, 1.5, 1.6, 2.1	1_spatial	–	–	1.1_urban planning, land 1.2_spatial 1.3_territorial 1.4_urban 1.5_public spaces 1.6_mobility 2.1_territorial	1.4_architectural	–	1, 2	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1
AUE	1, 2, 3, 4, 5, 6, 8, 9, 10	1.1, 1.2, 1.3, 2.3, 3.1, 3.2, 4.4, 5.2, 6.2, 8.1, 8.2, 10.2	1_territory, landscape 2_city 5_mobility, transport 7_urban	8_housing	–	1.1_land, territorial 1.2_landscape 1.3_green and blue infrastructures 2.1_urban 2.2_use 2.3_public spaces 2.4_urban 2.5_urban 3.1_territorial, urban 5.1_city 5.2_transportation 6.1_urban 9.1_cities	2.6_buildings 8.1_housing 8.2_housing	–	1, 2, 3, 4, 5, 6, 8, 9, 10	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 3.1, 3.2, 4.4, 5.1, 5.2, 6.1, 6.2, 8.1, 8.2, 9.1, 10.2,
EEEC PAEC 2018–2020	–	–	1_design	1_design	1_design	1.3_eco-design 6.8_ tourist destinations 7.4_ tourist municipalities	1.3_eco-design 1.5_ building 1.13_ tourist accommodations	1.3_eco-design 4.4_construction, demolition 4.6_construction	1, 4, 6, 7	1.3, 1.5, 1.13, 4.4, 4.6, 6.8, 7.4
PAEC 2021–2023	2, 3	2.4.5, 3.1.1, 3.2.1, 3.2.2, 3.2.3, 3.2.7, 3.2.9, 3.3.1	–	–	–	1.2.1_ eco-design 1.3.2_ tourist destinations 1.3.5_ municipalities	1.2.1_ eco-design	1.1.3_construction 1.2.1_eco-design 3.2.7_construction, demolition	1, 2, 3	1.1.3, 1.2.1, 1.3.2, 1.3.5, 2.4.5, 3.1.1, 3.2.1, 3.2.2, 3.2.3, 3.2.7, 3.2.9, 3.3.1
ELEC	1, 3, 4	–	3_urban, spaces 4_spaces	–	–	2.a.1_ supply and sewerage network 2.a.4_ storm drainage 3.a.1_urban 3.b.1_ space, mobility 3.b.2_ transport 4.a.1_ rural development 4.a.2_ urban planning	1.b.1_home* 3.a.2_ building	1.b.5_construction, demolition	1, 2, 3, 4	1.b.1, 1.b.5, 2.a.1, 2.a.4, 3.a.1, 3.a.2, 3.b.1, 3.b.2, 4.a.1, 4.a.2

Note: The numerical coding included can be consulted in the tables of each reference source included in Appendix A.

* This keyword is included because it is understood as contrary to the following: "1.b.1. Promote segregation at source and separate waste collection (household)", "1.b.2. Promote segregation at source and collection of waste generated outside the home".

with the levels of study is justified in their 1st and 2nd scales by means of the two links generated by the relationship with SDG 11 and the keywords. However, in the case of the EEEC, we can only establish its relationship through keywords, although it also occurs in the 1st and 2nd scales. Finally, the ELEC establishes a specific relationship with SDG 11, but only in its 1st scale, although the keywords establish a relationship with the levels of study in both the 1st and 2nd scales.

The multilevel nature of the scope of this research has been taken into account when linking using keywords. This action lets relate the indicators from the base sources with all levels of study (urban planning (macro), architecture (medium) and construction (micro)) (Table 3). This is a relevant question within the methodology, because if we only took into account one of the levels, such as the macro of the city, other indicators related to architecture and construction would not be selected, and vice versa. A fusion represented in the goals is proposed, which are valid for all levels. Subsequently, this distinction of levels is not carried out.

The relationship between reference sources and levels of study is duly recognized through these two links. This is a straightforward identification that is understood to need no further discussion (Van Dijk et al., 2014). The following sections justify this relationship for each of the sources.

Once the relationship between the levels of study and the reference sources has been established, the selection of the goals is made according to the relationship already established and from the bottom upwards, i.e., from the 2nd scale to the 1st scale. This means that it is the 2nd scale elements that establish the 1st scale that is selected and not the other way around. The latter is relevant in the sense that not all 2nd scale indicator items are selected because they belong to a selected 1st scale, nor is a 1st scale selected that does not have any item in the selected 2nd scale. This strategy allows the selection to be as complete and coherent as possible (Table 3).

3.3.2. Adaptation to study levels

The levels of study constitute an environment established in the city or human settlement, which, at the same time, encompasses its architecture and construction. The problem arises with the adaptation of those indicators that have been conceived from a general point of view (Sánchez Levoso et al., 2020).

This is the case with the EEEC for some of the goals selected in section 3.3.1. This adaptation (carried out only for 2nd scale goals according to section 3.2) follows a general line by substituting or eliminating terms related to norms and laws and introducing verbs such as "develop", "promote", "control" or "prevent". In this way, the general issues underlying the goals are transformed into issues compatible with the levels of study and the general structure of the other goals is followed. The adapted goals are shown in Table 4 and their modification is shown in Fig. 2.

3.3.3. Homogenization of goals

The selected goals have similarities among them, so a simple homogenization process is carried out, identifying the goals with a common meaning. The 1st scale will remain easily recognizable in the reference map (Fig. 3, Table 6) for each corresponding reference source as this process is carried out only for 2nd scale goals (section 3.2). As shown in Fig. 2, similarities are first established between goals of the same reference source but of different temporality, and then by groups of goals according to the nature of their sources and the concept in which they establish their rationale. In this way, those related to the different EEEC Action Plans are analyzed first, followed by those from the reference sources RFSC and AUE with respect to sustainability and those from EEEC and ELEC with respect to the CE, and finally all the selected goals. The relationship between the goals in most cases is understood as obvious and needs no discussion (Van Dijk et al., 2014).

Once this has been done, two goals operations are carried out (see "OP" in Table 5):

- Conversion: it does not undergo any change. This is the case when it is not related to any other goal and therefore acts independently, without homogenization.
- Union: one that includes all of them is incorporated. This is done when two or more goals are similar. In the case of goals that are similar to a greater extent, the union gives rise to an almost identical indicator. In the case of less similar goals, the union generates a new indicator as a compendium of the previous ones.

This results in 27 goals, as shown in Table 5.

3.3.4. Final resolution: reference map

The map is materialized from 27 goals in a figure (Fig. 3) that is detailed in a register (Table 6), achieving a complete definition of the map. The map and the detailed register are read in the same way, from the outside to the inside. The following scales are observed in them:

- 1st Scale: corresponds to the 1st scale of the selected 2nd scale goals of the reference sources (Table 3) (which have subsequently been adapted and homogenized (Tables 4 and 5)), which can be consulted in the tables of Appendix A. This allows us to transfer or compare the results obtained from the analyses carried out in this map with those obtained from the reference sources in other case studies. In the map (Fig. 3) it is indicated in the outer rings, and is reflected by the initials of each of the goals.
- 2nd Scale: represents the 27 goals obtained (Table 5) from the homogenization process (section 3.3.3.). This is the main body of the map and forms the basis of the sustainability and CE analysis of the case study to which it is applied. It corresponds to the inner ring of the map (Fig. 3) and is identified only by the number of the goal on it. The complete goal is indicated in the detailed map record (Table 6).
- 3rd Scale: includes a list with 155 indicators as such, coming directly from the selected 2nd scale goals of the reference sources (Table 3) (which have subsequently been adapted and homogenized (Tables 4 and 5)) and that, can be used to measure the progress of the projects implemented in favor of sustainability and the CE in the area of study. This scale is not included in the Fig. 3 due to its length and is developed in Table 6. In addition, an extended version of the detailed map record (see Table B1 in the Appendix B) details the methodology and the necessary expressions to obtain the indicators, along with the units of measurement, as indicated by the reference sources.

As a practical example, to apply goal nº1 "Manage the land in a manner compatible with its territorial environment, with sustainable urban planning and land use" (2nd scale), reference sources are located (Fig. 3, Table 6) through their goals: "Spatial"in RFSC and "Territory, landscape and biodiversity" in AUE (1st scale). Next, Table 6 is used to obtain the indicators referring to the base sources (3rd scale). Thus, the following RFSC indicators could be applied: "Ratio of land consumption to population growth rate", "Brownfield redevelopment", "Congestion index", "Roads maintenance", "Population density", "Housing space per capita"; and the following AUE indicators: "In the instruments of urban and land-use planning, are criteria incorporated to ensure the rational use of land based on sustainable development?", "Correlation between land development, demographic dynamics, employment and economic activities", "Budget for the actions planned to promote agricultural, livestock and rural development activities on lands preserved from urban transformation". Following the application process, taking the indicator "Ratio of land consumption to population growth rate", the measurement is made taking into account what is included in Table B1 in Appendix B, and therefore applying the formula "(Surface areas for which the land use has changed from agriculture, forest and other semi-natural and natural areas to urban and artificial land)/(growth of the population)", obtaining as a result a quantitative ratio.

In the application of the case study, discrepancies have been observed due to the fact that not all the base sources deal with the

Table 4
Goals of the EEEC that need to be adapted to the levels of study and its adaptation.

Reference sources	No.	Goals	Adapted goals
PAEC 2018–2020	1.3	Development of European eco-design and CE standards	Develop eco-design and CE
	1.5	Inclusion of CE measures in the development of building regulations	Develop the CE in building
	4.6	Elimination of regulatory barriers to the reuse of materials and products in the construction sector	Promote the reuse of materials and products in the construction sectors
PAEC 2021–2023	1.2.1	New eco-design regulations	Develop eco-design
	3.1.1	The new Waste and Contaminated Soil Law	Control waste and contaminated soils
	3.2.1	Revision of packaging and packaging waste regulations	Control of packaging and packaging waste
	3.2.2	Revision of the legal regime for batteries and their wastes	Control batteries and battery waste
	3.2.3	Strengthening of the legal regime for waste equipment management	Control equipment waste
	3.2.7	New legal framework for construction and demolition waste production and management	Control the production and management of construction and demolition waste
	3.2.9	Regulation of organic matter from waste	Control organic matter from waste
	3.3.1	Preparation and approval of the new Waste Prevention Program and the State Waste Management Framework Plan	Waste prevention and management

indicators in depth (see Table B1 in the Appendix B). In the case of RFSC, the information is very detailed, the application is simple and correctly directed, as can be seen in indicators such as "Ratio of land consumption to population growth rate". AUE includes less information due to in most cases it proposes to consult the policies or plans, and therefore a methodology is not required, for example with the indicator "In the instruments of urban and land-use planning, are criteria incorporated to ensure the rational use of land based on sustainable development?". However, when AUE proposes some indicators that require further explanation, such as "Sustainability of urban freight distribution (last mile)", the necessary information for its application is provided. Moreover, the reference sources EEEC and ELEC behave in the opposite way: the first one does not provide any methodological guidance information and the second provides examples of good practices related to its indicators. In the case of EEEC, due to the simplified and clear nature of its indicators, such as "No. of properties leased within the framework of the Assets for Development Program/annual frequency", it can be considered that it is not necessary to access methodological information. Although ELEC presents many clear indicators, such as "No. of pedestrian routes", this is not the case with other complex indicators, such as "Carbon footprint in the public transport sector". This issue is understood as a limit when applying RMap, since additional research is required by the agents involved applying the indicators; in turn, it also directly causes the quality of the RMap application to depend on the quality of the reference sources. The homogenizing nature of RMap can provide a solution to the mentioned limit, since when treating several reference sources for the same goal (2nd scale) several indicators are provided (3rd scale), so problems can be ruled out, being able to evaluate that goal with the rest of the indicators provided. Thus, in addition to the indicator "Carbon footprint in the public transport sector" (Table 6), there are 19 other indicators available for goal n°6.

Furthermore, different heterogeneities between the standards had to be resolved, such as the adaptation to the study levels of the EEEC because it deals with the CE in a generalized and normative way, and the integrated work with its two PAECs due to it is a standard with temporal progress. Although the adaptation of goals has been positively carried out (see Table 4), this step has focused only on adaptation in the 2nd scale (section 3.2 and 3.3.2). In some cases (i.e goals 21, 22 and 23 in Table 6), the indicators in 3rd scale have no sense for the case study and therefore have not been incorporated into the detailed map record. On this matter, Mitchell et al. (1995) suggests that the indicators "should be reviewed by the group that intends to use the indicators".

4. Conclusions

The assessment of sustainability and CE is gaining much prominence especially in urban environments; however, the existence of a large number of frameworks and indicator systems hinders and distracts its

application. After analyzing SI and CEI trends in cities, as well as existing official frameworks and tools, this article proposes the RMap methodological framework for their resolution.

The above map reflects the complexity of the subject of study through a holistic approach, combining and integrating different frameworks and catalogs of sustainability and CE, since it reflects the multi-conceptuality of the reality (sustainability and CE), responding to a multilevel (urbanism, architecture and construction) collected at the macro level of the urban, within a multi-scope (from Europe to the local of each case), developing in a multi-scale of the reference sources.

The main implications of the RMap methodological framework and thus, of the map created for the Spanish case study focus on the following issues.

On the one hand, the theoretical implications:

- From the point of view of the scientific research that has been carried out, it is concluded that it is possible to facilitate comparison with other case studies in the same or different fields. This comparison can be made both from directly comparing and similar common objectives (identified by the homogenization process) that depend on the evaluation being carried out in the same reality, in the same way. Consequently, by knowing and establishing that the content of the goals is similar, they can be compared relatively according to the scope that has been obtained in the measurement scales established for each indicator.
- It is rigorous, since it collects existing official sources. Accordingly, it is replicable in other areas due to the use of similar strategies or frameworks at European level. In the case study conducted, the RFSC framework is common to all of Europe and there is a parallelism between the Spanish regulations or programs and those of the rest of the European countries and regions based on the Urban Agendas or the CE strategies. The final adaptation to each local case reinforces this issue, managing to promote the exchange of experiences and therefore membership and participation in sustainability and CE networks.

On the other hand, the practical implications:

- The homogenization of indicators makes the created map a simpler and more transparent tool, in addition to harmonizing the horizon of existing indicators. It also makes it possible to evaluate simultaneously in several frameworks and to obtain a global vision.
- The limits between the different levels of study are removed in a certain way by integrating goals related to the three levels of study, to later deal with them together (section 3.3.1.). This proceeding favors interdisciplinarity, which is an essential aspect in the built environment research (Pomponi and Moncaster, 2017). "Super indicators" could be introduced, as they serve any scale transversally.
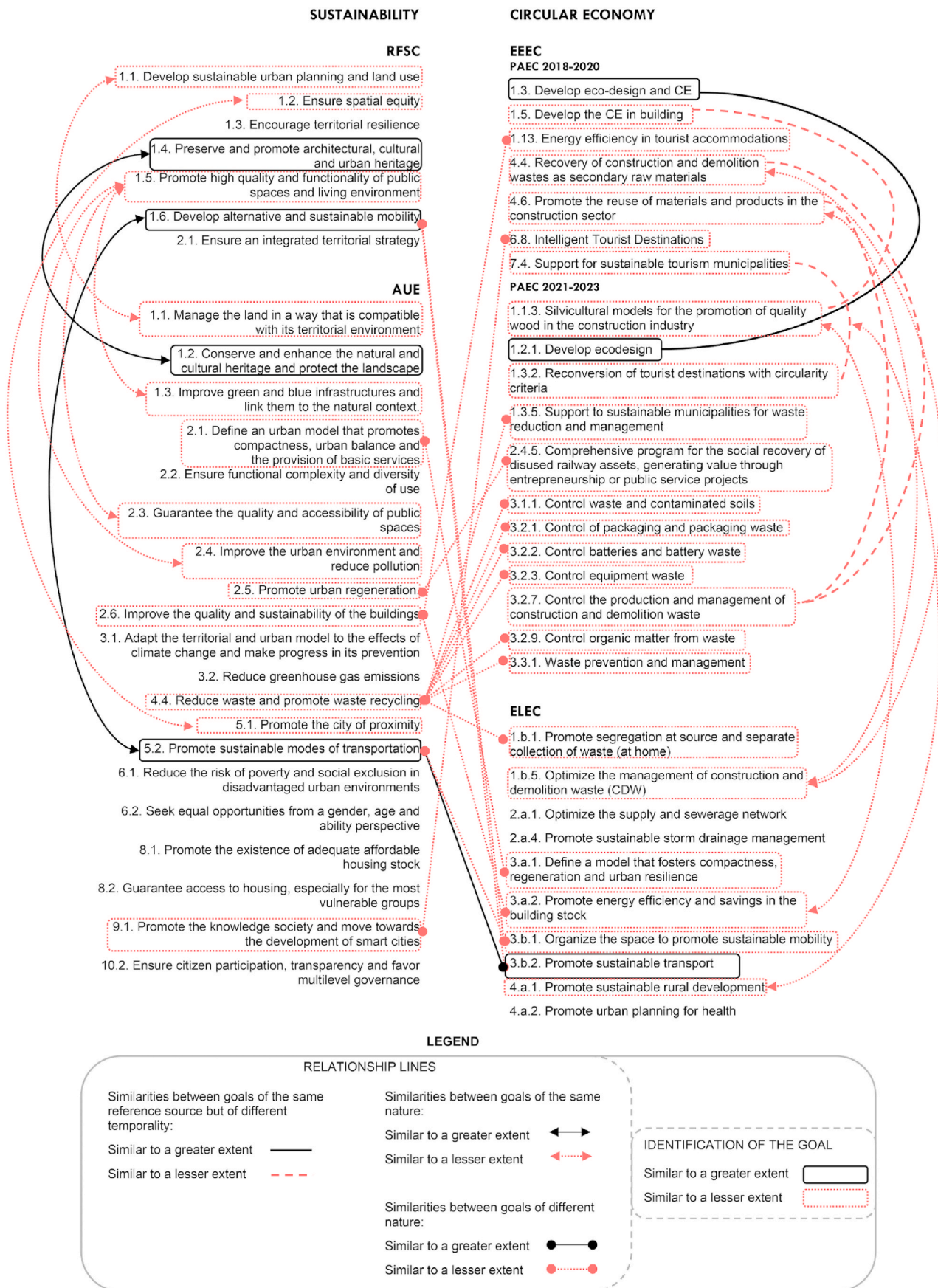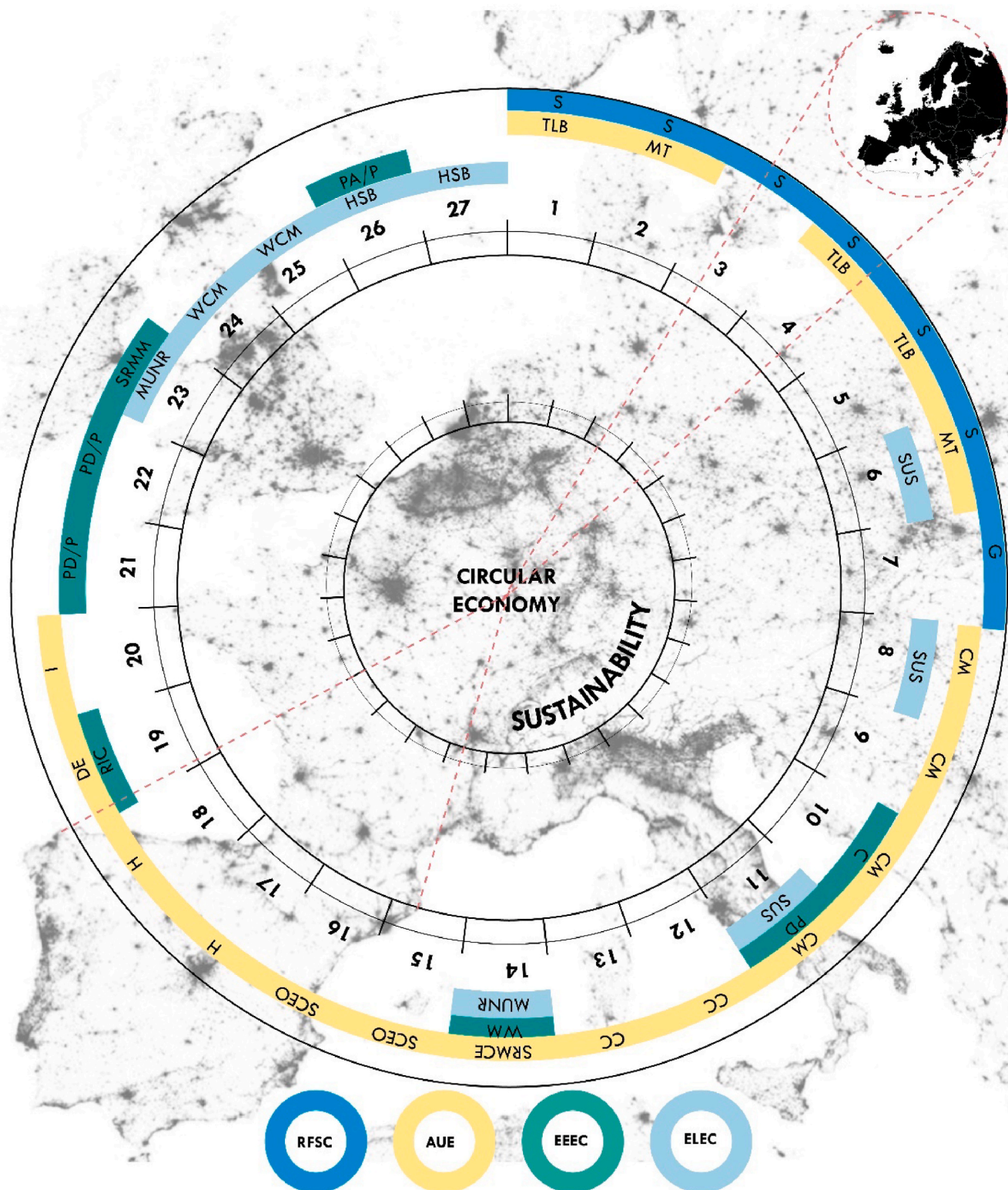
Fig. 2. Similarities between the goals (created by the author).

C = Consumption / CC = Climate change / CM = City model / DE = Digital era / G = Governance / H = Housing / HSB = Healthy spaces and behaviors / I = Instruments / MT = Mobility and transport / MUNR = Minimization of the use of natural resources / P = Production / PA = Participation and awareness / PD = Production and design / RIC = Research, innovation and competitiveness / S = Spatial / SCEO = Social cohesion and equal opportunities / SRMCE = Sustainable resource management and circular economy / SRMM = Secondary raw materials market / SUS = Sustainability of urban spaces / TLB = Territory, landscape and biodiversity / WCM = Water consumption management / WM = Waste management.

Note: The numerical coding included can be consulted in Table 5 or in Table 6 of the detailed map record.

Fig. 3. Map of sustainability and the CE in urban planning, architecture and construction, at the European and Spanish national levels (created by the author).

Table 5
Homogenization of goals.

Reference sources* (2nd scale)					OP		Goals obtained	
RSFC	AUE	EEEC — PAEC 2018–2020	PAEC2021-2023	ELEC	C	U	No.	Goal
1.1	1.1					●	1	Manage the land in a manner compatible with its territorial environment, with sustainable urban planning and land use.
1.2	5.1					●	2	Ensure spatial equity and favor the city of proximity.
1.3					●		3	Foster territorial resilience.
1.4	1.2					●	4	Conserve and enhance the architectural, cultural, urban and natural heritage and protect the landscape.
1.5	1.3 2.3 2.4					●	5	Promote the high quality, functionality and accessibility of public spaces and the living environment, as well as improve the urban environment and green and blue infrastructures and link them to the natural context.
1.6	5.2			3.b.1 3.b.2		●	6	Promote alternative and sustainable modes of transportation and mobility, and organize the space for this purpose.
2.1					●		7	Ensure an integrated territorial strategy.
	2.1			3.a.1		●	8	Define an urban model that promotes compactness, urban balance, regeneration, the provision of basic services and urban resilience.
	2.2				●		9	Ensure functional complexity and diversity of use.
	2.5		2.4.5			●	10	Promote urban regeneration, as well as the social recovery of disused railway assets by generating value through entrepreneurship or public service projects.
	2.6	1.13		3.a.2		●	11	Improve the quality, sustainability and energy efficiency of buildings.
	3.1				●		12	Adapt the territorial and urban model to the effects of climate change and make progress in its prevention.
	3.2				●		13	Reduce greenhouse gas emissions.
	4.4		1.3.5 3.1.1 3.2.1 3.2.2 3.2.3 3.2.9 3.3.1	1.b.1		●	14	Reduce and prevent waste, promote recycling, segregation and separate collection, as well as control contaminated soils and waste packaging, batteries, appliances and organic matter from waste, supporting sustainable municipalities.
	6.1				●		15	Reduce the risk of poverty and social exclusion in disadvantaged urban environments.
	6.2				●		16	Seek equal opportunities from a gender, age, and disability perspective.
	8.1				●		17	Promote the existence of adequate affordable housing stock.
	8.2				●		18	Guarantee access to housing, especially for the most vulnerable groups.
	9.1	6.8				●	19	Promote the knowledge society, move towards the development of smart cities and promote intelligent tourist destinations.
	10.2				●		20	Ensure citizen participation, transparency and favor multilevel governance.
		1.3	1.2.1			●	21	Promote eco-design and the CE.
		1.5	1.1.3			●	22	Promote the sustainable use of resources and develop silvicultural models for the promotion of quality timber in construction.
		4.4 4.6	3.2.7	1.b.5		●	23	Promote the recovery, reuse and optimization of construction and demolition waste management, as well as its control.
				2.a.1	●		24	Optimize the supply and sewerage network.
				2.a.4	●		25	Promote sustainable storm drainage management.
	7.4		1.3.2	4.a.1		●	26	Promote sustainable rural development and sustainable tourism municipalities, and reconvert tourism destinations based on circularity criteria.
				4.a.2	●		27	Promote urban planning for health.

OP = operation//C = Conversion//U = Union.

Note: The numerical coding included can be consulted in the tables of each reference source included in Appendix A.

Future research on implementation of the framework is supported by these last theoretical and practical implications. This procedure will stimulate a parallel critical analysis of existing frameworks as well as actual support for the EC and the definition of key dimensions of sustainable, circular urban environments. At the same time, it opens the possibility of expanding the methodological framework taking into account the need for participation in processes such as planning (Agger and Löfgren, 2008). The flexibility of the RMap methodology and its iterative application would allow the development of an alternative map for each case study that includes the participation of the relevant agents. This could be done once the local adaptation of the map to the case study has been carried out, supported by methodologies that transform technical indicators (in this case the goals) into themes that collect the perceptions obtained through participation, like InPar (Paisaje Transversal, 2013Paisaje Transversal, 2013; Paisaje Transversal, 2019). This qualitative aspect is noteworthy, since, although some authors such as Geissdoerfer et al. (2017) or Sauvé et al. (2016) only consider economic and ecological objectives, others such as Kirchherr et al. (2017) or

Murray et al. (2017) consider social objectives of CE as part of sustainable development. The latter supports the idea that decision making in the framework of sustainable development should not be free of social responsibility (Suárez-Eiroa et al., 2019). In this way, top-down (led by technicians or experts) and bottom-up (led by the local community) perspectives would be contributed and combined, considered as a necessary integration (Waas et al., 2014). This would make it possible to achieve the "hybrid knowledge needed" to carry out local sustainable development initiatives (Reed et al., 2006).

One issue to keep in mind is that this proposal is made from the field of research and is focused on the levels of study since it is intended to evaluate and understand sustainability and CE in urban planning, architecture and construction. If the intention is to lead broader studies focused on other issues (i.e local entities studying municipal sustainability in a more global way, or NGOs focusing on a social or political aim) the RMap methodological framework could still be valid. The differences would lie in the selection of goals based on SDGs and keywords related to the aspects to be studied (process carried out in section 3.3.1.).

Table 6
Detailed map record.

1st scale			2nd scale	3rd scale
S	T L B		1. Manage the land in a manner compatible with its territorial environment, with sustainable urban planning and land use.	• Ratio of land consumption to population growth rate • Brownfield redevelopment • Congestion index • Roads maintenance • Population density • Housing space per capita
				• In the instruments of urban and land-use planning, are criteria incorporated to ensure the rational use of land based on sustainable development? • Correlation between land development, demographic dynamics, employment and economic activities. • Budget for the actions planned to promote agricultural, livestock and rural development activities on lands preserved from urban transformation.
S	M T		2. Ensure spatial equity and favor the city of proximity.	• Basic services proximity • Percentage of people within 0,5 km of public transit running at least every 20 min • Compare "basic services proximity" in the Deprived Neighbourhood Areas relatively to the whole city
				• Are there "Worksite Transportation Plans" in the city to streamline travel to the main work centers? • Modal distribution of trips (all reasons) in the urban area. • Sustainability of urban freight distribution (last mile)
S			3. Foster territorial resilience.	• Did you implement a risk reduction and resilience strategy? • Fuel Poverty
S	T L B		4. Conserve and enhance the architectural, cultural, urban and natural heritage and protect the landscape.	• Do you have a heritage preservation policy? • Expenditure of local authority dedicated to the preservation, protection and conservation of cultural heritage per inhabitant • Evolution of the tourist frequency • Share of listed building restored
				• Is there a "Municipal Natural and Cultural Heritage Management Plan" or similar, to ensure its proper conservation and enhancement? • Budget for the actions planned to preserve and/or improve the natural and cultural heritage, including those destined to the urban-rural connection. • Area of buildings or places belonging to the cultural heritage upgraded and/or rehabilitated.
S	T L B		5. Promote the high quality, functionality and accessibility of public spaces and the living environment, as well as improve the urban environment and green and blue infrastructures and link them to the natural context.	• Satisfaction with public spaces • Square meters of public outdoor recreation space per capita • Availability of Basic Services • Access time to services • Percentage of people living within 300m of a public open area
				• Have green and water infrastructure plans been made based on the natural context? • Land area intended for urban green infrastructures in which actions will be carried out to recover, improve and interconnect for its network operation. • Are there plans to improve public space, which identifies problems and programs actions to guarantee universal accessibility and noise reduction? • Land area intended for public spaces in which actions will be carried out to improve accessibility and eliminate architectural barriers. • Land area intended for public spaces in which actions will be carried out to reduce noise and improve acoustic comfort. • Are there quality urban environmental plans to improve urban green areas and reduce pollution? • Percentage of people close to urban green areas or recreation areas. • Urban land area intended for recovery, rehabilitation or improvement actions.
S	M T	S U S	6. Promote alternative and sustainable modes of transportation and mobility, and organize the space for this purpose.	• Percentage of trips by private motorised transport • Percentage of people within 0,5 km of public transit running at least every 20 min • Passenger transport prices • Satisfaction with level of public transport services • Percentage of pedestrian streets and walkways
				• Is there a Sustainable Urban Mobility Plan (SUMP) in the city? • No. of buses with low emissions or "clean" fuels destined for urban public transport. • No. of trips by public transport.
				• No. of pedestrian routes. • No. of infractions derived from damage to pedestrians in public space. • Kilometers of cyclist routes. • No. of bicycle parking places. • Inventory of public roads. • Estimated travel time during peak traffic hours. • No. of deterrent parking areas. • No. of actions developed to promote pedestrian and cyclist mobility. • Increase in the number of users of public transport. • Carbon footprint in the public transport sector. • No. of vehicles that use alternative fuels registered in the municipality. • No. of public workers who travel on foot or by bicycle to their jobs.
G			7. Ensure an integrated territorial strategy.	• Latest approval or revision date of a master plan with an integrated vision for the city as a whole • Level of implementation of Agenda 21 processes / sustainable urban development masterplan • Adoption of integrated urban plans (environment, transport, land use) • Existence of multiscale level in the Urban Masterplan within focus on Deprived Neighbourhood Areas
	C M	S U S	8. Define an urban model that promotes compactness, urban balance, regeneration, the provision of basic services and urban resilience.	• Are there management criteria that improve compactness and urban balance in the consolidated city and in new developments? • Percentage of people close to the main basic services. • Area of public buildings and municipal facilities on which actions to improve quality and adaptation to existing demand will be carried out.
				• Percentage of waterproofed soil. • Vacant developable land area. • Constructed area as a result of exhausting its building capacity. • No. of houses rehabilitated.. • No. of underused buildings. • Redeveloped area in abandoned or disused industrial areas. • Green area surface. • No. of self-promotion campaigns in the urban area. • No. of urban planning initiatives for adaptation to climate change.
	C M		9. Ensure functional complexity and diversity of use.	• Are there criteria that improve the functional complexity and the mix of uses in the consolidated city and in new developments? • Urban land area in which actions to improve and readjust the uses will be carried out, to favor

1st scale	2nd scale			2nd scale objective	3rd scale
					proximity and diversity of uses in the city.
C M	C			10. Promote urban regeneration, as well as the social recovery of disused railway assets by generating value through entrepreneurship or public service projects.	• Is there a plan for urban regeneration of neighborhoods, which incorporates actions for social, economic and environmental improvement? • Budget for urban regeneration actions planned in vulnerable neighborhoods from a social, economic or environmental point of view. • Budget for actions in urban rehabilitation covered by public housing plans. • No. of properties leased within the framework of the Assets for Development Program / annual frequency.
C M	P D	S U S		11. Improve the quality, sustainability and energy efficiency of buildings.	• Is there a plan for the rehabilitation of the buildings, which makes a diagnosis of their situation and establishes priorities and actions to promote their improvement? • Surface of buildings subject to rehabilitation actions. • No. of homes subject to rehabilitation actions. • No. of actions financed. • Typology of buildings according to their energy efficiency rating. • No. of energy rehabilitations. • No. of energy audits carried out in buildings and public facilities • No. of distinctions of excellence for energy efficiency and savings awarded in the commercial and industrial sectors. • Evolution of the energy consumption of the Local Entity and its dependencies. • No. of assistances for energy advice carried out. • Campaigns to promote energy efficiency and savings in homes. • Percentage of renewable energy consumed over the total.
C C				12. Adapt the territorial and urban model to the effects of climate change and make progress in its prevention.	• Is there a plan or strategy for local adaptation to climate change and prevention against natural risks? • Urban land area in which it is planned to carry out actions to improve or prevent natural risks, including the risk of fires and floods.
C C				13. Reduce greenhouse gas emissions.	• Is there an air quality plan or strategy that makes a diagnosis of your situation and establishes priorities and actions to promote its improvement? • Estimated annual reduction in greenhouse gases (GHG) and in the number of days in which air quality limits are exceeded.
S R M C E	W M	M U N R		14. Reduce and prevent waste, promote recycling, segregation and separate collection, as well as control contaminated soils and waste packaging, batteries, appliances and organic matter from waste, supporting sustainable municipalities.*	• Are there waste management plans, or equivalent, with the aim of increasing the percentage of selective collection and recycling? • Generation of waste per inhabitant. • Management plans for tourist municipalities implemented. • Increase in the amount of waste separated in their respective fractions. • No. of fractions collected from municipal waste. • No. of containers by waste fractions and by number of inhabitants on public roads. • Trash container review frequency. • Degree of citizen satisfaction with the waste collection service.
S C E O				15. Reduce the risk of poverty and social exclusion in disadvantaged urban environments.	• Are the urban environments that present a greater degree of social, economic and environmental vulnerability adequately identified? • Budget invested in actions carried out in vulnerable neighborhoods from a social, economic or environmental point of view.
S C E O				16. Seek equal opportunities from a gender, age, and disability perspective.	• Is there a Plan or Strategy at the local level to guarantee equal opportunities, access to the job market and public life under equal opportunities? • Is there a Plan or Strategy that carries out protocols for the early detection of vulnerability/social exclusion? • Budget invested in actions aimed at guaranteeing equal opportunities from a social, economic and environmental point of view.
H				17. Promote the existence of adequate affordable housing stock.	• Is there a local housing plan that favors the existence of a public and private housing stock adapted to demand and, in particular, encourages rental housing at affordable prices? • No. of homes subject to protection regimes included in local housing plans. • No. of homes for social rent at an affordable price.
H				18. Guarantee access to housing, especially for the most vulnerable groups.	• Is there a plan of aid to guarantee access to housing for the most vulnerable households and groups, with particular attention to young people, the elderly and those affected by eviction processes? • No. of beneficiaries of the programs included in public housing plans.
D E	R I C			19. Promote the knowledge society, move towards the development of smart cities and promote intelligent tourist destinations.	• Is there a local plan or strategy to development a smart urban model? • No. of users that are covered by a certain electronic public Smart Cities service. • No. of tourist destinations.
I				20. Ensure citizen participation, transparency and favor multilevel governance.	• Is there a participatory budget and/or a municipal citizen participation plan that promotes active citizenship and empowerment? • Is the content of urban planning offered by electronic means and has it been incorporated into the information systems at the supramunicipal level? • Are there effective mechanisms to promote multilevel governance and, in particular, the coordination of management instruments?
	P D / P			21. Promote eco-design and the CE.*	
	P P D / P			22. Promote the sustainable use of resources and develop silvicultural models for the promotion of quality timber in construction.*	• Forest management models for the production of structural wood approved by the different Autonomous Communities. • No. of operational groups and innovative projects that incorporate the use of structural wood.
	S R M M	M U N R	W C M	23. Promote the recovery, reuse and optimization of construction and demolition waste management, as well as its control.*	• Increase in te collection of Construction and Demolition Waste (CDW) at clean points. • Decrease in the amount of CWD deposited in landfills. • Increase in the amount of recoverable materials used from CWD. • No. of sanctions applied related to the mismanagement of CWD.
			W C M	24. Optimize the supply and sewerage network.	• Evolution of network performance. • No. of leaks detected per network kilometer and year. • No. of failures detected per network kilometer and year. • No. of remote reading meters installed. • Proportion of separate sewerage networks. • No. of inspections of wastewater discharges carried out. • No. of sanctions imposed related to wastewater discharges. • No. of awareness campaigns on inappropriate waste in sewarage networks carried out..
			W C	25. Promote sustainable storm drainage management.	• No. of urban actions that integrate the sustainable management of rainwater. • Quality of the receiving stormwaters of urban runoff.

1st scale		2nd scale	3rd scale
P A / P	M H S B	26. Promote sustainable rural development and sustainable tourism municipalities, and reconvert tourism destinations based on circularity criteria.	• No. of urban sustainable storm drainage systems installed. • Management plans for tourism municipalities implemented. • No. of annual requests (for conversion of tourism destinations with circularity criteria). • No. of integrated management plans for natural and/or cultural spaces. • No. of fires occurred. • No. of agreements for the custody of the territory. • No. of organic production companies. • No. of commercial products with a local denomination of origin. • No. of initiatives developed related to rural tourism. • No. of training programs for sustainable rural entrepreneurship. • No. of trade fairs held. • Evolution of the number of inhabitants in the municipality. • No. of women engaged in economic activities.
	H S B	27. Promote urban planning for health.	• Evaluations carried out to assess the urban adequacy. • Renewal of urban planning for healthy purposes. • No. of urban planning modifications to improve citizen health. • Actions undertaken for the recovery of public space. • Density of equipment and distance to residential areas. • No. of air quality control actions. • No. of noise complaints.

The legend of the table is in the figure of the map (Fig. 3).
Note: * Goals adapted to the study levels are incorporated, whose third-scale goals in the reference source have ceased to make sense after said adaptation. Therefore, they are not included in this detailed map record.

Being aware of the "subjectivity, multiplicity, ambiguity and complexity" (Latawiec and Agol, 2015) that indicators entail, it is not intended to provide a single solution. The subjectivity associated with the concept of indicators is inferred by each person's own perception of the world (Antequera and González, 2005) and such indicators should not be confused with a reliable reflection of reality, since they obviously reduce and simplify it (Waas et al., 2014). Similarly, to what Avdiushchenko and Zając (2019) warned, during the process of applying the framework to the Spanish case study, correspondences or relationships were established in an assumed manner due to the authors' own knowledge. Therefore, this research is presented under the recognition that there may be different results and not all can be included here (Hély and Antoni, 2019), since even each person's view of sustainability is variable and may modify the choices made (Rowley et al., 2012). All these issues are presented for understanding, like authors such as Latawiec and Agol (2015) or Kitchin et al. (2015), that an important part of working with indicators is that of transparency and identification of limitations even if it is understood that the results obtained have many positive contributions.

By way of clarification, this article places greater emphasis on cities or urban environments as a simplification. These are more widespread terms and more studied contexts so far, probably, because of issues such as the concentration of high global energy consumptions and the projections of increasing global urban population, noted by Sodiq et al. (2019). However, this research is understood to be applicable to any type of human settlement along the lines of SDG 11, since simply "Human settlement is a place where people live. […] Human settlements come in many forms and can be permanent and temporary, rural and urban, mobile and sedentary, disseminated and agglomerated." (Živković, 2019). The adaptability of the RMap methodological framework allows contextualizing the indicators to any local context, so it would admit cities, villages or any human settlement in general.

CRediT authorship contribution statement

Inmaculada Bote Alonso: Term, Conceptualization, Methodology, Data curation, Writing – original draft, Writing – review & editing, preparation, Visualization, Investigation, Funding acquisition. **Mónica Victoria Sánchez-Rivero:** Investigation, Supervision, Writing – review & editing, Funding acquisition. **Beatriz Montalbán Pozas:** Investigation, Supervision, Writing – review & editing, Funding acquisition.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

Appendix A. Numerical coding of the 1st and 2nd scale of the reference sources

The numerical coding of the 1st and 2nd scale of the reference sources used are presented below.

Table A.1
RFSC - Reference Framework for Sustainable Cities

1st SCALE	2nd SCALE
DIMENSIONS	OBJECTIVES
1. SPATIAL DIMENSION	1.1. Develop sustainable urban planning and land use
	1.2. Ensure spatial equity
	1.3. Encourage territorial resilience
	1.4. Preserve and promote architectural, cultural and urban heritage

(*continued on next page*)

Table A.1 (*continued*)

1st SCALE	2nd SCALE
DIMENSIONS	OBJECTIVES
	1.5. Promote high quality and functionality of public spaces and living environment
	1.6. Develop alternative and sustainable mobility
2. GOVERNANCE DIMENSION	2.1. Ensure an integrated territorial strategy
	2.2. Foster sustainable administration and financial city management
	2.3. Implement a process for assessment and continuous improvement
	2.4. Increase citizen participation
	2.5. Strengthen governance in partnership
	2.6. Facilitate capacity building and networking
3. SOCIAL DIMENSION	3.1. Ensure social inclusion
	3.2. Ensure social and intergenerational equity
	3.3. Build up a supply for housing for everyone
	3.4. Protect and promote health and well-being
	3.5. Improve inclusive education and training
	3.6. Promote culture and leisures opportunities
4. ECONOMICAL DIMENSION	4.1. Stimulate green growth and the circular economy
	4.2. Promote innovation and smart cities
	4.3. Ensure connectivity
	4.4. Develop employment and a resilient local economy
	4.5. Encourage sustainable production and consumption
	4.6. Foster cooperation and innovative partnerships
5. ENVIRONMENTAL DIMENSION	5.1. Mitigate climate change
	5.2. Protect, restore and enhance biodiversity and ecosystems
	5.3. Reduce pollution
	5.4. Adapt to climate change
	5.5. Manage natural materials resources sustainably and prevent waste
	5.6. Protect, preserve and manage water resources

Table A.2
AUE - Spanish Urban Agenda (in its Spanish acronym)

1st SCALE	2nd SCALE
STRATEGIC OBJECTIVE	SPECIFIC OBJECTIVES
1. TERRITORY, LANDSCAPE AND BIODIVERSITY	1.1. Manage the land in a way that is compatible with its territorial environment.
	1.2. Conserve and enhance the natural and cultural heritage and protect the landscape.
	1.3. Improve green and blue infrastructures and link them to the natural context.
2. CITY MODEL	2.1. Define an urban model that promotes compactness, urban balance and the provision of basic services.
	2.2. Ensure functional complexity and diversity of use.
	2.3. Guarantee the quality and accessibility of public spaces.
	2.4. Improve the urban environment and reduce pollution.
	2.5. Promote urban regeneration.
	2.6. Improve the quality and sustainability of the buildings.
3. CLIMATE CHANGE	3.1. Adapt the territorial and urban model to the effects of climate change and make progress in its prevention.
	3.2. Reduce greenhouse gas emissions.
	3.3. Improve resilience to climate change
4. SUSTAINABLE RESOURCE MANAGEMENT AND CE	4.1. Promote energy efficiency and energy savings
	4.2. Optimize and reduce water consumption
	4.3. Promote the materials cycle
	4.4. Reduce waste and promote waste recycling.
5. MOBILITY AND TRANSPORT	5.1. Promote the city of proximity.
	5.2. Promote sustainable modes of transportation.
6. SOCIAL COHESION AND EQUAL OPPORTUNITIES	6.1. Reduce the risk of poverty and social exclusion in disadvantaged urban environments.
	6.2. Seek equal opportunities from a gender, age and ability perspective.
7. URBAN ECONOMY	7.1. Seek local productivity, job creation and the revitalization and diversification of economic activity
	7.2. Promote sustainable and quality tourism and key sectors of the local economy
8. HOUSING	8.1. Promote the existence of adequate affordable housing stock.
	8.2. Guarantee access to housing, especially for the most vulnerable groups.
9. DIGITAL ERA	9.1. Promote the knowledge society and move towards the development of smart cities.
	9.2. Promote eGovernment and reduce the digital divide
10. INSTRUMENTS	10.1. Achieve an updated, flexible and simplified regulatory and planning framework that also improves management
	10.2. Ensure citizen participation, transparency and favor multilevel governance.
	10.3. Boost local training and improve funding
	10.4. Design and implement training and awareness campaigns in urban matters, as well as information exchange and dissemination

Table A.3
PAEC 2018–2020: Circular Economy Action Plan (in its Spanish acronym) of the EEEC

1st SCALE	2nd SCALE
AXES OF ACTION	MEASURES
1. PRODUCTION AND DESIGN	1.1. Inclusion of CE criteria in the Strategic Framework for Spanish Industry and its agendas
	1.2. Promote Industry 4.0 as an effective way to promote CE
	1.3. Development of European eco-design and CE standards
	1.4. Preparation of the Spanish Strategy for Blue Growth
	1.5. Inclusion of CE measures in the development of building regulations
	1.6. Inclusion of CE measures in the development of regulations on ship construction/repair and other sectoral regulations
	1.7. Promotion of the eco-label
	1.8. EMAS System integration in sectoral policies
	1.9. Promotion of the integral sustainability of the agri-food industry
	1.10. Support for organic food production
	1.11. Promotion of the production of wood and other forest raw materials
	1.12. Support for the reconversion of tourist destinations, revitalization plans and the State Financial Fund for the Modernization of Tourist Infrastructures
	1.13. Energy efficiency in tourist accommodations.
2. CONSUMPTION	2.1. Incorporation of CE criteria in public procurement and grants
	2.2. Implementation of the Strategy "More food, less waste" 2017–2020
	2.3. Line for the Promotion of Innovation from Demand
	2.4. Support in the implementation of solutions that allow the recovery of energy and nutrients in the WWTP and DWTP, through the promotion of public purchase of innovation, as well as other financing mechanisms
	2.5. Project "Area CERO2" (Last Green Mile)
	2.6. Incorporation of CE criteria in tourism planning
3. WASTE MANAGEMENT	3.1. PEMAR and Waste Prevention Program
	3.2. Regulatory reviews
	3.3. Computer tools for the control and monitoring of waste
	3.4. Agreements with other Administrations for the inspection of waste transfer
	3.5. PIMA (Environmental Promotion Plans) and aid for the State Waste Management Framework Plan
	3.6. Study on the possible harmonization of the different regional taxes on waste in Spain
	3.7. Analysis of environmental taxation in Spain
	3.8. Identification of a network of state reference laboratories for the waste physical and chemical analysis and conducting dangerousness tests
	3.9. Protection and recovery of biodiversity and marine ecosystems. Waste collection
	3.10. Creating a coherent trash fishing scheme
	3.11. Management of railway works waste
4. SECONDARY RAW MATERIALS MARKET	4.1. By-product declaration and promotion
	4.2. Establishment of end-of-waste condition criteria
	4.3. Development of the work of the European Commission in relation to harmful chemicals
	4.4. Recovery of construction and demolition wastes as secondary raw materials
	4.5. Review of the regulations on recycled plastic materials and objects intended to come into contact with food
	4.6. Elimination of regulatory barriers to the reuse of materials and products in the construction sector
	4.7. Review of the Royal Decree on Fertilizing Products
5. REUSE OF WATER	5.1. Regulatory adjustment to promote the reuse of regenerated wastewater
	5.2. Preparation of a guide towards the implementation of the regulatory instrument at European level
	5.3. Support for irrigation projects whose resources are the wastewater reuse
	5.4. Actions regarding reuse included in the River Basin Management Plans
	5.5. Promotion of research work to establish the minimum quality criteria required for reused water from a health and environmental point of view
6. RESEARCH, INNOVATION AND COMPETITIVENESS	6.1. Aid for promoting cloud computing
	6.2. R&D&i project aimed at Society Challenges in public-private collaboration ("Investigation Challenges")
	6.3. R&D&i projects aimed at Society Challenges in public-private collaboration ("Collaboration Challenges")
	6.4. Encourage collaboration and communication with Technological Platforms and especially with the Circular Economy inter-platform group, and the Public Administrations responsible for sectoral policies and R&D&i policy
	6.5. Promotion of the General State Administration-Autonomous Communities collaboration. R&D&i Policy Network: Circular Economy Sector Roundtable
	6.6. Dissemination of the results of R&D&i projects financed in the field of circular economy
	6.7. Energy efficiency as a factor of competitiveness of the sector in the plans and programs of the SETUR (Secretary of State for Tourism)
	6.8. Intelligent Tourist Destinations.
7. PARTICIPATION AND AWARENESS	7.1. Pact for CE
	7.2. Knowledge transfer and exchange of good practices
	7.3. Awareness campaigns
	7.4. Support for sustainable tourism municipalities.
	7.5. Promotion of Sustainable Tourism
8. EMPLOYMENT AND TRAINING	8.1. Comprehensive program for the social recovery of disused railway assets, generating value through entrepreneurship or public service projects
	8.2. Green-Employ Program
	8.3. Preparation of an Intersectoral Plan for Vocational Training
	8.4. National Reference Centers with training plans aimed at the professional profiles necessary to advance towards the CE model
	8.5. Training programs for young researchers (Innovation - alternative raw materials/renewable energies)
	8.6. Strengthen Special Employment Centers for people with disabilities
	8.7. Preparation of a Comprehensive Plan to Support Innovation and competitiveness of companies in the different emerging sectors of CE.
	8.8. New programs for Workshop Schools and Trade Houses that favor the transition to the new production model
	8.9. Guide the Youth Guarantee Program as part of the Circular Economy Strategy

Table A.3 (*continued*)

1st SCALE	2nd SCALE
AXES OF ACTION	MEASURES
	8.10. Review of the catalog of Professionalism Certifications: ICT and activities related to sustainable development
	8.11. Strengthen the capacities of the SEPE (Public Service of State Employment) Occupations Observatory to detect new sources of employment
	8.12. Dissemination of the Spanish Circular Economy Strategy in actions related to CSR (Corporate Social Responsibility), in particular through the Social Responsibility Portal
	8.13. Study of emerging risks derived from new jobs and occupations in development of CE
	8.14. Study of the risks derived from the use of alternative energies, secondary raw materials or waste management
	8.15. Preparation of support material and tools for training and information

Table A.4
PAEC 2021–2023: Circular Economy Action Plan (in its Spanish acronym) of the EEEC

1st SCALE	2nd SCALE	
AXES/LINES OF ACTION	MEASURES	
1. PRODUCTION	1.1. Primary sector and bioindustry (circularity in biological cycles)	1.1.1. Promote circularity in the food industry
		1.1.2. Action plan for circularity in the production of wood and other forest raw materials
		1.1.3. Silvicultural models for the promotion of quality wood in the construction industry.
		1.1.4. Action plan for circularity in the production of wood and other forest raw materials
	1.2 Industrial production (circularity in technological cycles)	1.2.1. New eco-design regulations
		1.2.2. Inclusion of CE criteria in the Strategic Framework for Spanish Industry and its agendas
		1.2.3. Aid for the circular economy within the framework of Industry 4.0
		1.2.4. Introduction of the CE in the specifications and programs of public aid, loans and credit lines
		1.2.5. Indicators in the financial support programs of Industrial companies
		1.2.6. Circular economy in Small and medium-sized enterprises (SMEs)
		1.2.7. Inclusion of CE criteria in Best Available Techniques (BAT)
	1.3. Tourism	1.3.1. Incorporation of circular economy criteria in tourism planning
		1.3.2. Reconversion of tourist destinations with circularity criteria.
		1.3.3. Incorporation of circular economy criteria in tourism planning
		1.3.4. Support for the creation of a sustainable and circular tourism product
		1.3.5. Support to sustainable municipalities for waste reduction and management.
2. CONSUMPTION	2.1. Labeling Circular for the Economy	2.1.1. Promotion of the European Union Ecolabel
		2.1.2. Labeling obligations on the shelf life of the product
	2.2. Food waste reduction	2.2.1. Regulatory developments to reduce food waste
		2.2.2. Regulatory developments to reduce food waste
		2.2.3. Reduction of food waste in distribution, restaurants and hotels
	2.3. Sustainable consumption	2.3.1. Promoting the purchase and use of sustainable forest products
		2.3.2. Second-hand goods markets
		2.3.3. "Ecomilla" project
	2.4. Public procurement with circularity criteria	2.4.1. Incorporation of the CE in the field of centralized contracting
		2.4.2. CE criteria in contracting Ministry for the Ecological Transition and the Demographic Challenge
		2.4.3. Integrate CE into Ministry for the Ecological Transition and the Demographic Challenge supply chains
		2.4.4. Preparation of a catalog of environmental and social criteria for contracting in the field of railway infrastructures
		2.4.5. Comprehensive program for the social recovery of disused railway assets, generating value through entrepreneurship or public service projects.
3. WASTE MANAGEMENT	3.1. A new regulatory framework on waste	3.1.1. The new Waste and Contaminated Soil Law
	3.2. Review of the legal regime for the main waste streams	3.2.1. Revision of packaging and packaging waste regulations
		3.2.2. Revision of the legal regime for batteries and their wastes
		3.2.3. Strengthening of the legal regime for waste equipment management
		3.2.4. Review of the legal regime of vehicles at the end of their useful life
		3.2.5. New regime on the management of end-of-life tires
		3.2.6. New framework to facilitate the use of used industrial oils
		3.2.7. New legal framework for construction and demolition waste production and management
		3.2.8. Revision of Royal Decree 1310/1990, of October 29, which regulates the use of sewage sludge in the agricultural sector
		3.2.9. Regulation of organic matter from waste
		3.2.10. Regulation of waste from the textile sector
		3.2.11. Regulation of financial guarantees
		3.2.12. Extended Producer Responsibility (EPR) regulation for agricultural plastics and other single-use plastics
	3.3. Waste planning tools	3.3.1. Preparation and approval of the new Waste Prevention Program and the State Waste Management Framework Plan
		3.3.2. Preparation and approval of an Action Plan for plastics
	3.4. Measures to mitigate climate change in the waste sector	3.4.1. Environmental Promotion Plans, PIMA Waste

Table A.4 (*continued*)

1st SCALE	2nd SCALE	
AXES/LINES OF ACTION	MEASURES	
	3.5. Measures to improve the prevention and management of some waste streams	3.5.1. Guide for the development of environmental criteria to be taken into account in the dismantling and repowering of wind power generation facilities
		3.5.2. Pilot project for the reuse of photovoltaic modules and automotive lithium batteries in domestic self-consumption applications
		3.5.3. Study on the implementation of a financial system to promote the collection of old mobile phones
		3.5.4. Effective management of surplus land from railway infrastructure works to favor the environmental recovery of degraded environments or their reuse in other works
		3.5.5. Study of measures to optimize the recovery of waste from MARPOL Annex V
		3.5.6. Measures to increase the reuse of topsoil in works for restoration and landscape integration as a consequence of railway works
		3.5.7. Promote CE within the Environmental Sustainability Plan of the Institute of Cinematography and Audiovisual Arts of the Ministry of Culture and Sports
		3.5.8. Approval of the Biogas Roadmap
	3.6. Control and monitoring of waste	3.6.1. Implementation of an Electronic Waste Information System and development of other computer tools for the control and monitoring of waste
		3.6.2. Strengthen the inspection system for waste shipments
		3.6.3. Optimize the traceability and management of waste generated in ports
	3.7. Trash fishing	3.7.1. Creation of a national garbage fishing scheme
		3.7.2. Aid for the collection of waste and protection and recovery of biodiversity and marine ecosystems s
4. SECONDARY RAW MATERIALS	4.1. By-products and end-of-waste condition	4.1.1. By-product declaration and promotion
		4.1.2. Establishment of EOW criteria
		4.1.3. Impact study of the SRM market in Spain
	4.2. Reintroduction of materials in biological and technological cycles	4.2.1. Promotion of the use of sustainable management materials and techniques in railway stations
		4.2.2. List of authorized recycling processes for plastic materials and objects intended to come into contact with food
		4.2.3. Promotion of the recovery of construction and demolition waste in port works
		4.2.4. Use of SRM on roads
		4.2.5. Instructions for increasing the reuse of existing material on the road in road and pavement rehabilitation works
	4.3. Critical raw materials	4.3.1. Creation of a national inventory of closed or abandoned Extractive Industry Waste facilities containing critical raw materials
		4.3.2. Approval of a roadmap for the sustainable management of mineral raw materials
	4.4. Safe SRM - Substances of Concern	4.4.1. Support for the implementation of the SCIP database and dissemination of information that facilitates the knowledge of the substances of concern present in articles
		4.4.2. Methodologies to address the interface between chemicals, products and waste to promote non-toxic CE
5. REUSE AND PURIFICATION OF WATER	5.1. Improved circularity in water use	5.1.1. Support for irrigation projects that have as a resource the reuse of reclaimed water
		5.1.2. Knowledge improvement: allocations and reserves according to water uses
		5.1.3. Incorporation of reused water in the exploitation systems of the hydrographic basins
		5.1.4. Regulatory framework for water reuse
6. AWARENESS AND PARTICIPATION	6.1 Promotion of the circular economy in the professional field	6.1.1. Monitoring of the Pact for a circular economy
		6.1.2. Discussion forum on circular economy
		6.1.3. Circular economy council
		6.1.4. Circular economy newsletter
		6.1.5. Good practices for circular economy
	6.2. Promotion of the circular economy in society	6.2.1. Dissemination of the EEEC in actions related to Corporate Social Responsibility (CSR), in particular through the Social Responsibility Portal
		6.2.2. Communication strategy and dissemination campaign on plastics in a circular economy
		6.2.3. Raising awareness for reuse. Campaign "Waste prevention week"
		6.2.4. Campaign to promote the transition to a circular economy in Spain
		6.2.5. Institutional Advertising Campaign on "Ecological Production"
		6.2.6. Dissemination and sensitization of irrigators and the final consumer about the benefits of the reuse of treated water
		6.2.7. Campaign on "responsible food production and consumption"
		6.2.8. Consumers awareness about the responsible purchase and use of food and its packaging
		6.2.9. Campaign against obsolescence
		6.2.10. School campaign to promote circular and responsible consumption
	6.3. Awareness of the natural environment	6.3.1. Awareness and training on marine litter
		6.3.2. Communication campaign on the use of the forest
		6.3.3. Promotion of Sustainable Tourism
		6.3.4. Development of the Network of Natural Roads of Spain
7. RESEARCH, INNOVATION AND COMPETITIVENESS	7.1. Projects to improve circularity	7.1.1. Support for innovation related to the bioeconomy and CE in the agri-food and forestry sector
		7.1.2. CE research projects
		7.1.3. R&D&i projects for CE within the framework of the International Joint Programming
		7.1.4. Public-private collaboration projects in R&D&i to promote the transition to a CE in Spain
		7.1.5. Encourage collaboration and communication with the Technological Platforms, and especially with the CE Interplatform Group, and the public administrations responsible for

Table A.4 (*continued*)

1st SCALE	2nd SCALE	
AXES/LINES OF ACTION	MEASURES	
		sectoral policies and R&D&i policy
		7.1.6. Training and incorporation of human resources in R&D&i in the field of CE
		7.1.7. Dissemination of the results of R&D&i projects financed in the field of CE
		7.1.8. R&D&i projects to encourage CE solutions for wind turbine blades
8. EMPLOYMENT AND TRAINING	8.1 CE training	8.1.1. Training and Labor Insertion Program for Surplus Mining Workers
		8.1.2. New programs for workshop schools and trade houses that favor the transition to the new production model
		8.1.3. Guide programs for youth employment, including the Youth Guarantee Program, as part of the EEEC
		8.1.4. Review and update of the specialties of the Catalog of Training Specialties of the employment service
		8.1.5. Preparation of support material and tools for training and information
	8.2. Promotion of circular works	8.2.1. "Employ-green" program
		8.2.2. Strengthen Special Employment Centers for people with disabilities in line with the principles of CE
		8.2.3. Promotion of social economy entities related to CE and dissemination of their activities
		8.2.4. Measures to support innovation and competitiveness of companies in the different emerging sectors of the CE
		8.2.5. Strengthen the capabilities of the Occupations Observatory of the Employment Service to detect new sources of employment in CE
		8.2.6. Study of emerging risks derived from new jobs and occupations in development of the CE

Table A.5
ELEC - Local Circular Economy Strategy (in its Spanish acronym)

1st SCALE		2nd SCALE
STRATEGIC AXES	CIRCULAR POLICIES	MEASURES
1. MINIMIZATION OF THE USE OF NATURAL RESOURCES	a. Prevention and reuse	1.a.1. Prepare a municipal or supra-municipal waste prevention and management program
		1.a.2. Prepare a plan for the prevention and management of waste generated by the institution
		1.a.3. Encourage prevention in the generation of waste
		1.a.4. Promote reuse and repair
	b. Waste management	1.b.1. Promote segregation at source and separate collection of waste (at home).
		1.b.2. Promote segregation at source and the collection of waste generated outside the home
		1.b.3. Recycle street cleaning waste
		1.b.4. Promote segregation at source and treatment of organic waste (Bio-waste)
		1.b.5. Optimize the management of construction and demolition waste (CDW).
		1.b.6. Optimize the management of clean points
		1.b.7. Promote circularity in companies
2. WATER CONSUMPTION MANAGEMENT	a. Responsible consumption of water	2.a.1. Optimize the supply and sewerage network.
		2.a.2. Increase efficiency and savings in water consumption.
		2.a.3. Promote the reuse of water
		2.a.4. Promote sustainable storm drainage management.
	b. Process waste management	2.b.1. Promote the reuse of waste derived from water management
3. SUSTAINABILITY OF URBAN SPACES	a. Preventive and regenerative planning	3.a.1. Define a model that fosters compactness, regeneration and urban resilience.
		3.a.2. Promote energy efficiency and savings in the building stock.
	b. Sustainable mobility	3.b.1. Organize the space to promote sustainable mobility.
		3.b.2. Promote sustainable transport.
4. HEALTHY SPACES AND BEHAVIORS	a. Healthy territories	4.a.1. Promote sustainable rural development.
		4.a.2. Promote urban planning for health.
		4.a.3. Promote healthy lifestyle
	b. Responsible consumption	4.b.1. Promote responsable consume
	c. Food waste	4.c.1. Minimize food waste
5. TRANSVERSALITY POLICIES		5.1. Sustainable and innovative public procurement
		5.2. Development and implementation of new technologies
		5.3. Transparency and shared governance
		5.4. Communication and awareness

Appendix B. Extended version of the detailed map record

The extended version of the detailed map record (Table 6) is presented below. In Table B1, a column is included with the formula or methodology

necessary for the application of the 3rd scale obtained directly from the reference sources (indicators as such), and another column with the measurements units.[5]

Table B.1
Detailed map record (extended version).

1st scale			3rd scale		
S	T L B	1. Manage the land in a manner compatible with its territorial environment, with sustainable urban planning and land use.	3rd scale of the reference sources (indicators as such)	Formula / methodology	Measurement units
			· Ratio of land consumption to population growth rate	· (Surface areas for which the land use has changed from agriculture, forest and other semi-natural and natural areas to urban and artificial land)/(growth of the population)	· Number
			· Brownfield redevelopment	· (Brownfield area redeveloped in the last year [km²]/ total brownfield area in the city [km²])x 100	· %
			· Congestion index	· Each route is divided up into a series of 'links' – a section of road between two junctions. The average vehicle journey time for a route is simply the total of the link journey times divided by the total length of the route (vehicle flow is assumed to be constant along the route).	· Minutes and seconds
			· Roads maintenance	· The indicator is the length of carriageway identified as having a road condition indicator (RCI) greater than or equal to 100 as a percentage of the total length surveyed. (x/y) x 100 where: x = length of carriageway surveyed identified as having a road condition indicator (RCI) greater than or equal to 100; y = total length of principal road carriageway surveyed. Results are calculated automatically by the UK Pavement Management System (UKPMS) software.	· %
			· Population density	⊖	· Inhabitants per hectare
			· Housing space per capita	⊖	· m² per capita
			· In the instruments of urban and land-use planning, are criteria incorporated to ensure the rational use of land based on sustainable development?	· Indicate the planning instruments that include these criteria. If no instrument is available, the commitments to be assumed in this area will be indicated.	· Yes, No, Information
			· Correlation between land development, demographic dynamics, employment and economic activities.	· Contrast the percentage of growth of urbanized land planned in accordance with the urban planning instruments.	· %
			· Budget for the actions planned to promote agricultural, livestock and rural development activities on lands preserved from urban transformation.	· Collect the set of actions planned in this area in the budgets. Likewise, an estimate will be made of the planned investment and the contribution in this area by the private sector.	· €
S	M T	2. Ensure spatial equity and favor the city of proximity.	· Basic services proximity	· (Number of inhabitants that live near basic service centre / Total number of inhabitants)x100	· %
			· Percentage of people within 0,5 km of public transit running at least every 20 min	· (Number of inhabitants within 0,5 km of public transit running at least 20 min /total population) x100%	· %
			· Compare "basic services proximity" in the Deprived Neighbourhood Areas relatively to the whole city	· (Inhabitants that live near a basic service centre / Total number of inhabitants) x 100	· %
			· Are there "Worksite Transportation Plans" in the city to streamline travel to the main work centers?	·Indicate the actions aimed at promoting the preparation of Worksite Transportation Plans by the main work centers in the city, indicating the number of current WTPs, and the number of workers affected.	· Yes, No, Information; No. WTP; No.Workers
			· Modal distribution of trips (all reasons) in the urban area.	· Modal distribution of trips will be analyzed with origin and/or destination in the urban area (car and motorcycle, public transport, bicycle, on foot). This information will be obtained from data on the demand for modes of public transport, mobility surveys and the support of new sources of information from telematic systems. Trips (by car and motorcycle, public transport, bicycle, on foot) = (Number of trips made (by car and motorcycle, public transport, bicycle, on foot) / Total number of trips) x 100	· %
			· Sustainability of urban freight distribution (last mile)	· The indicator reflects the load breaking facilities, enabling the urban freight distribution with small vehicles. For this, cargo storage and consolidation centers are needed in urban areas. Density of freight distribution centers = (Number of centers in the city / Urban area (km2)) x 100	· %
S		3. Foster territorial resilience.	· Did you implement a risk reduction and resilience strategy?	· YES or NO answer	· Yes or No
			· Fuel Poverty	· The data needed for the calculation are: Household income; Energy consumption (dependent on dwelling characteristics and the lifestyle of householders) and Prices of energy. The cost of energy is	· %

1st scale			3rd scale		
			3rd scale of the reference sources (indicators as such)	Formula / methodology	Measurement units
				modelled rather than based on actual spending. It is calculated by combining the fuel requirements of the household with corresponding fuel prices. Household income data may be available from the city statistical office. Energy prices should be metered prices and should be available from the local energy providers. Energy consumption data per household is usually modelled based on statistics on dwellings, household size, etc.	
S	T L B	4. Conserve and enhance the architectural, cultural, urban and natural heritage and protect the landscape.	· Do you have a heritage preservation policy?	· YES or NO answer	· Yes or No
			· Expenditure of local authority dedicated to the preservation, protection and conservation of cultural heritage per inhabitant	· Ratio of Total expenditure by local authority in the heritage sector / Number of inhabitants	· €/hab
			· Evolution of the tourist frequency	· Percent. seasonality (tourists) = (Number of tourists in each month/Total number of tourists) x 100 Percent. seasonality (overnight stays) = (Number of overnight stays in each month/Total number of overnight stays) x 100	· No. of tourists and overnight stays per month and per year. Percentage of seasonality per month. (%)
			· Share of listed building restored	· Listed building restored / total listed building	· %
			· Is there a "Municipal Natural and Cultural Heritage Management Plan" or similar, to ensure its proper conservation and enhancement?	· Indicate whether or not there is a Heritage Management Plan. If no plan is available, the commitments to be assumed in this area will be indicated.	· Yes, No, Information
			· Budget for the actions planned to preserve and/or improve the natural and cultural heritage, including those destined to the urban-rural connection.	· The amount of the economic investment in the natural and cultural heritage that is planned to be made is reflected, as well as its relationship with the total budget. The data will be established from the set of actions planned in this area that are collected or the commitment to collect is assumed in future budgets. Likewise, an estimate of the planned investment and the contribution in this area by the private sector will be made.	· €
			· Area of buildings or places belonging to the cultural heritage upgraded and/or rehabilitated.	· Determine the total area in square meters (m2) of all the actions to be carried out for the conservation, improvement or enhancement of the buildings or places belonging to the city's cultural heritage.	· m²
S	T L B	5. Promote the high quality, functionality and accessibility of public spaces and the living environment, as well as improve the urban environment and green and blue infrastructures and link them to the natural context.	· Satisfaction with public spaces	· Percentage of people that agree with the question	· %
			· Square meters of public outdoor recreation space per capita	· Measurement guidelines: Include the area of the entire outdoor recreation site (including, for example, parking areas, wooded areas of parks, building maintenance and utility areas). Rationale: i) simplicity ii) these areas support the recreation function. For multi-use facilities count only the portion of the land devoted to recreation (the play areas at a school or college, for example, not the entire school site). Avoid double counting. For example, do not include indoor facilities on parkland.	· m² /capita
			· Availability of Basic Services	· Number of inhabitants living within 300 m from each single basic service / total number of inhabitants	· Percentage of population
			· Access time to services	· The time is calculated, first for each individual and for each service as the time required by car to travel from his town of residence in the town have this service, the closest to his place of residence, and secondly, his home or his commute for those who have jobs. The time is calculated at peak hours in the first case and at peak times in the second.	· Minutes and percentage
			· Percentage of people living within 300m of a public open area	⊖	· %
			· Have green and water infrastructure plans been made based on the natural context?	· Indicate the green and water infrastructure planning instruments. If no instrument is available, the commitments to be assumed in this area will be indicated.	· Yes, No, Information
			· Land area intended for urban green infrastructures in which actions will be carried out to recover, improve and interconnect for its network operation.	· Determine the land area in square meters (m2), of all the recovery, improvement and interconnection actions of the municipal urban green infrastructures.	· m²
			· Are there plans to improve public space, which identifies problems and programs actions to guarantee universal accessibility and noise reduction?	· Indicate whether or not there is a plan to improve public space that identifies the adequacy of open spaces for public use. If no Plan is available, the commitments to be assumed in this area will be indicated.	· Yes, No, Information
			· Land area intended for public spaces in which actions will be carried out to improve accessibility and eliminate architectural barriers.	· Determine the total area in square meters (m2) of all the actions that have been scheduled for the improvement and adaptation of public space, both, to improve accessibility and eliminate architectural barriers.	· m²
			· Land area intended for public spaces in which actions will be carried out to reduce noise and improve acoustic comfort.	· Determine the total area in square meters (m2) of all the actions that have been scheduled with the aim of reducing noise (day and night) and improving the acoustic comfort of the public space.	· m²

1st scale		2nd scale		3rd scale		
				3rd scale of the reference sources (indicators as such)	Formula / methodology	Measurement units
				· Are there quality urban environmental plans to improve urban green areas and reduce pollution? · Percentage of people close to urban green areas or recreation areas. · Urban land area intended for recovery, rehabilitation or improvement actions.	· Indicate the instruments for improving the quality of the urban environment. If no instrument is available, the commitments to be assumed in this area will be indicated. · This indicator reveals whether the inhabitants have easy access to green spaces, which indicates if these areas are integrated into the urban area or, on the contrary, are in peripheral areas of the urban area, far from the population. For the definition of the areas of proximity, the following criterion will be followed: z. green /recreation> 1,000 m2: maximum distance 300 m; z. green / recreation> 5,000 m2: maximum distance 500 m.; z. green /recreation>1 Ha: maximum distance 900 m. · Determine the area in square meters (m2) of all the areas that are going to be the subject of actions. The rehabilitated land surface will be counted and the actions carried out must affect several measures to be considered comprehensive (green areas, sidewalks, facades, shops, common areas, waste containers, etc.). It is not necessary that the rehabilitated soil was previously contaminated.	· Yes, No, Information · %? · m²
S	M T	S U S	6. Promote alternative and sustainable modes of transportation and mobility, and organize the space for this purpose.	· Percentage of trips by private motorised transport · Percentage of people within 0,5 km of public transit running at least every 20 min · Passenger transport prices · Satisfaction with level of public transport services · Percentage of pedestrian streets and walkways	· A simple questionnaire can be used: "Which means of transport do you mostly/primarily use to go to your working/training place?" · (Number of inhabitants within 0,5 km of public transit running at least every 20 min /total population) x100 · Prices indices for passenger detailed per transportation modes (road, rail, air, public transport, walking, cycling…) · The method hereby suggested (taking the expectations of the European indicator into account) is to carry out a survey on a representative sample, by means of personal interviews (or of telephone interviews). · 100*Pedestrian streets & walkways area/ Total streets and roads areas	· % · % · € (basis 100 for a reference year) · Percentage of distribution (net value unit for reporting over a period of time) of different satisfaction levels (very satisfied; fairly satisfied; fairly dissatisfied; very dissatisfied; no answer), percentage score of satisfaction related to different features weighed with the importance attributed to them, percentage score attributed to different aspects of each of the feature considered · %
				· Is there a Sustainable Urban Mobility Plan (SUMP) in the city? · No. of buses with low emissions or "clean" fuels destined for urban public transport. · No. of trips by public transport.	· Indicate whether or not there is a Sustainable Urban Mobility Plan (SUMP). If no Plan is available, the commitments to be assumed in this area will be indicated. · Identify the number of urban buses with low-emission engine technology, distinguishing between Euro III technology or earlier, Euro IV or later, and with clean fuels, in order to apply the following formulas: Buses with Euro III or earlier technology = (Number of buses Euro III or earlier / Total number of buses) x 100; Buses with Euro IV or later technology = (Number of Euro IV or later buses / Total number of buses) x 100; Buses with "clean" fuels (CNG, LPG, hybrids, biodiesel or electric) = (Number of buses with clean fuels / Total number of buses) x 100. · Know the number of trips in collective urban public transport per year. It is considered convenient to clarify that the number of trips of each traveler will be counted, and not the number of passengers, nor the number of trips of each vehicle. It will be considered collective urban public transport that which covers urban and developable land or joins urban centers of the same municipality. Taxis are not included. In urban areas made up of more than one municipality, interurban transport between these municipalities will also be considered. The information must be offered by the competent Administration.	· Yes, No, Information · % · No.
				· No. of pedestrian routes. · No. of infractions derived from damage to pedestrians in public space. · Kilometers of cyclist routes. · No. of bicycle parking places.	⊖ ⊖ ⊖ ⊖	· No. · No. · Kilometers · No.

1st scale		2nd scale		3rd scale		
				3rd scale of the reference sources (indicators as such)	Formula / methodology	Measurement units
				· Inventory of public roads. · Estimated travel time during peak traffic hours. · No. of deterrent parking areas. · No. of actions developed to promote pedestrian and cyclist mobility. · Increase in the number of users of public transport. · Carbon footprint in the public transport sector. · No. of vehicles that use alternative fuels registered in the municipality. · No. of public workers who travel on foot or by bicycle to their jobs.	⊖ ⊗ ⊖ ⊖ ⊖ ⊗ ⊖ ⊖	· Information -- · No. · No. · No. -- · No. · No.
G			7. Ensure an integrated territorial strategy.	· Latest approval or revision date of a master plan with an integrated vision for the city as a whole · Level of implementation of Agenda 21 processes / sustainable urban development masterplan · Adoption of integrated urban plans (environment, transport, land use) · Existence of multiscale level in the Urban Masterplan within focus on Deprived Neighbourhood Areas	· YES or NO answer ⊖ ⊖ ⊖	· Yes or No · Yes, No, Information · Yes or No · Yes, No, Information
C M		S U S	8. Define an urban model that promotes compactness, urban balance, regeneration, the provision of basic services and urban resilience.	· Are there management criteria that improve compactness and urban balance in the consolidated city and in new developments? · Percentage of people close to the main basic services. · Area of public buildings and municipal facilities to which actions to improve quality and adaptation to existing demand will be carried out.	· Indicate the territorial and urban planning instruments that meet these criteria. In the event that no instrument is available in relation to this matter, the commitments to be assumed in this area will be indicated. · The percentage of people close to the main basic services is measured. Basic service proximity = (Inhabitants living near a basic service control / Total number of inhabitants) x 100. · Determine the total area in square meters (m2), of all improvement actions and adequacy in public buildings and municipal facilities that have been scheduled to be carried out.	· Yes, No, Information · % · m²
				· Percentage of waterproofed soil. · Vacant developable land area. · Constructed area as a result of exhausting its building capacity. · No. of houses rehabilitated. · No. of underused buildings. · Redeveloped area in abandoned or disused industrial areas. · Green area surface. · No. of self-promotion campaigns in the urban area. · No. of urban planning initiatives for adaptation to climate change.	⊖ ⊖ ⊖ ⊖ ⊖ ⊖ ⊖ ⊖ ⊖	· % · m² · m² · No. · No. · m² · m² · No. · No.
C M			9. Ensure functional complexity and diversity of use.	· Are there criteria that improve the functional complexity and the mix of uses in the consolidated city and in new developments? · Urban land area in which actions to improve and readjust the uses will be carried out, to favor proximity and diversity of uses in the city.	· Indicate the urban planning instruments that meet these criteria. In the event that no instrument is available in relation to this matter, the commitments to be assumed in this area will be indicated. ·Determine two parameters in all the improvement and adaptation actions in public buildings and facilities that have been scheduled to be carried out: total area in square meters (m2), in which there is a mixture of compatible uses; Total area in square meters (m2) reserved for economic activity, in which the balance between residential and tertiary uses is maintained.	· Yes, No, Information · m²
C M	C		10. Promote urban regeneration, as well as the social recovery of disused railway assets by generating value through entrepreneurship or public service projects.	· Is there a plan for urban regeneration of neighborhoods, which incorporates actions for social, economic and environmental improvement? · Budget for urban regeneration actions planned in vulnerable neighborhoods from a social, economic or environmental point of view. · Budget for actions in urban rehabilitation covered by public	· Indicate whether or not there is an urban regeneration plan for neighbourhoods. If there is no Plan in this area, the commitments to be assumed in this area will be indicated. · The data will be collected from the actions planned in these areas by the local entity. · The data will be collected from the actions planned in these areas in the public budgets.	· Yes, No, Information · € · €

1st scale	2nd scale	3rd scale		
		3rd scale of the reference sources (indicators as such)	Formula / methodology	Measurement units
		housing plans. • No. of properties leased within the framework of the Assets for Development Program / annual frequency.	⊖	• No.
C M	P D / S U S	11. Improve the quality, sustainability and energy efficiency of buildings.	• Is there a plan for the rehabilitation of the buildings, which makes a diagnosis of their situation and establishes priorities and actions to promote their improvement? • Surface of buildings subject to rehabilitation actions.	• Indicate whether or not there is a Rehabilitation Plan for the building stock. • Through the data on building refurbishment and refurbishment licences, it will be possible to estimate the percentage of constructed area of buildings rehabilitated annually, according to the following expression: Rehabilitated area = (Constructed area obtained from building refurbishment licenses / Total park area building) x 100 The competent Administration aware of the rehabilitated area of buildings in which actions have been carried out to improve quality, energy efficiency and/or accessibility within the framework of a public aid program, may estimate the percentage of this area with respect to the total of the rehabilitated Area rehabilitated with public aid = (Area rehabilitated with public aid / ∑Constructed area obtained from building rehabilitation licenses) x 100	• Yes, No, Information • % of year
		• No. of homes subject to rehabilitation actions.	• Through the data on housing renovation and renovation licenses and from the information obtained from the Housing Census, it will be possible to estimate the percentage of homes rehabilitated annually, according to the following expression: Rehabilitated homes = (Number of renovation licenses and home renovation / Total number of homes) x 100	• % of year
		• No. of actions financed.	⊖	• No.
		• Typology of buildings according to their energy efficiency rating. • No. of energy rehabilitations. • No. of energy audits carried out in buildings and public facilities • No. of distinctions of excellence for energy efficiency and savings awarded in the commercial and industrial sectors. • Evolution of the energy consumption of the Local Entity and its dependencies. • No. of assistances for energy advice carried out. • Campaigns to promote energy efficiency and savings in homes. • Percentage of renewable energy consumed over the total.	⊖ ⊖ ⊖ ⊖ ⊖ ⊖ ⊖	• Information • No. • No. • No. • % • No. • Information • %
C C		12. Adapt the territorial and urban model to the effects of climate change and make progress in its prevention.	• Is there a plan or strategy for local adaptation to climate change and prevention against natural risks? • Urban land area in which it is planned to carry out actions to improve or prevent natural risks, including the risk of fires and floods.	• Indicate whether or not there is a Climate Change Adaptation Plan and strategies for disaster risk reduction in line with the Sendai Framework for Disaster Risk Reduction 2015-2030. If there is no Plan in this area, the commitments to be assumed in this area will be indicated. • Determine the area in square meters (m2) of all areas affected by some risk (flood, torrential rains, landslides, drought, seismic risk, etc.) in which actions have been scheduled to mitigate the effects of these risks.	• Yes, No, Information • m²
C C		13. Reduce greenhouse gas emissions.	• Is there an air quality plan or strategy that makes a diagnosis of your situation and establishes priorities and actions to promote its improvement? • Estimated annual reduction in greenhouse gases (GHG) and in the number of days in which air quality limits are exceeded.	• Indicate whether or not there is an air quality control and improvement plan. It will be specified if there is an Air Quality Surveillance and Control Network, from which data can be obtained from the sensors located in its stations. If there is no Plan in this area, the commitments to be assumed in this area will be indicated. • In the case of renewable energy production, the estimate is based on the amount of primary energy produced by the facilities, in a given year. Renewable energy is supposed to be GHG neutral and to replace non-renewable energy. In the case of measures related to energy saving, the estimate is based on the amount of primary energy saved in the year in which the actions are carried out. Energy saving is supposed to replace non-renewable energy production. For the estimation of greenhouse gas emissions from non-renewable energy that would result in savings in non-renewable energy, or the production of that same energy with renewable energy, the total greenhouse gas emissions are taken into account. emitted per unit of non-renewable energy production in Spain, which is 0.521 kg CO2/kWh of final energy. In the case of carbon sinks, the value of the indicator will be the theoretical (or design) tons of CO2/year that will be reduced as a result of the operation to be carried out. The	• Yes, No, Information • Equivalent tons of CO2

1st scale	2nd scale	3rd scale		
		3rd scale of the reference sources (indicators as such)	Formula / methodology	Measurement units
			competent Administration must offer the average annual levels of fine particles (for example, PM2.5 and PM10) and the number of days per year with poor air quality for each pollutant, that is, the number of days per year that has been exceeded the limit value for each pollutant.	
S R M C E	W M M / M U N R	14. Reduce and prevent waste, promote recycling, segregation and separate collection, as well as control contaminated soils and waste packaging, batteries, appliances and organic matter from waste, supporting sustainable municipalities.*	• Are there waste management plans, or equivalent, with the aim of increasing the percentage of selective collection and recycling? • Generation of waste per inhabitant.	• Indicate the instruments that meet these criteria. In the event that no instrument is available in relation to this matter, the commitments to be assumed in this area will be indicated. • The competent Administration, through the waste management department, must know the total amount of urban solid waste generated, the amount of selectively collected urban waste to know the total and the volume of urban solid waste recycling per year. Once obtained, the indicator can be calculated by applying the corresponding formula for the volume of urban solid waste per inhabitant per day, and the percentage of selective collection. Solid urban waste = (Total volume of solid urban waste) / (Number of inhabitants x 365); Selective collection (%) = (Volume of urban solid waste selectively collected / Total volume of urban solid waste) x 100. Likewise, the volume of urban solid waste that may be subject to treatment or irregular discharges or deposits will be collected. uncontrolled and the objectives established for their eradication.	• Yes, No, Information • Volume unit per inhabitant and day / %
		• Management plans for tourist municipalities implemented. • Increase in the amount of waste separated in their respective fractions. • No. of fractions collected from municipal waste. • No. of containers by waste fractions and by No. of inhabitants on public roads. • Trash container review frequency. • Degree of citizen satisfaction with the waste service.	⊖ ⊖ ⊖ ⊖ ⊖ ⊖	• Yes, No, Information • % • No. • No. • No. • %
S C E O		15. Reduce the risk of poverty and social exclusion in disadvantaged urban environments.	• Are the urban environments that present a greater degree of social, economic and environmental vulnerability adequately identified? • Budget invested in actions carried out in vulnerable neighborhoods from a social, economic or environmental point of view.	• The data will be collected from the actions carried out in this area by the Public Administrations and the set of urban environments identified as vulnerable or of priority attention within the context of the city will be indicated. For the identification, the methodology of the Urban Vulnerability Observatory in Spain of the Ministry of Public Works may be used as a reference. • The data will be collected from the actions planned in these areas in the public budgets. Priority will be given to those neighborhoods identified as vulnerable by the Local Entity, as well as those included in the Observatory of Urban Vulnerability in Spain as vulnerable neighborhoods.	• Yes, No, Information • €
S C E O		16. Seek equal opportunities from a gender, age, and disability perspective.	• Is there a Plan or Strategy at the local level to guarantee equal opportunities, access to the job market and public life under equal opportunities? • Is there a Plan or Strategy that carries out protocols for the early detection of vulnerability/social exclusion? • Budget invested in actions aimed at guaranteeing equal opportunities from a social, economic and environmental point of view.	• Indicate whether or not there is an Equal Opportunity Plan. If there is no Plan in this area, the commitments to be assumed in this area will be indicated. • It should be indicated whether or not there is a Plan that carries out protocols for early detection of vulnerability. If there is no Plan in this area, the commitments to be assumed in this area will be indicated. • The data will be collected from the planned actions aimed at these groups in the budgets public.	• Yes, No, Information • Yes, No, Information • €
H		17. Promote the existence of adequate affordable housing stock.	• Is there a local housing plan that favors the existence of a public and private housing stock adapted to demand and, in particular, encourages rental housing at affordable prices? • No. of homes subject to protection regimes included in local housing plans. • No. of homes for social rent at an affordable price.	• Indicate whether or not there is a Housing Plan with these requirements. If none are available, the commitments to be assumed in this area will be indicated. • The competent Administration will identify the number of dwellings subject to protection regimes that will be incorporated into the market. • The competent Administration will identify the number of dwellings subject to social rent existing and those planned	• Yes, No, Information • No. • No.
H		18. Guarantee access to housing, especially for the most vulnerable groups.	• Is there a plan of aid to guarantee access to housing for the households and groups, with particular attention to young people, the elderly and those affected by eviction processes? • No. of beneficiaries of the programs included in public housing plans.	• Indicate whether or not there is a Housing Plan with these requirements. Likewise, its connection with the programs of the State Housing Plan of the Ministry of Public Works will be indicated. If no Plan is available, the commitments to be assumed in this area will be indicated. • The competent Administration will identify the number of beneficiaries of these public aids. Beneficiaries will be considered those defined in the State Housing Plan, as well as the sum of natural	• Yes, No, Information • No.

1st scale		2nd scale	3rd scale		
			3rd scale of the reference sources (indicators as such)	Formula / methodology	Measurement units
			persons that make up the family or cohabitation unit that is the beneficiary.		
D E	R I C	19. Promote the knowledge society, move towards the development of smart cities and promote intelligent tourist destinations.	• Is there a local plan or strategy to development a smart urban model? • No. of users that are covered by a certain electronic public Smart Cities service.	• You must indicate whether or not you have a Smart City Plan. If none are available, the commitments to be assumed in this area will be indicated. • The determination of the number of users who use these services can be obtained from the statistics of the Public Administrations. The definition projects of these services, in their cost-benefit analysis, will have an estimate of these data. All users will be taken into account, regardless of whether they are internal users of the Public Administration or external users.	• Yes, No, Information • No.
			• No. of tourist destinations.	⊖	• No.
I		20. Ensure citizen participation, transparency and favor multilevel governance.	• Is there a participatory budget and/or a municipal citizen participation plan that promotes active citizenship? • Is the content of urban planning offered by electronic means and has it been incorporated into the information systems at the supramunicipal level? • Are there effective mechanisms to promote multilevel governance and, in particular, the coordination of management instruments?	• Indicate whether or not you have Participatory Budgets, as well as any Citizen Participation Plan. If none are available, the commitments to be assumed in this area will be indicated. • The Administration must be able to offer urban information (graphic data and alphanumeric) digitally and contained in a GIS accessible to all citizens through electronic means. This information must be incorporated into the supra-municipal information systems (those of the autonomous communities and the Urban Information System of the Ministry of Public Works). In the event that information or GIS is not available, the commitments to be assumed in this area will be indicated. • Indicate the effective mechanisms to favor multilevel governance. In case of not having any mechanism in relation to this matter, the commitments to be assumed will be indicated.	• Yes, No, Information • Yes, No, Information • Yes, No, Information
	P D / P	21. Promote eco-design and the CE.*			
	P D / P	22. Promote the sustainable use of resources and develop silvicultural models for the promotion of quality timber in construction.*	• Forest management models for the production of structural wood approved by the different Autonomous Communities. • No. of operational groups and innovative projects that incorporate the use of structural wood.	⊖ ⊖	• No. • No.
	S R M M	M U N R	23. Promote the recovery, reuse and optimization of construction and demolition waste management, as well as its control.*	• Increase in the collection of Construction and Demolition Waste (CDW) at clean points. • Decrease in the amount of CWD deposited in landfills. • Increase in the amount of materials used from CWD. • No. of sanctions applied to the mismanagement of CWD.	⊖ ⊖ ⊖ ⊖	• % • % • % • No.
		W C M	24. Optimize the supply and sewerage network.	• Evolution of network performance. • No. of leaks detected per network kilometer and year. • No. of failures detected per network kilometer and year. • No. of remote reading meters installed. • Proportion of separate sewarage networks. • No. of inspections of wastewater discharges carried out. • No. of sanctions imposed related to wastewater discharges. • No. of awareness campaigns on inappropriate waste in sewarage networks carried out.	⊗ ⊖ ⊖ ⊖ ⊖ ⊖ ⊖ ⊖	.. • No. • No. • No. • Proportion • No. • No. • No.
		W C M	25. Promote sustainable storm drainage management.	• No. of urban actions that integrate the sustainable management of rainwater. • Quality of the receiving stormwaters of urban runoff. • No. of urban sustainable storm drainage systems installed.	⊖ ⊗ ⊖	• No. .. • No.
	P A	H S B	26. Promote sustainable rural development and sustainable tourism	• Management plans for tourism municipalities implemented. • No. of annual requests (for conversion of tourism destinations with circularity criteria).	⊖ ⊖	• Yes, No, Information • No.

1st scale		2nd scale	3rd scale		
			3rd scale of the reference sources (indicators as such)	Formula / methodology	Measurement units
	/ P	municipalities, and reconvert tourism destinations based on circularity criteria.	• No. of management plans for natural and/or cultural spaces. • No. of fires occurred. • No. of agreements for the custody of the territory. • No. of organic production companies. • No. of products with a local denomination of origin. • No. of initiatives developed related to rural tourism. • No. of training programs for sustainable rural entrepreneurship. • No. of trade fairs held. • Evolution of the number of inhabitants in the municipality. • No. of women engaged in economic activities.	⊖ ⊖ ⊖ ⊖ ⊖ ⊖ ⊖ ⊖ ⊖ ⊖	• No. • No. • No. • No. • No. • No. • No. • No. • No. • No.
		H S B	27. Promote urban planning for health.	• Evaluations carried out to assess the urban adequacy. • Renewal of urban planning for healthy purposes. • No. of urban planning modifications to improve health. • Actions undertaken for the recovery of public space. • Density of equipment and distance to residential areas. • No. of air quality control actions. • No. of noise complaints.	⊖ ⊗ ⊖ ⊖ ⊗ ⊖ ⊖	• No. .. • No. • No. .. • No. • No.

The legend of the table is in the figure of the map (Fig. 3).
Notes: * Goals adapted to the study levels are incorporated, whose third-scale goals in the reference source have ceased to make sense after said adaptation. Therefore, they are not included in this detailed map record.
⊖ = The reference sources do not include methodological information but it is considered that it is not necessary for its application.
⊗ = The reference sources do not include methodological information and additional research by the agents involved applying the indicators is considered necessary.

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