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An Assessment of Local SDG Monitoring: Literature Review

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Abstract

In this working paper, we review existing SDG monitoring initiatives from around the world. Based on extensive desk research, we built up a matrix with data on existing local SDG monitoring initiatives. Starting from that information, we selected a sample of initiatives to analyse further, based on criteria of geographical spread, type of initiative, type of initiator, size of the entity, relevance, and extent of focus on the SDGs.

By reading through the existing literature and reports, we determined certain aspects of local SDG Monitoring that were analysed: a) type of actors initiating the process and partnerships, b) type of monitoring initiatives and instruments, c) reference to the official framework, d) process of frameworks (choice and number of indicators per SDG) e) data sources. Then, we looked deeper into the benchmarking studies by analysing the methodologies used to build composite indicators (indexes).

As most of them use a similar methodology, the significant differences lie in the development of local indicators for SDG monitoring, where there is a large variety in terms of chosen indicators. This is often due to a lack of good local data. Although many studies mention the ambition to use innovative data sources, the majority currently do not bring this into practice.

This leads to the recommendation to build more standardised sets of indicators.

Keywords

Sustainable Development Goals, monitoring, localisation

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1. Introduction

The Sustainable Development Goals (SDGs) were adopted on 25 September, 2015 by the United Nations General Assembly (UNGA) as an integral part of a resolution named “Transforming our World: the Agenda 2030 for Sustainable Development (Agenda 2030)” (UNGA, 2015). The SDGs form a universal set of goals that UN member states have committed to use to frame both domestic and international development policies until 2030. They find their origin in the recent history of sustainable development frameworks and definitions, and they build further upon the progress of the Millennium Development Goals (MDGs), which were agreed by governments in 2001 and expired in 2015. While the MDGs focused on reducing extreme poverty in all its forms within the developing world, the SDGs pursue a broader agenda that encompasses the social, environmental, and economic aspects of sustainable development, which is relevant for all countries worldwide (Kanuri et al., 2016).

The SDGs mark the most ambitious effort yet to place goal setting and sustainability at the centre of global governance and policy as they go one step further than earlier efforts (Kanie et al., 2017) by adding detailed content to the concept of sustainable development, identifying specific targets and indicators for each goal, and using the concept to help frame a broader, more coherent, and transformative agenda (Young, 2017). While the goals provide direction, their accompanying targets and indicators are necessary to operationalise them and measure progress towards them (Pipa, 2013).

Since the adoption of the Agenda 2030, including the SDGs in 2015, many attempts have been made to collect data and measure progress towards the goals at different geographical levels (international, national, regional, and local). So far, the most well-known attempts have been done at a Global (international) level and at the level of individual countries. At the first level, the most ‘official’ attempt is made by the United Nations Statistical Division (UNSD), a division of the Department of Economic and Social Affairs (DESA). Via a website and an annual report (UN DESA, 2021), a yearly update is given on the state of the world as a whole, on the main geographic regions¹ (report) and on individual countries (online public tool) with regard of the SDGs. Both the report and the online tool give an overview of a set of individual indicators per SDG. For the report, the information presented is based on the latest available data on selected indicators from the global indicator framework. The online tool presents for each country all indicators from the official UN indicator framework (the ‘Official Indicators’). Depending on the data availability, both historic data and trends are shown.

Next to this ‘official’ attempt, the main reference frameworks that inspired many more initiatives on the national and subnational level are the yearly updated SDSN Indexes and Dashboards and the OECD project ‘measuring distance to the SDG Targets’. Both differ from the Official UN attempt as they do not just give an overview of indicators but also construct indexes per SDG - allowing for benchmarking between countries - and do not only use Official Indicators, thus deviating from the Official UN Indicator Framework. On the national level, countries started to construct their own national indicator frameworks and report on their progress towards the SDGs. On the subnational level (regional and local), the number of initiatives is growing too, but these appear to be more ad hoc and sporadically. As international reference frameworks such as SDSN and OECD already deviate from the Official Indicator Framework, the question can be raised how subnational entities overcome issues of ‘translating’ the Global SDG Framework to their own local territories. Aiming to clear up this view, this review will provide an overview of monitoring initiatives at the local level.

Therefore, an assessment will be done from different perspectives raising the following questions:

1. Can we use the targets and indicators of the Global Indicator Framework at the local level? Which local initiatives follow them? And which do not?
2. How does the local SDG measurement look like? (What kind of measurement instruments exist at the local level)?
3. What are the features of these instruments (by whom are they done, what do they allow to monitor and do they allow comparison)?
4. What can we consider as a good (valid and informative) measurement of SDG achievement at the local level?

¹ The country groupings are based on the geographic regions defined under the Standard Country or Area Codes for Statistical Use (known as M49) which can be found on the Statistics Division Website at <https://unstats.un.org/unsd/methodology/m49>.

This review is not the first attempt to cover certain aspects of localising the SDGs. If we watch the existing literature, we come across studies that cover more aspects than only monitoring. The study of Fernández de Losada et. al. (2021) is one of the main reference works here. Simon et. al. (2016) does a similar exercise, but dates back to some years ago and focuses solely on SDG 11. This review is different as it has its primary focus on the monitoring of all the SDGs at the local level. It serves the key purpose to fill existing knowledge gaps on the variety of current local SDG monitoring initiatives by showcasing a wide range of initiatives and analysing their advantages and limitations. Thus, we give visibility to these initiatives, with a view to inspiring relevant actors working to strengthen their own SDG monitoring practices.

This study analyses a wide range of initiatives measuring progress towards achieving the SDGs at the local level. It includes a mapping of initiatives designed and developed by various actors. Data collection for the study was carried out through an extensive desk review.

The first phase of the study involved the mapping of existing monitoring initiatives through a desk review that focused on initiatives that are:

- Supposed to track progress towards the SDGs;
- Done by some form of monitoring using indicators and data;
- Focused on monitoring of the local territorial level;
- Limited to the public sphere (excluding any monitoring of individual organisations other than public entities like local governments).

According to the mapping performed in the first phase, a sample of initiatives was selected for further analysis, with specific added value and relevance for comparison to draw lessons and recommendations. The selection was done taking into account the following criteria:

- Consolidated existence and sufficient availability of information: the selected initiatives have a minimum level of maturity and sufficient data/information available;
- Geographic distribution: the selected initiatives cover a wide variety of geographic areas and represent a balanced sample of experiences from several territories across the world;
- Different focus and purpose: since initiatives differ in terms of focus and/or objective, the selected cases reflect a wide variety of approaches, set-ups, mechanisms, etc.;
- Variety in scale of the initiatives: some initiatives are done very locally by one (small) municipality, while others are done covering multiple local entities in one or more countries;
- Context of the initiative: Some initiatives are the result of an (inter)national program regarding localisation of SDGs (e.g. Pilot cities OECD), while others are not.

The information collected and analysed was systematised in a summary matrix. A comparative analysis was conducted with a focus on the main cross-cutting elements, with a view to drawing conclusions, action-oriented recommendations, and lessons learned. These recommendations seek to support policy orientation; improve existing systems; and promote effective monitoring, evaluation, and reporting systems of local territories.

2. Conceptual Framework

2.1 Conceptual framework of the SDGs: 17 goals, broken down in targets & indicators

The SDGs consist of 17 Goals covering a broad range of ambitious global objectives related to social, economic, and environmental issues to be reached by all countries by the end of 2030. They range from ending poverty, hunger, and inequality, to taking action on climate change and the environment, from improving access to health care and education, to building strong institutions and partnerships, and more (UN, 2016).

Each of these goals are accompanied by individual targets that zoom in on more specific problems, with some goals containing five and some others containing over 20 targets. This enables the SDGs to build a comprehensive framework by having broad far-reaching goals, with specific targets to pin-point certain areas². In total, there are 169 targets spread over the 17 goals. Both the 17 SDGs and the 169 individual targets are part of the official Agenda 2030. The preamble of the agenda states that they are “integrated and indivisible and balance the three dimensions of sustainable development: economic, social and environmental” (UNGA, 2015). To ensure follow-up of these goals and targets, there was also a clear need for indicators that focus on measurable outcomes. Where goals and targets describe the desired future state, an indicator allows for measuring the current state of a particular phenomenon thus acting as a proxy to measure the progress made towards that desired future state³.

Goals	Cover a broad range of ambitious global aspirations
Targets	Specific objectives to be achieved within a certain time period related to the broader goal.
Indicators	A quantitative or a qualitative measure derived from a series of observed facts that can reveal relative positions (e.g. of a country or a municipality) in a given area (OECD., 2008). An indicator only gives an indication of the evolution of the underlying reality and will rarely grasp the whole reality (De Peuter et. al., 2007).

Table 1. Structure of the SDG Framework: Goals, Targets; Indicators.

By stating that “The goals and targets will be followed up and reviewed using a set of global indicators”, Agenda 2030 demanded the development of an indicator framework by the Inter-Agency and Expert Group on Sustainable Development (IAEG-SDGs) (UNGA, 2015). The IAEG-SDGs came up with a formal mechanism of quantitative monitoring built on a system of indicators that was agreed upon at the 48th session of the United Nations Statistical Commission in March 2017 and adopted later that year by the UN General Assembly (UNGA, 2017). It is referred to as the Global Indicator Framework (or below as Official Global Indicators) and is being refined annually and reviewed comprehensively by the UN Statistical Commission. The last refinement dates from March 2021⁴.

Today, the total number of indicators listed in the Global Indicator Framework is 248. As 13 indicators are repeated under 2 or 3 different targets, it currently includes 231 unique indicators⁵. All indicators were grouped into three tiers according to data availability and the statistical methodology followed (IAEG-SDGs, 2016).

² ED X Mooc: KULeuvenX - UNSDGx. The UN Sustainable Development Goals: an Interdisciplinary Academic Introduction.

³ Ibid.

⁴ <https://unstats.un.org/sdgs/indicators/indicators-list/>

⁵ <https://unstats.un.org/sdgs/indicators/indicators-list/>

Goal 1. End poverty in all its forms everywhere

1.1 By 2030, eradicate extreme poverty for all people everywhere, currently measured as people living on less than \$1.25 a day	1.1.1 Proportion of population below the international poverty line, by sex, age, employment status and geographical location (urban/rural)
1.2 By 2030, reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions	1.2.1 Proportion of population living below the national poverty line, by sex and age 1.2.2 Proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions
1.3 Implement nationally appropriate social protection systems and measures for all, including floors, and by 2030 achieve substantial coverage of the poor and the vulnerable	1.3.1 Proportion of population covered by social protection floors/systems, by sex, distinguishing children, unemployed persons, older persons, persons with disabilities, pregnant women, newborns, work-injury victims and the poor and the vulnerable
1.4 By 2030, ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance	1.4.1 Proportion of population living in households with access to basic services 1.4.2 Proportion of total adult population with secure tenure rights to land, with legally recognized documentation and who perceive their rights to land as secure, by sex and by type of tenure
1.5 By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters	1.5.1 Number of deaths, missing persons and directly affected persons attributed to disasters per 100,000 population 1.5.2 Direct economic loss attributed to disasters in relation to global gross domestic product (GDP)

Figure 1. Part of the official SDG Framework with Goal, targets and official indicators.

In the table below, we listed up the different SDGs, their short title, description, the number of targets and official indicators for each of these SDGs (Lafortune et. al., 2018), based on the indicator list since the refinement in 2021. Note that if we will later refer to the 'Official Global Indicators', it might in some cases be a reference to one of the previous versions (for example the one from 2017, which consisted of 244 indicators).

SDG	Short title	Description	#Targets	#Official Global Indicators
SDG 1	No Poverty	End poverty in all its forms everywhere	7	13
SDG 2	Zero Hunger	End hunger, achieve food security and improved nutrition and promote sustainable agriculture	8	14
SDG 3	Good health and well-being	Ensure healthy lives and promote well-being for all at all ages	13	28
SDG 4	Quality education	Ensure inclusive and quality education for all and promote lifelong learning	10	12
SDG 5	Gender equality	Achieve gender equality and empower women and girls	9	14
SDG 6	Clean water and sanitation	Ensure access to water and sanitation for all	8	11
SDG 7	Affordable and clean energy	Ensure access to affordable, reliable sustainable and modern energy for all	5	6
SDG 8	Decent work and economic growth	Promote inclusive and sustainable economic growth, employment and decent work for all	12	16
SDG 9	Industry, innovation and infrastructure	Build resilient infrastructure, promote sustainable industrialisation and foster innovation	8	12
SDG 10	Reduced inequalities	Reduce inequality within and among countries	10	14
SDG 11	Sustainable cities and communities	Make cities inclusive, safe, resilient and sustainable	10	14
SDG 12	Responsible	Ensure sustainable consumption and	11	13

Table 2. Each of the SDGs, together with their short title, description, the number of targets and official indicators.

2.2 Measured with indicators (instrument)

Before the launch of the official Global Indicator Framework, some other initiatives already constructed alternative indicator sets to monitor the SDGs. One of the early movers in the field was the Sustainable Development Solutions Network (SDSN), a network launched by UN Secretary-General Ban Ki-Moon in 2012 to mobilise scientific and technical expertise from academia, civil society and the private sector in support of sustainable development, including the design and implementation of the SDGs. In 2015, SDSN developed a set of Global Monitoring Indicators, with 100 parameters that adapt to the SDGs by linking several measurements together across various domains (SDSN, 2015). In the same year, a study and report titled “Sustainable Development Goals: Are the rich countries ready?” was conducted by SDSN in collaboration with the Bertelsmann Stiftung - a German foundation promoting science. The report focused on 34 high-income countries that were also OECD member states in 2015, and monitored them with 34 indicators (Kroll, 2015). Two ‘snapshot indicators’ per goal were selected based on feasibility, suitability, and relevance. The report shows performance by country and performance by goal. In order to summarise each country’s performance, a first prototype of an SDG Index was compiled based on these 34 individual indicators. In the years after, the report was extended in several directions, by adding more indicators, refining the methodology and taking a more global approach by including non-OECD countries as well. In 2016, it was renamed to ‘Annual Global SDG Index and Dashboards’. It became the reference for SDG Global SDG monitoring on the country level.

In the first place, the report consists of an SDG Index which is built on a set of indicators for each of the 17 SDGs. It indexes them and then averages them together to arrive at a score for each goal. Then, the 17 goals are averaged together in turn to come up with one final figure. It uses the most recent published data and includes indicators that offer data for at least 80% of all countries with a population greater than 1 million. Where possible, the SDG Index uses the official indicators proposed by the IAG-SDGs in the Global Indicator Framework. When official indicators have insufficient data available or where indicator gaps remain, it reviews official and other metrics published by reputable sources for inclusion in the SDG Index (Sachs et. al, 2016). It presents the most up-to-date data from official sources (e.g. UN, World Bank,...) as well as from non-official sources (research institutions and non-governmental organisations).

In the second place, there are the SDG Dashboards that provide a visual representation of each country’s performance on the SDGs. They are included in individual country pages and represent the available data on SDG achievement across the 17 goals using a colour-coded scheme. The “traffic light” colour scheme illustrates how far a country is from achieving a particular goal (Sachs et. al, 2016): Green (SDG Achieved), yellow (challenges remain), orange (significant challenges remain) red (major challenges remain). Since the latest editions there are also SDG Trend Dashboards included (SDSN & IEEP, 2020):

- Green: On track or maintaining SDG Achievement: score increases at the rate needed to achieve the SDG by 2030 or performance has already exceeded the SDG achievement threshold;
- Yellow: Moderately improving: Score increases at a rate above 50% of the required growth rate but below the rate needed to achieve the SDG by 2030;
- Orange: Stagnating: Score remains stagnant or increases at a rate below 50% of the growth rate needed to achieve the SDG by 2030;
- Red: Decreasing: Decreasing score, i.e. the country moves in the wrong direction.

In contrast with the Global Indicator Framework, the SDG Index and Dashboards are not officially endorsed by any government or the United Nations (UN), but they are complementary to and supportive of the Global Indicator Framework (Sachs et. al., 2016). The SDG Index and Dashboards evolved from purely being a report to an online tool⁶, where all underlying data is made available via a publicly available web page. Starting from 60 indicators in 2016, it evolved and currently includes 91 Global Indicators plus an additional 30 Indicators for OECD countries (Sachs et.al, 2021). Indicators in this last category are only used for member states of the OECD.

⁶ See: <https://dashboards.sdgindex.org>.

	2016	2017	2018	2019	2020	2021
Total number of indicators	60	83	111	114	115	121
<i>For all countries</i>			88	85	85	91
<i>Additional, only for OECD Countries</i>			23	29	30	30
# of Countries included	149	157	156	162	166	165

Table 3. Number of global indicators in the SDG Index and Dashboard editions

The Organisation for Economic Co-Operation and Development (OECD) also developed a methodology to measure SDG progress, which has already been presented in its first study ‘Measuring Distance to the SDGs Targets – An assessment of where OECD Countries stand’ on the UN High-Level Political Forum on the SDGs in New York in 2016, published as a report in 2017. In its study, the OECD developed an indicator framework closely aligned with the Global Indicator Framework and with the main objective to provide an innovative analytical tool that may help OECD members and possibly other countries to plan SDG implementation, identify policy priorities, and develop their own reporting tools (OECD, 2017). The study got updated several times, of which the last time in 2022. Similar to the SDSN initiative, it currently reports on countries current position towards the defined targets but also assesses trends (is a country moving fast enough towards the target to reach in in time?).

Apart from these two well-known initiatives, other monitoring frameworks were also developed to provide indicators for monitoring the SDGs at a supranational or national level. Below we give some examples of efforts done covering a certain region of the world.

Year	Organisation	Name	Description	# Indicators
2021	Eurostat	Report 'Sustainable development in the European Union - Monitoring report on progress towards the SDGs in an EU context' (5th version)	EU SDG indicator set, developed in cooperation with a large number of stakeholders. 37 indicators are 'multi-purpose', meaning they are used to monitor more than one goal. 67 of the EU SDG indicators are aligned with the UN SDG indicators.	102
2017, 2019, 2020, 2021	ESCAP	Asia and the Pacific SDG Progress Report	In total, 134 indicators are used to compute the Current Status Index for SDG progress assessment.	134

Table 4. Other existing SDG indicator frameworks allowing for monitoring at the supranational or national level.

2.3 At the local level (object)

Although the SDGs were developed and designed by and for national governments, the idea that there would be a crucial role for regional and local governments in the success of the goals was already present during the establishment of the Agenda 2030 (Reddy, 2016; Ståhle, 2018). It was one of the lessons learned from the MDGs when developing the SDGs (UNDG, 2014). Issues such as peace, human security, health, employment, climate change, and migration were addressed mainly at the national and international level, but long-term solutions often require attention to local dimensions, implications and nuances, and most solutions will require local planning, participation and governance (Ibid.).

The Agenda 2030 became therefore the first major UN policy process to have been informed by global consultations with a wide range of stakeholder groups, including representatives from local and regional authorities. This resulted in the idea that SDGs are to be owned and implemented by all people, across different territorial scales, meaning that subnational and local governments are as integral to SDG implementation as national governments (Kanuri et. al., 2016).

This brings us to the concept of 'localisation of the SDGs' which, according to the United Nations Development Programme (UNDP, 2014), refers to the process of defining, implementing and monitoring strategies at the local level for achieving global, national and subnational sustainable development goals and targets using local indicators to monitor and measure progress (UNDG, 2014; Lafortune et. al., 2019). It will involve concrete mechanisms, tools, innovations, platforms, and processes to effectively translate the development agenda into results at the local level. The concept should therefore be understood holistically, beyond the institutions of local governments, to include all actors through a territorial approach including civil society, traditional leaders, religious organisations, academia, the private sector and others (UNDP, 2014).

This tendency to 'localise' certain global or national goals is of course not new. Since the UN Conference on Environment and Development in Rio de Janeiro, Brazil in June 1992, local governments and civil society have gained a wealth of experience on how to translate the Agenda of Rio into practice at local level: more than 6000 Local Agenda 21 Initiatives in 113 countries have demonstrated, in their own way, how to raise awareness, advocate and practically implement the Agenda 21 in their communities (GFT, 2016).

Although the Agenda 2030 explicitly recognises the key role of cities and municipalities by dedicating a specific SDG to Sustainable Cities and Communities (SDG 11), the importance of the local level within the SDGs goes further than SDG 11. The reasoning is that efforts to achieve certain subgoals will mainly have to be done in the context of local governments (cities and municipalities), which is the closest level of governance to citizens and is a necessary level to stimulate other actors to work towards these sustainability goals (UNDG, 2014). Various sources have estimated that around two-third or 65 percent of the 169 SDG Targets will only be reached with a clear mandate and role for local (urban) actors in the implementation process (Cities Alliance, 2015; OECD, 2020a; Lafortune et. al., 2019).

These targets are linked to 62 percent of all the Official Global Indicators (Ciambra et. al., 2020), which brings us to the topic of local monitoring of the SDGs. As stated above, to operationalise the SDGs, a form of progress measurement towards the goals will be necessary. But the existing efforts done on the global (international) and national scale will not be sufficient because of various reasons. For example, national averages of scores on indicators can misinterpret realities on the ground and mask large regional or local disparities (SDSN & IEEP, 2019). Thus, local indicator frameworks and monitoring instruments are needed. Below, we will take a deeper look into monitoring of the SDGs at the local level. We will structure this by looking deeper into the who, how, what of the initiatives.

European Union, stakeholders in trade agreements actively participate through positions on trade and policy committees and civil society dialogues. This level of involvement allows stakeholders to communicate and incorporate environmental considerations throughout the negotiation process. Public participation emerged as a consensus among all interview participants as a critical step in the EIA process. They emphasised that increased stakeholder involvement would enhance awareness of environmental issues, thereby exerting greater pressure on politicians to utilise the findings obtained from the EIA responsibly.

3. Conceptual Framework

3.1 [Who] Cities or higher? (local, regional, national and international level, taking into account the specific role)

3.1.1 Overview: Local and Supra-Local Initiatives

We have defined two levels from which the monitoring is initiated: the local and the supra-local level. Regarding the governance of the initiatives, there are two elements that are important. The first one is the type of actor(s) that are involved. There are different type of actors to set up local monitoring initiatives (Fernández de Losada et. al., 2021): a) local governments themselves, b) LRG associations and networks, c) national governments, d) international organisations (IOs), e) universities, research centres, civil society organisations (CSOs) and private corporations. The second element is in what kind of setup the monitoring is developed: it can be done by one of the abovementioned actors alone or in a collaboration with other actors.

Local level

At the local level, the most important type of actor that initiates the monitoring are local governments themselves. The ‘government’ here often means a collaboration of certain governmental departments. New York’s VLR for example, was developed in partnership by the NYC Mayor’s Offices of Operations, and Climate Policy and Programs, and in consultation with other relevant NYC agencies (VLR New York, 2019). In Buenos Aires, the General Secretariat and International Relations (SGyRI, its acronym in Spanish) was designated as the focal point for the development, elaboration, follow-up and monitoring of the SDGs. 27 government agencies adapted the global goals and targets to the local reality (VLR Buenos Aires, 2019). Doing some form of SDG monitoring or follow-up is not dependent on the size of the local government: there are municipalities or cities of a variety of sizes, from very small municipalities like Shimokawa or Kopavogur to mega cities like New York or Buenos Aires. In the table below we listed up our sample cities and municipalities, their size and if they were in the lead alone or with another organisation.

City	Lead organisation	Population (Approx.)
New York (USA)	City	8,800,000
Bristol (UK)	Academic + City	471,000
Los Angeles (USA)	City	3,971,000
Buenos Aires (Argentina)	City	3,500,000
Winnipeg (Canada)	City	750,000
Kitakyushu (Japan)	Academic + city	9,700,000
Shimokawa (Japan)	Academic + Town	3,200
Bonn (Germany)	City	338,000
Stuttgart (Germany)	City	635,000
Kopavogur (Iceland)	City	39,000
Utrecht (NL)	City	361,699
Helsinki (Finland)	City	642,000
Cape Town (South Africa)	City	4,890,000

Table 5. Overview of local governments included in sample with its role and number of inhabitants.

Some of these cities took part as (pilot) cities in broader regional or national SDG localisation programs, which often led to support by the actors initiating and coordinating these programs. **New York** was one of the three pilot cities under the USA-Sustainable Cities Initiative (USA-SCI) organised by SDSN, together with some leading academic institutions to develop local-level strategies based on SDGs. The Icelandic municipality of **Kopavogur**, the German city **Bonn** and the Japanese city of **Kitakyushu** were pilot cities in the OECD's Programme 'A Territorial Approach to the Sustainable Development Goals' and have worked closely with the organisation in reporting on the SDGs. The city of Kitakyushu and the town of Shimokawa were both selected by the Japanese government as one of the 10 cities for local Government SDGs Model projects. They got support by the Strategic Research Fund of the Institute for Global Environmental Strategies (IGES) in writing and publicising their VLRs. Stuttgart was one of the pilot cities for the German 'SDG Indicators for Municipalities' and was supported by the Bertelsmann Stiftung and the German Institute of Urban Affairs in writing its pilot SDG baseline study. In Winnipeg the monitoring efforts are managed by a collaboration between United Way Winnipeg and the International Institute for Sustainable Development (IISD). For the reporting, the economic development agency of the city 'Economic Development **Winnipeg**' was added as a partner.

The localisation efforts in **Los Angeles** were set up with the support of SDSN and in close collaboration with multiple partners from the academic sector. University partners that contributed to Los Angeles's SDG strategy include the John Parke Young Initiative on the Global Political Economy at Occidental College (Oxy), the Thunderbird School of Global Management at Arizona State University (ASU), WORLD Policy Analysis Centre at the University of California at Los Angeles (UCLA) and the Institute on Inequalities in Global Health at the University of Southern California (USC). What was special was the city's reliance on students in relevant domains for the monitoring. The process was initiated by 18 graduate and undergraduate students, who spent the summer of 2018 gathering data and mapping activities on the SDGs across the public, private, and non-profit actors. Students also developed a methodology to determine the applicability of the targets to Los Angeles's local context, and proposed revisions.

Supra-local level

Apart from initiatives activated at the local level itself, there are initiatives acting at the 'supra local level'. They do a form of SDG monitoring not only focussing on one single local territory or government, but multiple within the same region, country, continent, or organisation. The most well-known initiatives are done by local branches of the SDSN, which has published (inter) national reports on local performance of SDG progress in the United States, European Union (+ EFTA), Italy, Spain, Brazil, Bolivia. These reports build on the approach and methodology constructed by the SDSN and the Bertelsmann Stiftung in the Global SDG Index and Dashboards. The local branches are collaborations of researchers and specialists around the topic of sustainable development. The monitoring efforts are often developed in collaboration with or supported by local actors. For example, the Cities Sustainable Development Index - Brazil (IDSC-BR) was done by SDSN, supported by the Brazilian Center for Analysis and Planning (Cebrap) and financed by the CITinova Project. The SDSN Italia SDGs City Index was done as a collaboration between SDSN Italia and Fondazione Eni Enrico Mattei (FEEM). The integration of the Italian data in an international SDGs Portal is the result of a wider partnership between Fondazione Eni Enrico Mattei, Bertelsmann Stiftung, and the Italian Association for the Council of European Municipalities and Regions (AICCRE).

The other well-known initiative is realised by the OECD and is called 'a Territorial Approach to the Sustainable Development Goals'. Similar to SDSN, the OECD developed a methodology and framework to do subnational (regional and local) SDG monitoring for regions and cities within OECD member states.

In Germany, a multi-stakeholder working group 'SDG Indicators for Municipalities' has been developing mainly two instruments for the systematic monitoring of municipal SDGs within German towns and cities: the SDG indicator set and the SDG Portal. The Association of German Cities initiated the project and is moderating the working group with representatives of the 7 other participating organisations. The German Association of Counties, the German Association of Towns and Municipalities as well as the Council of European Municipalities and Regions support the project work and – like the Association of German Cities – are advocating the application of the SDG Indicators in their respective member municipalities. The German Institute of Urban Affairs is in charge of developing and refining the SDG Indicators with funds from Bertelsmann Stiftung. Bertelsmann Stiftung is responsible for the overall organisation of the project, the publication of the project results and the provision of data via the portals.

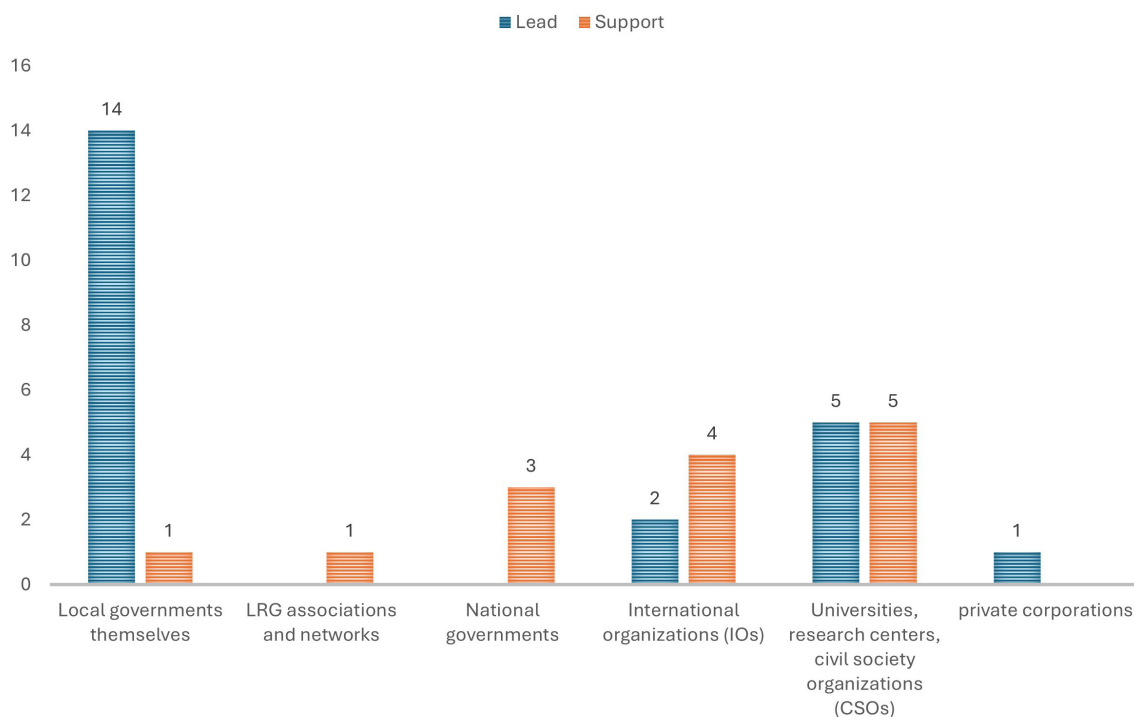
In Flanders, the SDG Monitor was developed by a private company IDEA Consult together with the United Nations University Institute on Comparative Regional Integration Studies (UNU-CRIS), supported by the regional LRG Association of Flemish Cities and Towns (VVSG - ‘Vereniging voor Vlaamse Steden en Gemeenten’) and CIFAL Flanders, a UNITAR affiliated centre of expertise on the SDGs. The Portuguese Municipal Sustainability Index (ISM) was developed by CESOP (the Research and opinion polls centre of the Catholic University of Portugal) in collaboration with the Mayors and technical staff of the Municipalities belonging to the CESOP-Local/Sustainable Territories Network, as part of a “Sustainable Territories” Project.

Name	Scope	Form + Editions	Entities involved	Geographical level	Coverage
US Cities Sustainable Development Report	USA	Report (2017, 2018, 2019)	SDSN USA	USA -Metropolitan Statistical Area (MSA)	105
SDG Index and Dashboards for European Cities	European Union (+EFTA)	Report (2019) Online dashboard	Brabant Center for Sustainable Development (TELOS, Tilburg University)	Capital cities and a selection of large metropolitan areas in the European-Union (EU) and European Free Trade Association (EFTA).	45
Informe Los ODS en 100 ciudades españolas	Spain	Report (2018, 2020) Online dashboard	RED (SDSN Spain)	City level	103
Sustainable development index of Cities - Brazil (IDSC-BR)	Brazil	Online dashboard	Instituto Cidades Sustentáveis (ICS) (Sustainable Cities Institute)	Municipaliti-es	770
SDSN Italia SDGs City Index	Italy	Report (2018, 2020) Online dashboard	Fondazione Eni Enrico Mattei (FEEM) University of Siena’s Santa Chiara Lab	Municipaliti-es-capitals of provinces	103
Municipal Atlas	Bolivia	Report (2020)	Universidad Privada Boliviana (UPB) and the SOLYDES Foundation.	Municipaliti-es	339
A territorial Approach to the SDGs	OECD Countries	Report, Online Dashboard	OECD	Regions and cities	601 and 649
Municipal Sustainability Index (ISM)	Portugal	Report (2020)	CESOP-Local	Municipaliti-es part of a local network	22
SDG Monitor	Flanders	Report (2020, 2021) Online Dashboard	IDEA Consult UNU-CRIS VVSG CIFAL Flanders	Cities and Municipaliti-es	300
SDG Indicators for Municipalities	Germany	Report SDG Portal	Bertelsmann Stiftung, Federal Institute for Research on Building, Urban Affairs and Spatial Development, German County Association, German Association of Towns and Municipalities, Deutsches Institut für Urbanistik, ICLEI - Local Governments for Sustainability, and Council of European Municipalities and Regions / German Section	Cities and Municipaliti-es	47 Core indicators

Table 6. Supra local initiatives regarding SDG Monitoring in our sample

3.1.2 Summarising remarks

As we already mentioned, there are a variety of types of actors involved and forms of collaboration to govern the different initiatives. Below we provide an overview of type of actors involved in our sample initiatives, following the division made by Fernández de Losada et. al. (2021) and adding if these actors had lead or support roles. Although there are some variations, we see that in our sample most of the initiatives are led by LRGs themselves or by Universities, research centres or CSOs and supported by National Governments, IOs and Universities, research centers or CSOs.



Graph 1. (L)ead and (S)upport organisations of the different initiatives

3.2 [How] Quantitative and qualitative monitoring: VLRs, online tools, indicator-based monitoring

3.2.1 Overview: 4 categories of SDG Monitoring Initiatives

The way the monitoring of the SDGs is performed and presented varies between the different initiatives. We determine four main categories.

A first category is represented by initiatives that write SDG Monitoring Reports, which means that reporting on individual SDGs is done via Voluntary Local Reviews (VLRs) or other reporting documents that provide data on individual indicators, often clustered per analysed SDG (or structured following an own framework – as discussed below). This is, of course, the most basic form of SDG Monitoring. While they provide the reader with some trends regarding specific indicators that are linked by the initiative to the SDGs, the data is not easy to be consulted. An advantage of this format is that additional context information is often provided about the evolution of a specific indicator, links of relationships with other indicators can be explicated more thoroughly, and indicators can further be clarified with more quantitative proof (description of ongoing projects or actions that might explain the evolution of the indicator).

All local initiatives in our sample include a form of SDG monitoring into their SDG reporting documents. This is done through Voluntary Local Reviews (VLRs), a document that often follows a similar structure in which local governments describe their implementation of the SDGs and assess their progress towards the SDGs. Most of the analysed local initiatives have included its monitoring into a VLR, some of these cities combined it with a monitoring exercise on SDGs in any other strategic documentation. Some local initiatives did not write a VLR but similar types of sustainability reporting (Stuttgart) or very briefly reported on their indicators (Utrecht).

A second category is composed of initiatives that provide an online SDG Monitoring Platform. These initiatives provide data on individual indicators clustered per individual SDG (or following an own framework – as discussed below). Los Angeles and Bristol use the Open SDG Platform, an open source, free-to-use platform for managing and publishing data and statistics related to the SDGs. Winnipeg developed Peg, an online tool that presents more than 60 indicators. They both follow the original framework (both targets and indicators) and provide data for as many indicators as possible. Utrecht built its own online tool that monitors the SDGs mainly via proxy indicators.

A third category gathers initiatives that publish reports or develop tools that consist of an SDG index. Here, individual indicators are aggregated as an index per SDG and/or an overall SDG index. We will later go more in depth into the meaning of SDG composite indicators or indexes. Most of the initiatives building an index are supra-local initiatives. But, interestingly, there is also a local initiative, the City of Kópavogur, that has built an SDG Index that then is visualised with a tool that has been programmed in Nightingale, a data software developed by Kópavogur's IT department that standardises indicators and calculates the composite indices.

A fourth and last category is represented by initiatives that develop an Online SDG Benchmarking Tool. Via an online interactive tool comparison and benchmarking of individual local governments or territories regarding their performance on the SDGs is being facilitated. Most initiatives that do this are supra-local initiatives that construct SDG indexes and via an interactive tool allow benchmarking of individual local governments or territories. A first subcategory are international studies that allow comparison between countries. The most well-known examples are SDSN European Cities and OECD a Territorial Approach towards the SDGs. A second subcategory are initiatives that do a similar exercise, but then within one country. Examples here are the Flemish SDG Monitor that allows comparison of all Flemish Municipalities, and the Sustainable Development Index of Cities - Brazil (IDSC-BR) that allows comparison between all Brazilian municipalities. One supra-national initiative has a more particular approach: although the German 'SDG Indicators for Municipalities' initiative does not build an SDG Index, its SDG Portal allows comparison of German cities based on individual indicators per SDG.

Both the SDG Monitor and the IDSC-BR go a step further to allow comparison between municipalities.

The IDSC-BR fulfills the dual function of helping cities to measure their performance according to the SDGs, as well as allowing a series of analyses that go beyond municipal limits. It is possible, for example, to verify and compare data from cities in broader territorial areas (large regions, biomes, states, and metropolitan regions), or to groups according to common and specific characteristics, which go beyond territorial issues (such as demographics), social and environmental, among others⁷.

The Flemish SDG Monitor allows for comparison of Flemish municipalities with similar municipalities based on the Belfius' typology, which groups municipalities in function of their socio-economic, demographic and geographical characteristics to create the most relevant reference group. It divides the 300 Flemish municipalities into six main categories and 16 sub-categories (Standaert et. al., 2021).

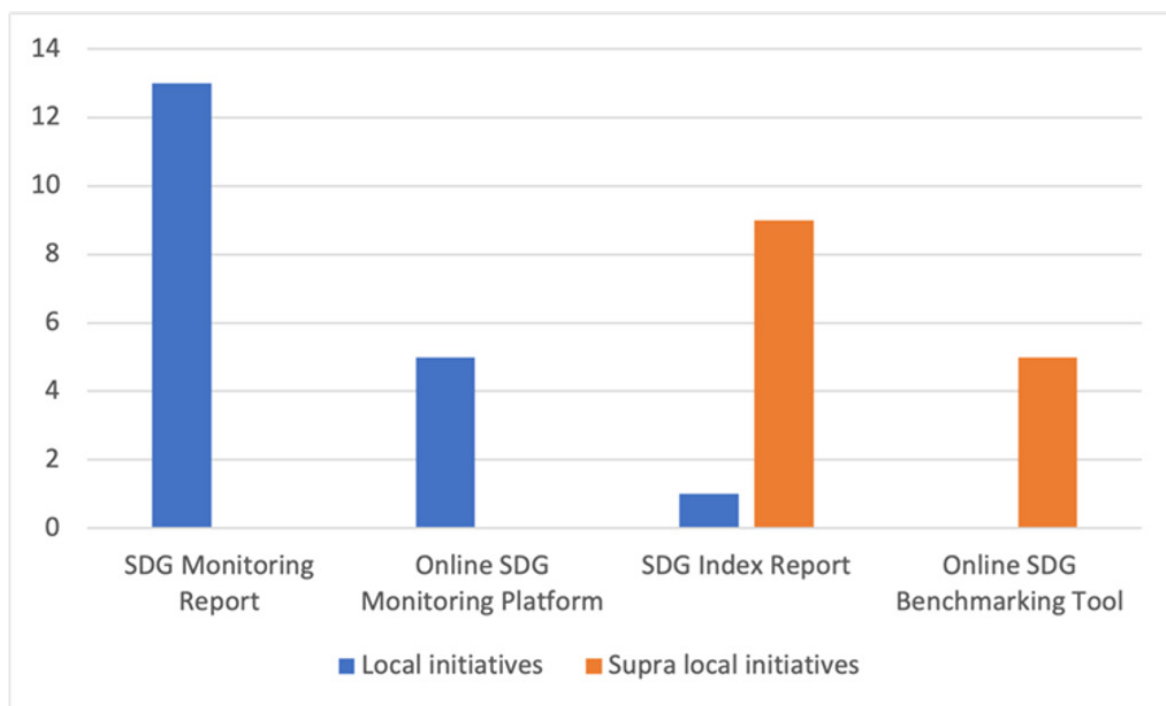
7 <https://idsc.cidadessustentaveis.org.br/introduction>.

Type	Description	Examples
SDG Monitoring Report	Reporting on individual SDGs done via Voluntary Local Reviews (VLRs) or other reporting documents that provide data on individual indicators that are clustered per analysed SDG.	New York's VLR 2018 Stuttgart - a Liveable City The Global Agenda 2030 at a local level
Online SDG Monitoring Platform	Online platform that provides data on individual indicators clustered per individual SDG.	Open SDG Platform (Los Angeles and Bristol) Peg (Winnipeg) Utrecht Dashboard 'Gezond stedelijk leven voor iedereen: Sustainable Development Goals'
SDG Index Reports and Tools	Aggregation of individual indicators as an index per SDG and/or an overall SDG index.	Nightingale (Kópavogur) US Cities Sustainable Development Report SDSN Italia SDGs City Index Bolivia Municipal Atlas Portuguese Municipal Sustainability Index (ISM)
Online SDG Benchmarking tool	Online tools that facilitate comparison and benchmarking of individual entities regarding their performance on the SDGs.	SDG Index and Dashboards for European Cities OECD A territorial Approach towards the SDGs Sustainable Development Index of Cities - Brazil (IDSC-BR) German SDG Portal for Municipalities SDG Monitor

Table 7. Different types of SDG Monitoring Instruments

3.2.2 Concluding remarks

All local initiatives in our sample have implemented a form of SDG monitoring via a written report. The supra-local initiatives also provide their monitoring in a written report but go one step further by combining individual indicators into an index per SDG and sometimes an overall index. There is one exemption here, the German 'SDG Indicators for Municipalities' initiative that does not construct an index, but it just provides a framework of individual indicators. On the other hand, there is one local initiative, the city of Kópavogur that does construct an SDG index. In both local and supra-local initiatives, some provide an online platform or tool to allow a more visually attractive representation of the data and to some form of analysis or benchmarking of the data. The sample initiatives show the large variety in the type of SDG Monitoring Instruments developed for the local level.



Graph 2. Division of usage of different SDG Monitoring Instruments between sample initiatives

3.3 [What] All the SDGs, a selection or “none” (SDGs integrated in a separate monitoring scheme), official framework or a specific one

3.3.1 Overview

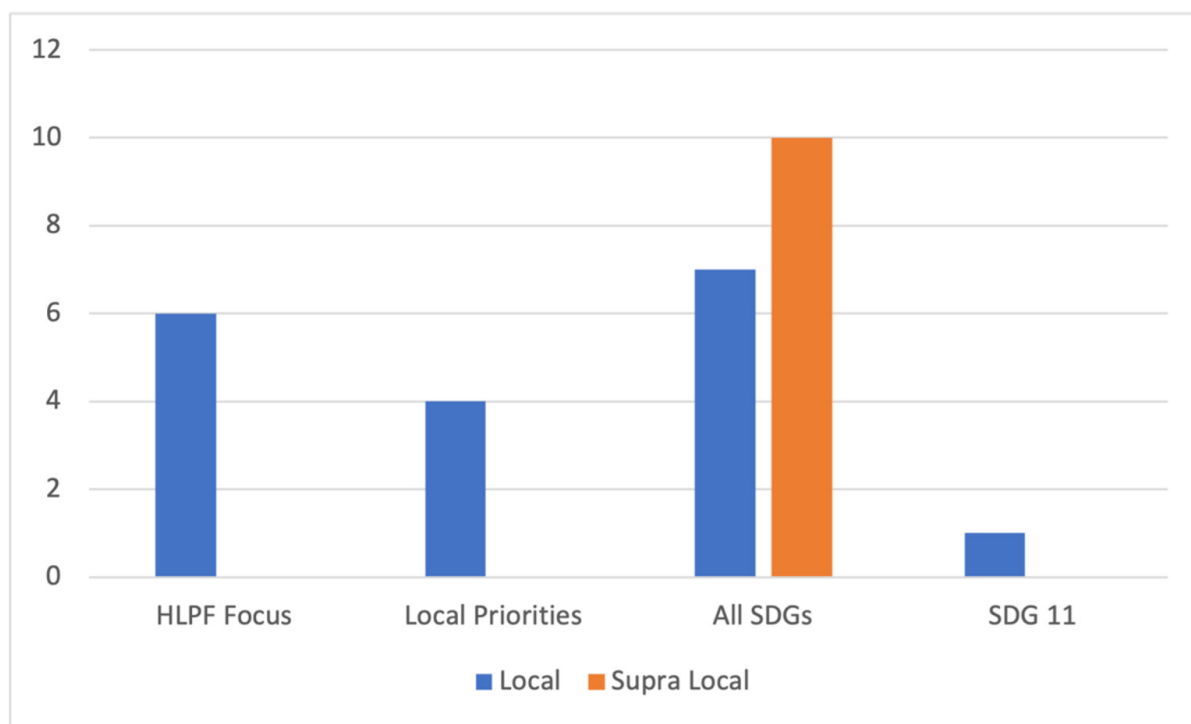
The initiatives analysed address the Official SDG Framework (Goals, Targets, and Official Global Indicators) to different extents and in different ways, as we will show later on First, we look into the goal level, including two elements: on the one hand the goal coverage, i.e. the number of goals that are covered by the monitoring initiative; on the other hand how the follow-up of these covered goals is structured. Second, we zoom in into the adaption by the initiatives of the official SDG targets. The coverage of the Official Global Indicators will be discussed in section 5.

3.3.2 Sustainable development goal coverage

Regarding goal coverage, various approaches are followed, mainly within the group of local initiatives. Some monitor the SDGs that are presented that year in the High-Level Political Forum on Sustainable Development (HLPF), the main UN platform on sustainable development that has a central role in the follow-up and review of the SDGs. Each year, the HLPF determines a specific set of goals to be reviewed in depth those twelve months. Some other initiatives determine their own local priorities and monitor the SDGs that are related to these priorities. Some combine the HLPF focus with own extra priorities. For example, in its first VLR, Los Angeles highlights initiatives in place to address eight of the 17 goals, beginning with 2 of its own priority goals (5, 11) and the goals under review by the HLPF 2019 (4, 8, 10, 13, 16) and a case study on SDG 15.

A large group of both local and supra-local initiatives choose to monitor all SDGs. Still, some of them do exclude one or more specific SDGs that have no direct relevance for the local level. Often SDG 14 on life below water is one of them. Sometimes this is due to the impossibility of gathering relevant data. At the supra-local level, initiatives sometimes exclude a specific SDG for one monitored local government, while the same SDG is included for the other monitored local governments.

One initiative, the VLR of Cape Town, focuses its monitoring specifically on SDG 11 on sustainable cities and communities.



Graph 3. SDG Goal Coverage by the different initiatives in our sample

Regarding the way of structuring the covered SDGs into a monitoring framework, some initiatives cluster the SDGs according to their own strategic plans. Bonn, for example, focuses on its own strategic areas of action as the main perspective and with (some of the) SDGs assigned to these topics additionally. In the case of achieving SDGs, the Sustainability Strategy of the city, adopted in February 2019, has translated them into six fields of municipal action: Mobility (SDG 3,8,9,11,12), Climate and energy (SDG 7,12,13,17), Natural resources and the environment (SDG 2,3,6,11,13,14,15), Labour and business (SDG 4,5,8,9,10,12), Social participation and gender (SDG 1,4,5,8,10,11,16), Global responsibility and One World (SDG 1,2,4,8,10,12,17).

Some other initiatives present the SDGs by clustering them around different existing concepts, like the 5 pillars of sustainable development. The Portuguese Municipal Sustainability Index (ISM) provides an average overall score for each municipality in all the SDG and a score per SDG. Apart from that, results are also calculated and presented for each of the 5 Pillars (People, Planet, Prosperity, Peace and Partnerships) and the GESA dimensions (Governance, Economy, Social and Environmental) – these dimensions are considered to represent the four spheres of society that must be interconnected to ensure a sustainable future, supported but inclusive, coherent and transparent governance systems (Abreu et. al., 2020, and Id., 2021).

3.3.4 Reference to the official targets

As there are differences to what extent the 17 SDG Goals are monitored by the different initiatives, the same can be said about the level of reference and usage of the official targets. As every country has its own national circumstances and national priorities, during the development of the SDG Framework it was recognised by UN member states that the list of targets is indicative (Kanuri et. al., 2016). This means that the official targets are intended to help guide implementation. We will now take a deeper look to what extent local initiatives do follow the official targets. Below, we will describe different methodologies and practices regarding the reference and usage of the official targets.

A large group of the local initiatives in our sample make use of the official targets when implementing the SDGs. Those that do, often start with a 'relevance check' to see if the targets are relevant for the local context. This is done thoroughly, for example, by Los Angeles and Bristol (see box below).

In Bristol, the 169 targets were assessed by the stakeholders based on their local relevance through the "Hacking the SDGs" Methodology of the Urban Institute (Greene & Meixell, 2017). Generally speaking, a target was deemed irrelevant for three reasons: (1) if focused on or limited to developing or least developed countries, (2) if the target explicitly referenced laws or policies at higher levels of government, or (3) if it addressed sustainable development issues that occur outside urban contexts (Fox & Macleod, 2019). This initial mapping identified 75 SDG targets relevant to the city. A second mapping was done to align the targets to the One City Plan, which yielded a set of 79 targets, some of which did not overlap with the 75 targets identified in the first exercise.

Los Angeles' selection of Official Targets to locally follow-up, was the third step of a broader process to implement the SDGs on the local level done in 4 phases: After a) mapping its existing plans and policies to the SDGs and b) making an analysis of existing shortfalls or gaps in SDG targets that are not yet covered, it c) added local context to the 169 targets and indicators. The city developed a 5-step methodology to examine each target:

1. (sort): consider whether the target as written is applicable to the city or not;
2. ('Golden rule'): For those not applicable, determine which targets may be applicable with revisions to the language or context, taking into consideration the original intent and vision;
3. (revise or replace): Alter the target language as appropriate, revising the measure or language to reflect our local values and context;
4. (new targets): Develop new targets to ensure they leave no one behind;
5. (validation): Validate the revised targets by ensuring alignment with existing city commitments and by coordinating with policy owners and community stakeholders.

Other local initiatives prioritise certain targets, based on an analysis of local, regional, or national plans and strategies (Buenos Aires), or on an evaluation of their own core strengths (Kitakyushu). Other initiatives use the targets that are already prioritised for the local level by other organisations. An example here is Kópavogur, which uses the 92 targets identified as important for local governments by United Cities and Local Governments (UCLG) (UCLG, 2015), a global network of local and regional governments and their association.

Apart from selecting existing targets, some initiatives also add own targets or adapt existing targets to reflect their own local reality. Shimokawa, for example, refers to some of the official targets. It took inspiration from the official framework and adapted this to reflect its own reality. In doing so, the town has acknowledged the distinct character of cities and their smaller scale, disregarding criteria whose inherent scale of action cannot be translated to the local level. Kópavogur added six context-specific targets relevant based on ongoing commitments by the municipality, such as the UN Convention on the Rights of the Child (CRC) and the participatory budget platform OKKAR Kópavogur. Most of the supra-local initiatives do not refer to the official targets, except for the German 'SDG Indicators for Municipalities' and the OECD localised indicator framework.

In the first phase of the methodological development of its indicator framework, the German ‘SDG Indicators for Municipalities’ couples its indicators with the original goals and targets. It comprises three stages: in the first, the targets were sub-divided into individual statements (intermediate targets) where necessary. In the second stage, the question of whether the respective individual target addresses a major problem for German municipalities (problem check) was assessed. In the last one, the question of whether municipal tasks could help to contribute to the achievement of the respective individual sub-target or intermediate target (task check) was examined.

The OECD localised indicator framework has classified the 169 targets by their level of relevance at the subnational level through an extensive literature review and expert consultation. 159 appeared to have a strong subnational component. Subsequently, a subset of these SDG targets has been selected on the basis of its applicability to the context and specificities of OECD countries (contrary to targets highly directed at “low-income countries”). The result is a selection of 105 SDG targets for OECD regions and cities. For cities, it covers 65 targets using 135 indicators.

3.4 Concluding remarks

Although starting from the same official global framework, local monitoring initiatives make decisions to what extent they follow the official framework. Regarding the goals, some focus on a limited number of priority SDGs, on key local issues, areas of competencies or political priorities. Others have a more holistic focus and cover all SDGs. Most supra-local initiatives do try to cover all goals, sometimes except for one specific goal that is not directly relevant for the local level (often SDG 14). Regarding the official targets, the local initiatives tend to use them as a guide in developing their own local targets by referring to those that are relevant for the local context or by adapting them.

The official framework also provides the Official Global Indicators. To what extent our sample initiatives make use of these Official Global Indicators we will cover below in the section on the methodology of goal monitoring.

4. The methodology of goal monitoring

4.1 The construction of an SDG Indicator Framework

An important step in local SDG monitoring is the development of a local indicator framework. Before we zoom deeper in on certain aspects of local indicator frameworks, we give an overview to what extent the Goals, targets, and indicators of the Official Global Framework are covered by all our sample initiatives. Wherever possible, we have also distinguished the indicators which were taken from the Global Indicator Framework and the indicators which the initiatives have developed according to their local context.

Implementing Actor	Goals Covered	Excluded (SDG) Goals	Number of Official Targets	Number of Indicators	Of which IAEG-SDGs Indicators	Of which own indicators
New York	167 (8 local goals)	17		110+		
Bristol	17		79	140	50	32
Los Angeles	17		157	250+	244	6+
Winnipeg	17 (8 themes)			68		
Buenos Aires	16	14	57+	180+	107+	73
Kitakyushu	8	1, 2, 3, 4, 6, 10, 14, 15, 16	8+	22+	10+	
Shimokawa	16 (7 local goals)	14		37+		
Bonn	17			46		
Stuttgart	17		44	77	43	17
Kopavogur	15 (5 thematic areas)	2,7	36	94		
Utrecht	17 (7 core themes)			140		
Helsinki	16 (14 goal clusters)	17		55		55 (adopted from city strategy)
Cape Town	SDG 11	All except SDG 11		15	15	/
SDSN USA Cities	15	14,17		57	57 (modified for relevance)	
SDSN European Cities	17			113		
SDSN Italian Cities	16	14		48		
Brazilian Cities	17			88		
Spanish Cities	17			106		
German cities	17			120		
SDSN Bolivia	15	12, 14	43	62		
Portuguese Municipalities	17		66	129		
OECD a Territorial Approach	17		105	130+		
SDG Monitor Flanders	16	14	/	71	/	71

Table 8. Overview of coverage of the Official Global SDG Framework of the sample initiatives

When comparing the number of indicators for cities, there is an almost equal distribution with some cities preferring greater than 100 and others less than 100. Initiatives preferring less than 100 indicators mention that a larger indicator framework makes data unfeasible to interpret, thus making the results difficult to communicate to policy stakeholders; whereas initiatives preferring greater than 100 consider covering all aspects regarding a goal to be able to properly assess and convey results to policymakers. Fewer indicators to measure a goal also mean that policymakers will focus on taking action on panacea-type indicators, minimising the achievement of the goal on other fronts and thus not making holistic progress as the UN set out to achieve SDGs. Due to data availability, local frameworks must limit the number of indicators for maximum data coverage. Within the SDSN Localising Initiatives, there is a lot of heterogeneity. USA and Italy have the least number of indicators while Brazil has the most overlapping indicators. The European Cities Index has a larger indicator database due to greater data availability.

4.1.1 Selection of indicators

Different methodologies are developed, as well as varying criteria followed to select relevant SDG indicators. They range from seeking inspiration and guidance from existing international or national reference indicator frameworks to mapping existing local indicators within the sustainability reporting efforts to the SDGs. This section highlights some of the commonalities and challenges that emerge from these different attempts.

A first approach is the usage of the Official Global Indicators to do local monitoring. Cape Town does this in its SDG Voluntary Review. As some of these indicators are hard to monitor at the local level, it has as a disadvantage that it leaves gaps in the monitoring exercise.

A second approach is to take the Official Global Framework as a starting point. The localised framework for regions and cities does not often use official UN indicators, but rely mostly on proxy indicators (i.e. indicators that capture part of the essence of the SDGs targets, but do not necessarily coincide with the exact definition suggested by the UN).

The OECD project 'A Territorial Approach to the SDGs' first constructed a 'local indicator framework' - a broader set of SDG indicators - and selected certain of these indicators to compute SDG Indexes for Regions and for Metropolitan areas. The Official Global Indicators suggested for the selected targets were by default considered as potentially relevant for OECD regions and cities and subjected to a second assessment, like the one applied at the target level (see above). Finding the exact "UN indicator" for subnational units was often challenging, and sometimes not even relevant. To select subnational indicators for SDGs, the OECD prioritised proxy indicators - those capturing the essence of the target - with high methodological comparability and spatial coverage over exact UN official indicators with low territorial availability.

The OECD Regional and Metropolitan Databases provide a set of economic, environmental, social, labour market and demographic estimated indicators on the 649 OECD metropolitan areas (functional urban areas with 250 000 or more inhabitants) and about 2 000 regions in 36 OECD countries, plus Brazil, China, Colombia, India, Peru, the Russian Federation, South Africa and Tunisia.

By looking at its Regional and Metropolitan Databases through an SDG lens, the OECD gathered 135 indicators to monitor progress in regions and cities toward the SDGs. These indicators cover around 62% of the subnational SDG targets and cover at least one aspect of each of the 17 SDGs for both regions and cities. Only 56 of the gathered indicators (covering 32% of the subnational SDG targets) are currently available for cities.

Not all indicators from the local indicator framework were selected for the computation of the index. Only a subset of 64 indicators (43 unrepeated indicators) were used to produce indexes that measure the distance of regions and cities to the SDG goals, to maximise the coverage of OECD regions and cities as data availability tends to be lower at the subnational level. A third approach is to start from an existing indicator framework, other than the Official Global Indicators. These existing frameworks can be International (ISO 37120, SDSN Index and Dashboard Indicator Framework), national (the German SDG indicator catalogue used as inspiration by German cities and towns) or local (existing local sustainability monitoring frameworks).

A fourth and last approach is to start from scratch and develop an own indicator framework, starting from the local context (local data availabilities).

Approach	Examples
Usage of (part of) official indicator framework	Cape Town (SDG 11)
Adaptation of official indicator framework (adaptation of indicators, search for proxy indicators, additional indicators to fill data gaps)	Buenos Aires Los Angeles Bristol OECD
Start from other existing (SDG) (intern)national or local indicator frameworks	International: Kopavogur (ISO 37120), SDSN Italia SDGs City Index (SDSN Index and Dashboards Indicator Framework) National: Stuttgart (German SDG Indicator catalogue for municipalities) Local: Bonn (Own Sustainability report), Winnipeg (Peg), New York (OneNYC)
Development of an own SDG Indicator Framework	IDSC-BR Flemish SDG Monitor Shimokawa German SDG Indicators for municipalities

Table 9. Approaches followed to build an indicator framework

4.1.2 Distribution of indicators

Not only the choice of indicators itself, but also the distribution of the indicators will have an impact on the representation of the SDGs and their monitoring. In this section, we will look at how many indicators are representing each SDG, how they are distributed (equally or unequally) among the different SDGs and if the same indicators are used under different SDGs.

Distribution of indicators among goals	Initiative
Equally	OECD A Territorial Approach
Unequally	VLR Stuttgart
(Striving to) a minimum number of Indicators per SDG	Spanish SDG City Index German SDG Indicator Catalogue
Sub-Indexes	Flemish SDG Monitor

Table 10. Examples of different approaches regarding the distribution of indicators among SDG Goals

For most of the local initiatives, the choice of the number of indicators and the equal or unequal distribution per SDG does not necessarily have to represent a (strategic) choice by the initiators of the monitoring. It is just a consequence of the exercise that is done to select the indicators in combination with the availability of data sources (see below).

In the group of supra-local initiatives, the number of indicators per SDG and their equal or unequal distribution is more often the consequence of a decision that is part of the construction process of the indicator framework. This is because these initiatives often construct an index, which means the number and distribution of indicators will have larger implications on the result than for those initiatives that just list up individual indicators. When an index is constructed, the number of indicators per SDG can have an influence on the weighing and the scores per SDG.

Some initiatives strive to have a certain (minimum) number of indicators per SDG. In the Spanish SDG City Index, the distribution of the 106 indicators that are used for each of the 17 SDGs is reflected in the table below. The number of indicators for each SDG varies depending on the differences in access and availability of existing data according to the thematic area addressed. However, as a general criterion, a minimum of four indicators per SDG has been established to ensure that each SDG is measured with a sufficient level of detail (Sánchez et. al., 2020).

SDG	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
#	5	5	13	6	5	6	4	8	6	6	11	5	4	5	4	9	4

Table 11. Distribution of Indicators within the Spanish SDG City Index

The German SDG Indicator Catalogue makes the distinction between core and additional indicators (see below). The number of selected core indicators are limited, as developing a clear and manageable catalogue of indicators is needed. Despite the limited number of selected indicators, it was important to the authors that all 17 SDGs were included because the individual SDGs under Agenda 2030 are to be considered as equal and integrated. As a result, identical target measurements of approximately three core indicators were sought for all SDGs in the indicator catalogue. However, these target measurements were deliberately exceeded for certain individual SDGs which are particularly important to municipalities. For instance, SDG number 11 is represented using five indicators. For other SDGs, the target measurement size was not met due to the somewhat lower importance of the goal to the municipalities, or due to a lack of available and/or suitable indicators. When possible, indicators were assigned to not just one but several SDGs. With these multiple assignments, the individual SDGs -with a limited total number of indicators- can be presented in a manner as differentiated as possible (Assmann et. al., 2018).

The **Flemish SDG Monitor** works with sub-indexes.

Within the SDG Monitor there was one restriction when assigning indicators to SDGs to avoid assigning the same indicator to different goals. However, the number of indicators for which such a choice had to be made was relatively limited and often quite straightforward. For example, while the gender gap in unemployment can be assigned to SDG10 Reduced Inequalities, it is a more natural fit for SDG5 Gender Equality. All goals contained at least two and on average more than four indicators. The only exception is SDG14 Life Below Water, where the authors were unable to find indicators meeting both criteria. For some specific targets of the SDGs, multiple suitable indicators were available. However, including all of them risks drowning out the signal from those targets in which only one indicator is available. To avoid them dominating the overall score on the SDG, the authors combined those indicators in a sub-index.

Although the OECD set of indicators aims to cover the broad spectrum of all 17 SDGs, the coverage in terms of indicators varies widely across SDGs. Whereas SDGs 8 and 16 have indicators for at least 85% of the selected targets, SDGs 12 and 14 have indicators for less than one-third of the selected targets.

4.1.3 Categorisation of indicators (core and others)

Speaking of the construction of the indicator frameworks, the last thing we highlight is the subdivision of indicators according to their relative importance for local SDG monitoring. Here, we mention the German SDG Indicator Catalogue, which draws the distinction between core and additional indicators. To make the catalogue clear and manageable for municipalities, it provides a limited number of selected indicators that are seen as core. But as the catalogue is seen as suggestive in nature, it is up to the individual municipality to decide on its own which indicators it would like to use while considering overall local conditions and using its own strategic priorities as a basis for mapping the implementation of SDGs. Thus, those 47 proposed SDG core indicators may be modified, discarded, or expanded. Apart from the core indicators, approximately 150 additional indicators were listed which in principle can also be used for SDG monitoring. The SDG indicator catalogue, therefore, assumes the role of a toolkit for individual cities, counties, and communities (Assmann et. al., 2018).

4.2 Data characteristics

One of the greatest challenges in building indicator sets is the search for relevant data. The availability of (high-quality) data is crucial for implementing efficient monitoring systems based on reliable indicators. According to SDSN, indicators should draw on well-established sources of both public (local, regional, national, international) and private data, and be consistent to enable accurate measurement over time. Below, we will first describe the type of data sources used by the different initiatives and we will look closer to the quality these data sources have. Then, we will look at what the initiatives use as observation unit and how disaggregated the data is presented.

4.2.1 Data sources

Indicators can use data produced by a variety of sources. In many reports, the need is stated that, for proper measurement, follow-up and monitoring of the SDGs, new data sources will be needed. Already in 2014, the United Nation's Secretary-General's Independent Expert Advisory Group on a Data Revolution for Sustainable Development stated in its report 'A World That Counts: Mobilizing the Data Revolution for Sustainable Development' that new 'non-traditional' sources of data should be integrated with traditional ones to produce the necessary high-quality information to foster and monitor the SDGs (Morales et. al., 2014). With the term 'traditional' data sources we refer to data from international organisations, national, regional, and local statistical offices and other ministries or government agencies (Fritz et. al., 2019). These official sources thus are as 'public' sources originating from public organisations.

Conversely, non-traditional data sources are represented by categories such as commercial data, official sensor networks, citizen-generated data, spatial data infrastructure, earth observations, and data from knowledge-based institutions and philanthropies (Fritz et. al., 2019; Fernández de Losada, 2021). However, public and not-public data sources are sometimes included here. We mainly see the usage of traditional sources, like data from governments of all levels ((Inter)national, regional, local) or statistical offices, and a lack in the usage of non-traditional data sources.

	Traditional	Non-Traditional
Local		
Bristol	Municipal data (Bristol Key Facts Document, Bristol Quality of Life Survey) National Government data (Councils' internal performance framework Office for National Statistics Public Health England)	
Los Angeles	Official National Statistics Municipal data Local Health Surveys	Community generated data
Buenos Aires	Official Governmental sources	
Shimowaka	Questionnaire survey ('Survey on Residents' Perception of Town Development in Shimokawa')	
Kópavogur	50 local databases, including service data from schools and kindergartens, building inspections data, human resources indicators, among others.	
Bonn	Quantitative data from public sources supplemented with qualitative information on relevant activities.	
Supra local		
SDSN US Cities	Public sources, like national agencies or the states, counties and cities.	Research institutes data

SDSN European cities	Data from European-Commission via Eurostat, but also from the European Environmental Agency, the Joint Research Centre, and the Eurobarometer. Data from the OECD Regional and Large Metropolitan Areas databases, the European Social Survey.	Peer-reviewed papers
SDSN Spanish cities	Official public or acknowledged sources.	Academic articles valid for Spanish context
SDSN Italian cities	Central public sources (e.g. national statistical offices, national employment agencies, national research centres, national ministries)	
Bolivian Municipality Atlas	Public registers from central government agencies, census data.	Data from satellite sensors
German SDG Indicator Catalogue for Municipalities	Public data sources from the Federal and State Statistical Offices, besides other public authorities and a database of municipal data.	Research institutions
Brazilian Cities	Public official (National) sources	
OECD a Territorial Approach	OECD Regional and Metropolitan Databases, Eurostat, JRC, Gallup World Poll, the World Database on Protected Areas, the Global Database of Power and the Historical global-gridded degree days Database.	
Portuguese Municipalities Study	Data from Eurostat, OECD, and local public sources (Statistics Portugal, Portuguese Environmental Agency and several directorates-general).	
Flemish SDG Monitor	Town and City Monitor ('Gemeente-Stadsmonitor') from the Flemish Agency of Internal Affairs, a database combining information from official statistical sources with a three-yearly household survey. Province in Numbers ('Provincie in Cijfers'), a database bringing data together from the 5 Flemish provinces.	

Table 12.

4.2.2 Data quality

Not all indicators are conceptually clear or have an internationally established methodology or available standards. The IAEG-SDGs distinguishes between Tier I indicators, which are methodologically mature and reliable using data generally available in all national contexts with adequate periodicity and frequency; Tier II indicators, which have universally accepted standards and methods, but whose data is not regularly produced by most countries; and Tier III indicators, whose methodology is being developed and tested but have not been acknowledged internationally. Since the last update, the indicator framework contains 130 Tier I indicators, 97 Tier II indicators and 4 indicators that have multiple tiers (different components of the indicator are classified into different tiers) (IAEG-SDGs, 2021).

Considering this tier system, national level indicators do not always qualify similarly at the local level. This is illustrated within the OECD report ‘a Territorial Approach to the SDGs’: even when indicators are classified as Tier I for their established methodology and availability for countries worldwide (which is only the case for 116 out of the 232 official UN indicators), disaggregating the indicators at the adequate subnational scale is not always available. This suggests that, if disaggregation at the regional or city scale were also a criterion of “availability”, less than 50% of the UN indicators would be classified as Tier I. Buenos Aires got inspired by the classification of the IAEG-SDGs and defines three indicator levels: 1. indicators with available data and methodology produced by the city; 2. indicators using data and methodology not produced by the city; 3. indicators under development.

Also the German SDG Indicator Catalogue for municipalities uses its own system to label the quality of its indicators. It divides them into two types: Type I Indicators show high or very high validity, very good data availability, high or very high data quality and which, in general, are indicators of results or effects. Additional indicators, defined as Type II Indicators, have high validity but not very good availability. “Very good” availability means that data for all municipalities with more than 5,000 inhabitants, or at least for county-free cities and counties across Germany, can be accessed regularly, based on a uniform collection concept, from a central data source and without undue effort.

4.2.3 Data frequency

In most of the initiatives, the data is only provided for one year in the past showing a snapshot in time. Progress over time (trends) is not often integrated in the monitoring initiatives. For example, in the SDSN US Cities study data dates back from one (or multiple) years between 2014, and 2017, but no evolution or trends are shown. The same counts for the SDSN European Cities report or the SDSN Italian cities where no trends or historical data are included.

Some of the initiatives do include data from the past (historical data), which can be very valuable to perform a trend analysis. The Flemish SDG Monitor currently collects historical data when possible, in most cases going back to 2014, and to 2011 for the larger regional cities. This way it allows the municipalities to trace their performance into a wider timeframe, and it enables them to see whether a low score is a momentary dip, a long-term problem, or an improvement on historically lower scores.

4.2.4 Urban delineation

Measuring local SDG performance is influenced by how the ‘local level’ is delineated and defined as unit of measure. We can distinguish mainly between two approaches.

A first one is a functional approach, where functional urban areas (FUAs) are defined according to where people work and live. The 2019 US Cities SDG Report for example, analyses, in the majority of cases, data for the geographic area known as Metropolitan Statistical Area (MSA)⁸, rather than using city limits. MSAs are designated and defined following a set of official standards, developed by the US Census Bureau to capture cities and the surrounding metro areas, including areas where commuters to the relevant city are likely to live (Lynch et. al, 2019). Analysing the data at the MSA level presents both benefits and limitations. MSAs include cities and surrounding areas, and so conducting analysis at this level accounts for much of the population that commutes into city areas. Because the MSA is designated by the Census Bureau, using this level of geographic analysis allows for consistent measurement across time and place. On the other hand, using the MSA as a geographical unit presents challenges because an MSA represents multiple jurisdictional boundaries (Ibid.).

The OECD study a Territorial Approach follows a similar functional approach. Together with the European Commission, it has developed a methodology to define ‘Functional Urban Areas’ (FUAs) in a consistent way across countries (Dijkstra et. al., 2019). Using population density and travel-to-work flows, a FUA consists of a densely inhabited ‘city’ and of a surrounding area (commuting zone) whose labour market is highly integrated with the city (OECD, 2020b)⁹.

⁸ The US Census Bureau defines it as a core area containing a large population nucleus, together with adjacent communities that have a high degree of economic and social integration with that core. See: <https://www2.census.gov/geo/pdfs/reference/GARM/Ch13GARM.pdf>.

⁹ For more information on the definition of ‘city’ and ‘commuting zone’, see Dijkstra et. al., 2019 and (OECD, 2020b).

A second one is an Administrative Boundaries Approach, where the main unit of analysis are cities defined according to an administrative definition. This is done within the SDSN European cities study where a city is defined as a local administrative unit (LAU), where the majority of the population lives in an urban centre of at least 50,000 inhabitants (Lafortune et. al., 2019). Some entities try to combine both approaches which can be challenging. In its VLR, Bristol states that finding the appropriate geographic scale of measurement for local monitoring is an unresolved challenge. Like for most cities, the functional urban area of Bristol is much larger than the area controlled and monitored by the Bristol City Council. While the City of Bristol has a population of roughly a half million people, the functional area of the city is over one million people. Monitoring progress towards the SDGs only within the city boundaries could thus be highly misleading. For example, a reduction in homelessness in the City of Bristol could correspond with an increase in a local authority area that is just meters away.

Therefore, the report concludes that it is important to measure progress both at the functional and administrative levels. The functional approach is extremely useful to measure outcomes in policy domains that are place-sensitive, span across administrative boundaries and require understanding the economic dynamics of the contiguous territories. At the same time, it is important to measure SDGs progress within administrative boundaries, including for data availability and consistency with local official statistics (OECDa, 2020). In the Italian City Index, the main unit of measurement was the municipal level and, that failing and depending on the object of measurement, the provincial scale. The report takes as reference unit the municipality – political and administrative entity primarily responsible for a wider range of policies supposed to influence the territory under jurisdiction.

The focus of analysis in the second Spanish Cities report is centred exclusively on cities, and it does not include an analysis of urban areas. Urban areas in Spain lack a political-administrative entity and therefore political agents capable of implementing the Agenda 2030 at this scale. Eighty-four percent of the proposed indicators (89 out of a total of 106) have data at the municipal level.

	Functional	Combination	Administrative
Meaning	A larger urban area is considered, often including a densely populated ‘city’ core and a commuting area. Functional areas better take into account the actual territorial extent within which different processes take place (Valencia et. al, 2019)	Depending on the measured topic, a more functional area is chosen or the administrative city boundaries are followed.	The unit of measurement is the administrative boundary as defined by the government.
Example	US Cities – MSA OECD – Functional Urban Area	Bristol	SDSN European Cities Spanish cities Italian Cities Index
Pros	Can better represent urban realities Extremely useful to measure outcomes in policy domains that are place-sensitive, span across administrative boundaries and require understanding the economic dynamics of the contiguous territories	Leaves flexibility to choose for the most appropriate approach.	Data availability Consistency with local official statistics
Cons	Might be harder to measure as it represents multiple jurisdictional boundaries. Lack a political-administrative entity and therefore political agents capable of implementing the Agenda 2030 at this scale.	Can be challenging for the administration to decide what approach to use when.	Can be misleading as administrative boundaries do not always represent urban realities as cities have influence on a wider area. As these are based on national definitions, they can be starkly different among countries and are problematic for international comparison.

Table 13.

4.2.5 Observation Unit

Besides identifying viable indicators for the measurement of SDG localisation performance, the reliability of VLRs also depends on the capacity of local governments to compile these indicators with accessible, disaggregated, durable, and affordable data. To what extent data is available at the local level will have an impact on what will be able to measure at what geographic scale. Often, reports or monitoring tools will try to find data closest to the unit of measure (local level) but will take data from a higher geographical scale if not available at the local level. The Bolivian Municipalities study uses aggregated data at the country level, data corresponding to the nine departments and data corresponding to each of the 339 municipalities. Seeing the size of the town, in Shimokawa some publicly available data is aggregated at higher levels and, therefore, does not address conditions in municipal governments.

In the SDSN European cities study in many instances, city-level data did not exist for some cities or for an entire indicator. In these cases, closest territorial levels (TL) were used, following Eurostat's Nomenclature of territorial units for statistics (NUTS). The NUTS classification is the official EU system for dividing EU territories into specific statistical units for the purpose of collecting, harmonising, and analysing data, in addition to defining EU regional policy (Lafortune et. al., 2019). Overall, about half of the metrics included correspond to city-level data. When not available, the Nuts classification (typically NUTS 3 or NUTS 2) was used to impute closest proxies. The smallest level of disaggregation was used when possible, which corresponds to NUTS 3 data (territorial level corresponding to basic regions of EU countries for the application of regional policies). When not available, NUTS 2 or NUTS 1 data were imputed. In rare cases, such as for the obesity rate and CO2 emissions, sometimes national level datapoints were used as imputations for a few cities with missing data. This was done in cases where it was considered that, given the indicator's importance, it would rather cope with the bias of using a datapoint from a larger agglomeration than the bias of having no datapoint at all.

In the German study, the data could be divided into three or five categories: Germany, county, large-, medium-sized- and small city. Data for a maximum of 25 indicators were available at municipality level, whereas the data of a maximum of 50 indicators could be investigated at district level. In general, local data in Germany is available at the municipal or county level. In the SDSN US Cities study, many indicators were collected at the county level and aggregated to the MSA level. An MSA consists of multiple counties, a legally defined political and administrative subdivision of a US State that consists of a geographic region with specific boundaries¹⁰. Two indicators were measured at the state level: Renewable Energy Consumption and Production.

4.2.6 Disaggregation of data and LNOB

The global SDG Indicator Framework has an overarching principle of data disaggregation: "Sustainable Development Goal indicators should be disaggregated, where relevant, by income, sex, age, race, ethnicity, migratory status, disability and geographic location, or other characteristics, in accordance with the Fundamental Principles of Official Statistics." (UNGA, 2014). Thus, the term "disaggregated data" refers to data that can be used to generate statistics and indicators for population groups defined by (or disaggregated by or broken down further into) one or more dimensions or characteristics.

It is linked to the 'leave no one behind' (LNOB) principle of the Agenda 2030, which on its turn states the need for disaggregated data into the characteristics named in the SDGs (income, gender, race and ethnicity, age, sexual orientation,...), to be able to identify vulnerable groups or populations that are most likely to be left behind. And this would be achieved by generating indicators, understanding the factors that keep them in or move them out of that position, and monitoring their progress in achieving the development targets and goals. Despite its importance, not so many studies do get to the point of disaggregating its data according to the LNOB principle. SDSN European Cities, for example, states that a key dimension for which there tends to be poor data coverage is the "Leave no one behind" agenda.

But there are examples that show how it should be done. As Los Angeles is one of the most diverse cities in the world, measuring without accounting for geographic or demographic characteristics can hide important underlying differences in outcomes. It therefore foresees information at a more disaggregated scale than city aggregates and unpacks data for different socioeconomic

¹⁰ 'States, Counties, and Statistically Equivalent Entities', <https://www2.census.gov/geo/pdfs/reference/GARM/Ch4GARM.pdf>.

groups. Over 30% of Los Angeles' reported indicators have been disaggregated by gender, race and ethnicity, age group, sexual orientation, or other characteristics. In its online tool, the user can choose categories from a dropdown menu on the left side to see different breakdowns of the data. If available, data can be broken down into percentages by age (18 to 64 years, 65 and over, Under 18 years), education (bachelor's degree or higher, higher school graduate, less than high school), gender (female, male), race (American Indian and Alaska Native, Asian, Black or African American, Hispanic or Latino origin (any race), Native Hawaiian and other Pacific Islander, white) and employment (employed, unemployed).

4.3 Constructing composite indicators

Indexes as composite indicators are formed by aggregating indicators for the purpose of characterising a multi-dimensional issue (such as sustainable development), which cannot be measured by a stand-alone indicator¹¹. They can enable and facilitate comparison of the performance of different, individual entities based on a benchmark to each other. As each of the SDGs or the SDGs together cannot be measured by a single descriptive indicator, but should be represented by multiple dimensions, certain studies build global indexes or composite indicators wherefore they apply a certain methodology. An SDG index therefore is an integrated framework of indicators that considers the interdependence of social, economic, and environmental aspects of the SDGs holistically, as the multidisciplinary nature of sustainable development greatly complicates its monitoring using single indicators (Diaz-Sarachaga et. al., 2018).

Seeing the wide range of methodologies applied in the development of such indexes, a manual was developed by the JRC and the OECD with the objective to provide researchers with a set of recommendations on how to design, develop, and disseminate a 'Global SDG Index' (EC JRC, 2020). It suggests a checklist with the following ten items to be followed (OECD, 2008):

1. The creation of a theoretical framework as a basis for the selection and combination of the indicators;
2. The selection of the indicators (data);
3. The imputation of missing data through a) case deletion, b) single imputation or c) multiple imputation;
4. A multivariate analysis to investigate the overall structure of the indicators;
5. Normalisation to render the indicators comparable;
6. Weighting and aggregation according to the underlying theoretical framework and data properties;
7. Robustness and sensitivity analysis of the composite indicators to identify possible sources of uncertainty;
8. Disaggregation of the index to test transparency of underlying indicators or values;
9. Correlation of the composite indicator with other published indicators; and
10. Presentation and visualisation of the composite index in a clear and simple way.

There are mainly two reference studies (SDSN Global Indexes and OECD a Territorial Approach) that construct an index and base themselves on JRC and the OECD manual. We will describe them and indicate where other initiatives deviate from their methodology. We will do this below for items (5) normalisation and (6) weighting and aggregation, together with the establishment of performance thresholds of the above checklist, as these are the main elements discussed within the methodological explanations within the reports of the different initiatives. The selection of indicators (2) already has been discussed above.

4.3.1 Establishing performance thresholds (upper and lower bounds)

Before rescaling (see normalisation below), performance thresholds need to be established (an upper and a lower bound needs to be defined). Within the SDSN methodology, for the upper bound a 'five step decision tree' was developed (Sachs et. al., 2021):

11 Environmental governance indicators and indices in support of policy making.

1. Use absolute quantitative thresholds in SDGs and targets: e.g., zero poverty, universal school completion, universal access to water and sanitation, full gender equality.
2. Where no explicit SDG target is available, apply the principle of “leave no one behind” to set the upper bound to universal access or zero deprivation.
3. Where science-based targets exist that must be achieved by 2030 or a later date, use these to set the 100 percent upper bound (e.g., zero greenhouse gas emissions from CO₂ as required by no later than 2050 to stay within the 1.5°C target, or 100 percent sustainable management of fisheries).
4. Where several countries already exceed an SDG target, use the average of the top 5 performers (e.g., child mortality).
5. For all other indicators, use the average of the top performers¹².

The SDSN studies on European and US cities, Italian and Spanish cities follow this 5-step decision tree. Two others slightly deviate from it: The SDSN Brazilian cities take step 4 and 5 together. The Bolivian Municipality Atlas only uses step 1 and step 5. The OECD a Territorial Approach methodology for defining the upper bound is inspired by the ‘OECD Decision Tree’, used in its country level SDG study ‘Measuring distance to the SDG Targets at the country level’ (OECD, 2019):

1. Wherever possible, targets are derived directly from the wording of the SDGs themselves or targets in the wording of the SDGs relative to the starting position.
2. If 1. is not possible, a three-step approach is followed:
 - As a first preference, target end values are based on international agreements and expert opinion, whether absolute or relative;
 - Still a clear normative direction to the indicator (i.e., higher/lower values of the indicators unambiguously imply better performance), the top-performing OECD countries are used to set a benchmark value.
 - Where there is neither international consensus on a target end value nor a clear normative direction to the indicator, then no target end value is set, and the indicator is excluded from the normalisation procedure and from the aggregated normalised results presented.

The OECD a Territorial Approach starts from the OECD Decision Tree but leaves step 2.c out. For 2.b, an unweighted average of the top performer region of each country is used.

The Portuguese Municipality study also uses the OECD Decision Tree. Step 2.b (‘top performers’) is further split up into a) best national performance and b) national values.

However, while the SDSN defines upper bounds or end values using top performer cities (five top cities), the OECD localised framework uses the average generated by the top regions or cities of each OECD country (OECD, 2020a). The OECD approach – which covers all regions and cities in each country – allows this method to set end values, where at least one region or city of each country involved in the analysis participates to define an end value that is both ambitious and feasible in their own context (Ibid.).

The Flemish SDG monitor uses the average of the top 8 performers (of municipalities within the region) as upper bound. Benchmarking the municipalities against the top performers means that the municipalities will be scored in relation towards other top scoring municipalities and that the target will be moving. As a consequence, the SDG index in the Flemish SDG Monitor does not indicate the extent to which a town is on its way meeting all SDG goals. Rather, it expresses how well it is performing relative to other Flemish municipalities. Even a perfect score on a particular SDG does not necessarily indicate that there is no further room for improvement. Similarly, an increasing score does not suggest that this municipality is necessarily improving, but only that its position relative to the top and bottom performances is changing (Standaert et. al., 2021). A municipality that moves forward, but does that slower than the top performers, will thus get a lower score in the following edition of the monitor. The

¹² In the case of global indicators retained, the upper bound was set by taking the average value of the top 5 global performers. For OECD indicators, the average top 3 performers.

monitor will be updated to also include the absolute scores to give the municipalities the opportunity to better interpret their own personal performance over time.

Within the SDSN Global Index Methodology, the lower bound was defined at the 2.5th percentile of the distribution. SDSN European, Italian and Brazilian cities and the Flemish SDG Monitor use the same definition. The Bolivian Municipality Atlas also, but if indicators are identical to the global or regional SDG index, it tries to use the same cut-off values. SDSN Spanish cities uses a variant on this definition: where (OECD) data exist, it uses the lowest 2.5 percentile of the international benchmark, where no (OECD) data exist, the 2.5 percentile of the case study cities has been used. The SDSN American cities study uses a three-step decision tree: 1) Science based threshold or expert advice; 2) If absolute skewness is greater than 2.0 and kurtosis is greater than 3.5, and/or data coverage is below 80%, distributions were analysed for further adjustments and 3) the 2.5 percentile score of available data.

The OECD a Territorial Approach Study defines the lower bound as the average of the bottom 10% of the regions and cities. The Portuguese Municipal SDG Index from its side uses a) the starting point (2015 value) or b) the minimum acceptable value.

4.3.2 Normalisation

Generally, indicators are computed in different measurement units and in various ranges and value scales. To avoid problems introduced by the different measurement units and to make the data comparable across indicators, they need to be 'normalised', i.e. positioned on a common baseline (Kogachi et. al, 2021). Variables are also normalised to avoid problems with outliers or extreme values (Jacobs et. al, 2004). Within the SDSN methodology, each variable is transformed linearly to a scale between 0 and 100 using the following rescaling formula for the range [0; 100] (Sachs et. al, 2021):

$$x' = \frac{x - \min(x)}{\max(x) - \min(x)} \times 100$$

Where x is the raw data value; \max/\min denote the upper and lower bounds, respectively; and x' is the normalised value after rescaling. The rescaling equation ensured that all rescaled variables were expressed as ascending variables (i.e., higher values denoted better performance). This min-max formula is also used in all other studies.

A similar element between the OECD localised framework and the SDSN is the use of normalised indexes from 0 to 100 (where 100 is the best possible score).

4.3.3 Weighting

Variables which are aggregated in a composite indicator have first to be weighted. All variables may be given equal weights, or they may be given differing weights which reflect the significance, reliability, or other characteristics of the underlying data (Freudenberg, 2003).

The SDSN global Index methodology gives fixed, equal weights both at indicator and at goal level. All the other studies also work with equal weights at both levels, except for the OECD study a Territorial Approach. For goals with more than one indicator, the index is defined by the unweighted mean of the normalised value of the respective indicators (OECD, 2020a).

4.3.4 Aggregation

Regarding aggregation, the SDSN Global Index estimates scores for each goal using the arithmetic mean of indicators for that goal. These goal scores are then averaged across all 17 SDGs. All other studies do aggregate in the same way, except for the OECD a Territorial Approach study, where the index is defined by the unweighted mean of the normalised value of the respective indicators (OECD, 2020a).

	European cities	American cities	Italian cities	Spanish cities	Brazilian cities	Bolivia Municipality Atlas	OECD a Territorial Approach	Portuguese Municipalities	Flanders SDG Monitor
Target setting (boundaries)									
Upper bound									
SDSN 5-step decision tree	x	x	x	x	x, var	x, var			
OECD decision tree							x	x	
Average top 8 performer									x
Lower bound									
Bottom 2.5th percentile as minimum	x		x		x	x, var			x
Three step decision tree		x							
Average of bottom 10%									
2015 value or minimum acceptable value									
Normalisation									
Min-max	x	x	x	x	x	x	x	x	x
Weighting and Aggregation									
<i>Weighting</i>									
Equal weights	x	x	x	x	x	x		x	x
Unweighted mean of normalised values							x		
<i>Aggregation</i>									
Arithmetic average at both levels	x	x	x	x	x	x		x	x
Unweighted mean of normalised values							x		

Figure 2.

4.4 Comparability of indicators: correlating the OECD, SDSN European cities and SDSN US Cities scores.

By describing and comparing the different SDG Local Indexes, we learned that the big differences between them lie mainly in the choice of the indicators and the number of indicators included per SDG, not in the choice of the methodologies to build the indexes. We now want to know if the same cities score differently under different existing indexes to see what the impact is of different indicator choices on the scores of similar municipalities on the same SDGs.

We performed Pearson and Spearman's Rank Correlation using three databases, 2020 OECD: A Territorial Approach to SDGs, 2019 SDSN European Cities and 2019 SDSN US Cities. OECD does not aggregate the composite goal score and only creates indices per goal so we were unable to perform correlation on the total aggregated score. The Pearson Correlation Coefficient shows the strength and direction of association between two continuous variables. The Spearman Rank correlation evaluates

the monotonic relationship between two continuous variables. Pearson uses raw data and can only measure a linear relationship whereas Spearman uses ranks and measures a monotonic relationship irrespective of the proportion of change in the two variables.

SDGs	OECD and EU			OECD and US		
	No. of Cities	Pearson	Spearman	No. of Cities	Pearson	Spearman
1	13	0.6587*	0.7602*	46	0.4809*	0.4944*
2	39	0.3916*	0.4114*	0		
3	27	0.6946*	0.7727*	0		
4	11	0.2774	0.4374	0		
5	27	0.6478*	0.7475*	0		
6	37	-0.2457	-0.1287	38	-0.2514	-0.2678
7	37	0.2592	0.2651	51	0.2835*	0.2072
8	31	0.7469*	0.7891*	0		
9	36	0.6143*	0.6688*	51	0.6667*	0.6547*
10	13	0.4352	0.2971	46	0.2922*	0.2102
11	39	0.1252	0.1486	51	-0.1975	-0.1759
12	26	0.1962	0.1671	0		
13	37	0.2313	0.1453	51	0.0776	0.0694
14	0			0		
15	37	-0.0402	0.0872	37	0.1945	0.1524
16	18	0.446	0.3435	51	0.6199*	0.6410*
17						
Overall	428	0.2054*	0.2491*	428	0.1595*	0.1488*

Table 14.

The above results show that computed scores across SDSN and OECD are not closely related. Only a small number of SDGs - those marked with an asterisk - are statistically significant (with a p-value less than 0.05).

The statistically significant correlations varying between 0.1 to 0.2 indicate a mild correlation which is in the overall results as well as individual SDG results between OECD and US for Goal 7 and 10. 0.3 to 0.4 indicate a medium correlation shown by SDG 2 between OECD and EU and SDG 1 between OECD and US. 0.6 onwards indicate a high correlation displayed by the remaining statistically significant values. This means that the same city does not necessarily get the same score for an SDG under the different indexes. For the Brussels Capital Region, the table below illustrates the point by comparing more in detail the scores and ranks by SDG between the OECD and SDSN measure.

SDG	OECD			SDSN		
	Score (max=100)	Distance to benchmark	Rank (total)	Score (max)	Distance to benchmark	Rank (total)
1				61 (87)	O	30 (45)
2	100	0	1 (132)	70 (87)	Y	13 (45)
3	72	28	118 (227)	66 (85)	Y	29 (45)
4				56 (79)	O	29 (45)
5	56	44	112 (233)	61 (81)	O	17 (45)
6	80	20	72 (469)	100 (100)	G	22 (45)
7	51	49	291 (546)	34 (98)	O	16 (45)
8	55	45	297 (359)	70 (99)	O	36 (45)
9	40	60	141 (542)	54 (98)	O	22 (45)
10				57 (86.5)	O	42 (45)
11	87	13	254 (637)	52 (77)	O	32 (45)
12	41	59	154 (227)	65 (99)	O	19 (45)
13	78	22	242 (543)	52 (67)	R	13 (45)
14	15	85	235 (318)			
15	48	52	304 (469)	35 (91)	R	30 (45)
16	100	0	1 (462)	31 (90)	R	44 (45)
17						
All				60		25 (45)

Table 15.

5. Conclusions: homogeneity in theory, heterogeneity in practice

Since the launch of the SDG Framework, a substantial number of monitoring initiatives concerning the achievement of the SDGs at the local level have started, this in many countries across different continents and at different geographical levels. We listed more than 60 cities who actively and recurrently monitor and report about their SDG-achievement. At the national and international level several initiatives have been set up which extend SDG monitoring to cities that, at this stage, do not have a voluntary SDG reporting strategy.

This indicates the drive that the SDGs have caused and the broad-based movement to achieve them. However, we still see concentration within certain parts of the world (European Union, USA, some parts of Asia and some South American countries) and some others that generally lack any form of follow-up or monitoring. In certain, more developing regions (Africa), we still see that they lag in terms of SDG Monitoring and reporting. In other words, there is a clear development bias in local SDG monitoring. However, despite the existence of a worldwide official framework, the different initiatives are characterised by substantial heterogeneity in scope, methodology, and type of reporting or monitoring.

First, the most monitoring initiatives in practice use indicators that deviate from the official UN SDG targets and indicators, initially established in 2017 but refined a last time in 2021. Although a lot of sources state that a large part of the official targets and indicators can be followed up and measured at the local level, our study shows the difficulty and limitations that local governments and other actors face regarding the implementation of it. All things considered, it is not that surprising. The Official Indicators respond to the national context and are defined to measure national development policies. Not all of them are conceptually clear, have an internationally established methodology or available standards, and data may not be produced regularly. This poses challenges to monitoring initiatives at all levels and obliges them to adapt the indicators, use proxies or search for alternatives. Therefore, the initiatives are developing local level monitoring systems and indicator sets that are not always aligned with the ones from the United Nations. In particular, monitoring initiatives that aim at providing cross-region or country (and intertemporal) comparable data, fall back on the SDSN framework, except for the OECD which has developed his proper set of indicators to monitor SDG achievement.

A consequence that we also see is that SDGs, as such, are often used as a framework to work around sustainable development, the official targets and official global indicators are not always followed. In a way, this makes sense seeing that they are developed with a primary focus on countries, but it doesn't help the homogeneity of the follow up done by local initiatives around the world.

While a minority of actors, including some front-running cities, have created systems to measure SDGs, most initiatives use existing (domestic) sets of indicators linked to data and information that are easily available to them. Most supra-national initiatives use international and national data sources. The production and access to local reliable data is still complex and not feasible everywhere, usually as a consequence of the lack of resources and capacities. Frameworks include different types of indicators, with diverse scopes and linked to different data sources that vary significantly. Local initiatives tend to use local and regional (provincial) data to fit their systems and to report progress, whereas local initiatives use more national and international data or produce their own data.

The way these data are used and visualised varies from being included in reporting documents (i.e. VLRs), to being gathered through open data portals (i.e. L.A., Bristol) and visualised for benchmarking purposes (i.e. OECD and SDSN European cities). The diversity and incomparability of the monitoring initiatives has important consequences, in particular considering that the correlation between the ranking according to different indicator schemes for the same units is very weak. In the absence of clear and strong arguments to prefer one set of indicators to another, the incommensurability between monitoring schemes leads to confusion about the degree of SDG achievement, e.g. in function of the definition of best practices, that seriously flaws the use of local SDG monitoring as a policy tool. This may also explain why SDG monitoring and indexes still lack a prominent place in policy making.

6. Discussions

Based on the main findings of this study, a set of recommendations for supporting the monitoring and measurement of SDGs can be done. Studies like the one conducted in Bristol suggest that there is a clear need for a standard set of spatially appropriate and globally applicable indicators for cities.

Regarding the methodology followed to choose indicators and eventually to prioritise SDGs, we see a large variety among reports and tools, which questions their comparability. Moreover, because of data issues, to the extent that intertemporal and cross-sectional comparable monitoring tools exist, they tend to be less informative, falling back on a small number of indicators because of data availability problems.

Another issue to mention is that the municipalities that choose their own monitoring are often ones that already have a history with sustainable development follow up. This might lead to a lack of information on cities and municipalities that do not directly follow up SDGs and might also lead to a selection bias when researching the impact of the SDGs on sustainability monitoring. For the study itself, it is another reason why initiatives that cover more than one entity are to be preferred, as they will also include cities or municipalities that score worse.

It is good to have VLRs, but for reporting it is better that an instance from a higher level produces the monitoring, because of less chance of cherry picking.

What we furthermore have found is that these initiatives show a lot of specificities in their approach and methodology, mainly in their search for indicators and regarding the choice and prioritisation of SDGs to focus on. Mainly as a consequence of data availability constraints, but as well because of political preferences (Voluntary reporting at the local level) and strategic choices (different, sometimes more ambitious targets than the SDGs: some cities have a richer tradition regarding sustainable development that already started before the SDGs, which makes them even more advanced and ambitious in target setting).

7. Recommendations

Based on our analysis, we think there are two clear priorities in the SDG monitoring at the local level.

- First, a broadening of the geographical coverage of the monitoring tools, in particular to local entities in the Global South, which are barely present in the existing schemes and certainly not proportional to their weight in total population.
- Second, the convergence of existing monitoring schemes to a common, standardised framework to which all existing and new initiatives would align. The comparability of achievement between regions, countries and over time is essential to determine best practices and identify essential determinants of SDG performance. In addition, in this way a broader forum can be established to exchange views on data availability, methodology, and reporting as well as benefiting from externalities more in general. The starting point for the standardisation and convergence of monitoring schemes can be a common SDSN-OECD framework to which new local, regional or national initiatives could align. Furthermore, it could be appended by a set of locally relevant indicators, in function of a locally specific strategy of sustainable development beyond the SDGs or a more refined monitoring of SDG achievement, closer to the official indicator framework.

To improve validity and comparability, the SDG monitoring tools could try to converge to the official framework or a similar Official Framework with indicators could be set up for monitoring SDGs at the local level. This could start from a common set of indicators that are used over all the different cities, with some subsets of indicators that can be used regarding the context of certain cities (geographical or other context specificities).

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Annex 1: Overview of Index Studies

	Targets setting (boundaries)	Normalization	Weighting and Aggregation
SDSN Global SDG Index and Dashboard	<p>Upper bound: 5-step- decision tree:</p> <ul style="list-style-type: none"> - Use absolute Quantitative threshold outlined in SDGs and targets; - Upper bound to universal access or zero deprivation; - Science based targets; - Where country exceed the target, Average of top 5 OECD/Index performers; - Average of top 5 performers¹³. <p>Lower bound: Bottom 2.5th percentile as minimum value.</p>	<p>Rescaling: Min-Max on a 0 to 100 scale using as minimum and maximum values the pre-set bounds.</p>	<p>Weighting: Equal weights at both levels.</p> <p>Aggregation formula: Arithmetic average at both levels.</p>
American Cities	<p>Upper bound: 5 step decision tree.</p> <p>Lower bound: 3 step decision tree: 1. Science based threshold or expert advice 2. If absolute skewness was greater than 2.0 and kurtosis was greater than 3.5, and/or data coverage was below 80%, distributions were analysed for further adjustments 3. 2.5 percentile score of available data.</p>	<p>Rescaling: Min-Max on a 0 to 100 scale using as minimum and maximum values the pre-set bounds.</p>	<p>Weights: / Aggregation formula: Arithmetic average at both levels.</p>
European Cities	<p>Upper bound: SDSN 5-step decision tree.</p> <p>Lower bound: Bottom 2.5th percentile as minimum value.</p>	<p>Rescaling: Min-Max on a 0 to 100 scale using as minimum and maximum values the pre-set bounds.</p>	<p>Weights: Equal weighting.</p> <p>Aggregation formula: Arithmetic average at both levels.</p>

¹³ For cities: top 5 cities of all those included in the dataset, minus clear outliers.

Italy	<p>Upper bound: SDSN 5-step decision tree.</p> <p>Lower bound: Bottom 2.5th percentile as minimum value.</p>	<p>Rescaling: Min-Max on a scale of 0 to 100 using as minimum and maximum values the pre-set bounds.</p>	<p>Weights: /</p> <p>Aggregation formula: Arithmetic average at both</p>
Brazil	<p>Upper bound: SDSN 5-step decision tree where the last 2 steps are taken together.</p> <p>Lower bound: Bottom 2.5th percentile as minimum value.</p>	<p>Rescaling: Min-Max on a 0 to 100 scale using as minimum and maximum values the pre-set bounds.</p>	<p>Weights: /</p> <p>Aggregation formula: Arithmetic average at both levels.</p>
Flanders SDG Monitor	<p>Each variable was rescaled from 0 to 100, where 0 indicates the worst performance (2.5th percentile) and 100 (97.5th percentile) describes the best performance. All values below lower bound: set equal to 0; all values above upper bound: set equal to 100.</p> <p>Upper and lower bound: best and worse performers</p>	<p>Rescaling: 0 to 100, in ascending order (higher = better, lower = worse performance).</p>	<p>Weights: Equal weights at both levels.</p> <p>Aggregation formula: Arithmetic average at both levels.</p>
Spanish cities	<p>Upper bound: SDSN 5 step decision tree.</p> <p>Lower bound: 1. Where data exists, the lowest 2.5 percentile of the international benchmark has been used. 2. Where OECD data does not exist, the 2.5 percentile of the case study cities has been used.</p>	<p>Rescaling: Min-Max on a 0 to 100 scale using as minimum and maximum values the pre-set bounds.</p>	<p>Weights: Equal weights at both levels.</p> <p>Aggregation formula: Arithmetic average at both levels.</p>
OECD a territorial approach ¹⁴	<p>Upper bound: Tree step decision tree: - UN framework; - Experts' knowledge; - Best performers.</p> <p>Lower bound: Average of bottom 10% of regions and cities</p>	<p>Rescaling: Min-Max on a 0 to 100 scale using as minimum and maximum values the pre-set bounds.</p>	<p>Weights: For goals with more than one indicator, the index is defined by the unweighted mean of the normalised value of the respective indicators.</p> <p>Aggregation formula: Arithmetic average at both levels.</p>

14 OECD (2020), "Measuring the distance to the SDGs in OECD regions and cities: Framework and overview", in A Territorial Approach to the Sustainable Development Goals: Synthesis report, OECD Publishing, Paris, <https://doi.org/10.1787/f71fd73f-en>.

Bolivia Municipalities	<p>Upper bound:</p> <ul style="list-style-type: none"> - Absolute quantitative threshold outlines in SDGs and Targets -Average of top 5 performers <p>Lower bound:</p> <p>Bottom 2.5th percentile as minimum value.</p> <p>If indicators are identical to the global or regional SDG index, try to use the same cut-off values.</p>	Rescaling: Min-Max on a 0 to 100 scale using as minimum and maximum values the pre-set bounds.	<p>Weights:</p> <p>Equal weighting.</p> <p>Aggregation formula:</p> <p>Arithmetic average at both levels.</p>
Portuguese Municipalities	<p>Upper bound: 7 step decision tree (inspired by OECD)</p> <p>Lower bound:</p> <ol style="list-style-type: none"> 1. Starting point (2015 value) 2. Minimum acceptable value 	Rescaling: Min-Max on a 0 to 100 scale using as minimum and maximum values the pre-set bounds.	<p>Weights:</p> <p>/</p> <p>Aggregation formula:</p> <p>Arithmetic average at both levels, plus also at level of 5Ps and GESA dimensions (Governance, economy, social, environment).</p>

Annex 2: List of Acronyms

Voluntary National Reviews (VNRs), i.e. countries report on their sustainable development progress at the UN as part of the official follow-up and review process.

Voluntary Local Reviews (VLRs), in which they describe their implementation of the SDGs and voluntarily assess their progress towards specific targets in the Agenda 2030.

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