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Open Government Data for the Implementation of Sustainable Development Goal 11
(Sustainable Cities and Communities)

By

GULNARA NURIDINOVNA NABIYEVA
DISSERTATION

Submitted in partial satisfaction of the requirements for the degree of

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Abstract

The prime area of the research is the open government data (OGD) impacting sustainable urban development. Specifically, the research investigates how the use of OGD supports the progress of cities toward implementing the United Nations (UN) Sustainable Development Goal 11 (Sustainable Cities and Communities) (SDG 11).

In Chapter 1, the study examines how SDG 11 is being implemented worldwide by analyzing 336 UN SDG Good Practice data between 2018 and 2021 using five criteria: (1) geography, (2) actors, (3) progress toward targets, (4) areas of implementation, and (5) scale of action. The findings show that reporting is highly concentrated in a small number of countries and gives limited attention to equity-related targets: only 86 of the 193 countries submitted at least one good practice, 33 countries accounted for 73.8% of all submissions, and equity-related targets were addressed in only 2.6% to 9.1% of responses. Overall, the analysis highlights the need for more systematic reporting, a stronger public sector role, greater attention to social equity, and improved urban sustainability targets and indicators.

In Chapter 2, to assess the strengths and gaps of the current SDGs framework, the study analyzes how SDG 11 interacts with the other SDGs. The results show the strongest connections with SDG 17 (Partnerships for the Goals) and SDG 13 (Climate Action), but comparatively weak attention to SDG 7 (Affordable and Clean Energy), SDG 2 (Zero Hunger), and SDG 16 (Peace, Justice, and Strong Institutions). Developing countries more often emphasize gender equality and water-related issues, whereas developed countries focus more on environmental resources and economic activity. These findings highlight the need to strengthen targets, indicators, and international support in underrepresented areas when revising SDG 11 beyond 2030.

In Chapter 3, the study examines OGD in 19 United States (U.S.) cities from the

Sustainable Cities Index 2024, analyzing municipal portals, policies, plans, and sustainability performance through document and portal reviews, content and statistical analyses, and expert interviews. Findings show that OGD initiatives remain underdeveloped, with notable disparities across four criteria: (i) breadth of portal content, (ii) the structure of governance, (iii) user-friendly support, and (iv) equitable user access between higher- and lower-ranked cities, limiting their capacity to support planning and advance SDG 11. No city consistently integrates OGD across planning documents, and only nine define their role in OGD policies, general plans, or sustainability or climate plans. Enhancing OGD effectiveness requires broader user engagement, targeted training, prioritization of policy-relevant datasets, improved standardization, and stronger integration into urban planning processes.

In Chapter 4, the study assesses how U.S. city-level OGD portals support SDG 11 and explores ways to enhance their effectiveness. To address limitations in SDG 11, it introduces an expanded set of indicators, which I call SDG 11+, to better capture urban sustainability. The analysis evaluates portal search results against SDG 11, develops SDG 11+ indicators based on common measures, accessible data, related SDGs, and urban sustainability literature, and examines portal alignment with these indicators. Findings show that no city provides data directly aligned with SDG 11 indicators. Data availability is highest for transportation (31%) and green/public spaces (25%), often lacking demographic detail, while key areas such as slums, disaster losses, and infrastructure impacts remain unaddressed. Most datasets (86.7%) originate from higher-ranked cities, with limited contributions from lower-ranked ones. The results highlight the need to adopt SDG 11+, strengthen data quality and timeliness, expand disaggregation, improve usability, and better integrate locally relevant indicators into global sustainability frameworks.

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Introduction

The 2030 Agenda for Sustainable Development (2030 Agenda) is in grave danger (UN, 2022). The multiple, cascading, and intersecting crises, such as climate change, conflicts, and geopolitical tensions, affect all 17 Sustainable Development Goals (SDGs), which were adopted by all United Nations (UN) Member States as a shared blueprint and global guideline for peace and prosperity for people and the planet (UN, 2015). One of the landmark steps in the movement towards more sustainable cities is Sustainable Development Goal 11 - Sustainable Cities and Communities: Make cities and human settlements inclusive, safe, resilient, and sustainable (SDG 11). This research investigates how SDG 11 might be more effectively implemented, especially through OGD, with special attention to the various dimensions, which are often underemphasized.

Cities play a crucial role in accelerating sustainable development. According to reports, the World Population Prospects (2017) is expected to reach 8.6 billion in 2030 and 9.8 billion in 2050, and by 2050, an estimated 7 out of 10 people will likely live in urban areas. Rapid urbanization provokes extra pressure on the shortage of resources, air quality, freshwater supplies, waste management, and public health. Urban areas are increasingly epicenters of crises, insecurity, exclusion, and injustice, fueling displacement and forced social movements. For instance, more 99% of the world's urban people live in areas that exceed the World Health Organization guidelines on air quality, and 4.2 million deaths are attributed to air pollution each year. Nearly three billion people worldwide face housing affordability challenges, and more than a billion people live in slums, experiencing poverty, exclusion, and inequality (UN, 2025). That is why the dissertation focuses on the urban dimension of sustainable development, examining how cities can address growing environmental, resource, and public health pressures using data.

The concept of sustainable development, introduced by the Brundtland Commission nearly four decades ago, has yet to translate into sufficiently comprehensive policies and transformative change. The contemporary world continues to face challenges of overconsumption, global warming, dependence on fossil fuels, pollution, economic inequality, and democratic dysfunction. No country (of 165 under review) achieved the targets of SDG 11, and over 62% of countries experienced significant challenges in the implementation of SDG 11 (UN, 2021). Thus, even though SDG 11 is a significant step toward sustainable cities, its implementation remains uncertain and will require tools, data systems, and analytical perspectives.

The prime object of my research is OGD. It is a part of the efforts of governments to open data to thoroughly foster greater transparency, improve accountability, generate economic growth, promote innovation, empower citizens, fight corruption, achieve environmental goals, and provide better public services (Berrone et al., 2016; Davies & Perini, 2016; Jaakola et al., 2015).

The research addresses an important issue of sustainable urban development that has not been addressed by scholars and has attracted little attention from society. The implementation of SDG 11 highly depends on (i) the availability and accessibility of robust local data and (ii) the reconfiguration of governance systems because capacity in data collection and analysis is highly variable and often inadequate among cities (Patel et al., 2017; Satterthwaite, 2016). Relevant in national contexts and collected at the local level, high-quality, accessible, and timely disaggregated data is a key to decision-making and necessary to measure progress and ensure that no one is left behind. However, only 60% of 194 countries had the entire data on SDG 11 available (UN, 2020). OGD in an urban context is a relatively new concept in developing

countries, and interrelations between them through the lens of sustainable development and urban context are still underexplored. According to Mohd Khalid et al. (2020), the lack of information and the limited capacity of many countries to collect and analyze relevant data cause significant problems in SDG implementation.

The primary focus of this dissertation is the role of OGD in sustainable urban development. Specifically, through four chapters, it examines the interrelationships between OGD and progress toward sustainable urban development, particularly SDG 11. It investigates how SDG 11 has been implemented globally, how it relates to the broader SDG framework, and how city-level OGD systems can support planning, sustainability assessment, and progress toward SDG 11. Chapter 1 addresses how SDG 11 has been implemented worldwide and fills a gap in the literature by providing one of the first systematic empirical assessments of reported SDG 11 good practices. Chapter 2 examines how SDG 11 is linked with the other SDGs and addresses a gap in understanding how SDG 11 functions within the broader SDG system and how it differs between developed and developing countries. Chapter 3 investigates how OGD in 19 U.S. cities relates to municipal OGD portals, policies, plans, and sustainability performance and fills gaps by providing one of the first comprehensive comparative analyses of OGD as a planning and sustainability tool in U.S. cities. Chapter 4 examines how municipal OGD portals support SDG 11 and proposes an expanded set of locally relevant indicators, as SDG 11+, thereby addressing a major gap by linking city-level open data systems with global sustainability indicators and offering a more practical framework for evaluating urban sustainability. Collectively, the dissertation demonstrates that stronger data systems, more relevant indicators, and better integration of OGD into planning processes can enhance cities' ability to monitor and advance progress toward SDG 11 and sustainable urban development more broadly.

Chapter 1. Implementation of Sustainable Development Goal 11 (Sustainable Cities and Communities): Initial Good Practices Data

Abstract

SDGs represent a central framework to guide sustainable urban development in the 2030 Agenda. However, it is not clear how and where SDG 11 is being implemented, and how such implementation might be improved. I investigated this subject by analyzing UN SDG Good Practices data from 2018 to 2021. I applied five criteria to the 336 SDG 11 responses: (1) geography; (2) actors; (3) progress toward targets; (4) areas of implementation; and (5) scale of action. Overall, 86 of the 193 countries that adopted the 2030 Agenda submitted at least one SDG 11 good practice. 33 countries contributed 73.8% of the total, and most developing countries did not make submissions. A very small number of responses (between 2.6 and 9.1%) addressed equity-related targets. Good practices from developed countries were usually more technology-based and system-forming; developing countries typically focused on issues of day-to-day concern. Overall, this analysis points to the need for better and more systematic reporting on SDG 11 implementation, a more active public sector role in SDG implementation and reporting, more focus on dimensions related to social equity, and better formulation of urban sustainability targets and indicators in the future.

1. Introduction

Cities are crucial sites for sustainable development. More than half of the global population lives in urban areas, and the urban component of the world's population is expected to reach 68% by 2050 (UN Department of Economic and Social Affairs [UNDESA], 2018). SDG 11 is one of 17 SDGs adopted by the General Assembly of the UN in 2015 (UN, 2015). SDG 11's 10 targets and 15 indicators cover a broad scope of issues from affordable housing and infrastructure to cultural and natural heritage.

According to the 2023 Sustainable Development Reports, only one of the 219 countries has SDG 11 achievement on track, and 143 (65%) countries experience significant and major challenges in its implementation (Sustainable Development Solutions Network [SDSN], 2023). For example, only countries in Europe, North America, Australia, and New Zealand have achieved the indicators in reducing the proportion of the urban population living in slums, while the rest of the world is still far from that, and the situation continues to deteriorate (UN DESA Statistics Division, 2022).¹ Because of such challenges, fulfilling the SDGs requires much stronger “co-production” between governments, researchers, bottom-up civil society organizations, and other players (Satterthwaite, 2016, p. 5).

In this chapter, I analyze SDG good practices information collected by the UN from around the world in 2018-2021 (UNDESA, n.d.-a; UNDESA, n.d.-b) to ask what can be learned from these initial calls about how SDG 11 has been implemented to date worldwide. I structure responses by five criteria: (1) geography of submitted good practices; (2) actors addressing SDG 11; (3) progress toward SDG 11 targets; (4) topical areas of implementation; and (5) scale of

¹ Note, the term “slums” has been criticized as having a stigmatizing effect, but I use it here to match the UN's own language, Target 11.1, “By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums”

action. I seek to find out major patterns in this field, with attention to practical implications and social equity, and develop recommendations based on this data in light of existing literature on the topic. The results of this study will be helpful for policymakers, advocates, and researchers at international, national, regional, and local levels of sustainable development.

2. Literature Review

In documents relevant to SDG 11 implementation, three thematic areas emerged: (i) practical issues around implementation, (ii) measurement of progress, and (iii) criticism of SDG 11 and its implementation.

2.1 Practical Issues Around Implementation

Most of the studies explored specific cases of SDG 11 implementation within national, regional, or local contexts. Predictably, many found that implementing sustainable city concepts is not easy. For example, Krellenberg et al. (2019, p. 16) found that Milwaukee (USA), Saint Petersburg (Russia), and Hamburg and Magdeburg (Germany) struggled to establish a long-term commitment to sustainability, indicators, and political leadership in their strategic plans because of “insufficiently participatory, inadequately ambitious, and/or competing or overlapping with other city initiatives.” Koch et al. (2019, p. 14) considered cities in Germany and found the main challenges: “indicators and data availability, tradeoffs with other SDGs, the role and limitations of urban planning, and the difficulties of city-wide integration of sustainability policies.”

Several studies investigated effective governance systems to support the implementation of SDG 11. Common themes included coordination between international, national, regional, and local goals and policies, and the need for bottom-up approaches, but also state assistance and leadership. For example, Martínez-Córdoba et al. (2021) found that progressive municipal governments in Spain prioritized increasing civic engagement over other targets of SDG 11,

while conservative governments mainly addressed housing, safe and accessible public areas, and daily solid waste removal. They concluded that ideological consensus between the levels of government positively influenced the progress toward SDG 11. In a study of three Indian cities, Tiwari et al. (2021) concluded that a bottom-up approach is essential in implementing SDG 11, but that state support for local governments to do this is needed. Zhu et al. (2019, p. 347) discussed interactions between multiple stakeholders in implementing green building initiatives in China, whose different stakeholder roles and interests may lead to positive synergies or negative trade-offs in achieving SDG 11, and that “all parties need to do more.” Abraham and Iyer (2021, p. 5) presented case studies of SDG implementation from Canadian and U.S. cities, concluding that “when localization has occurred, the impetus has predominantly come from the bottom-up in most of these cities,” but that low awareness of the SDGs and lack of leadership are hampering North American SDG implementation.

Some authors mentioned the efficacy of different approaches: a chain-based or nexus approach to program development, for example, “the water-energy-food nexus” (Koch et al., 2019, p. 22; Latif et al., 2022, p.3), the clustering of targets from several SDGs in addressing a single local issue (Lopes et al., 2020), and an integrated approach dimensions: social, environmental, economic, and political (Almeida et al., 2018). Sustainable development of cities requires incorporating long-term thinking, a holistic perspective, and proactive leadership to address problems (Wheeler, 2021).

2.2 Measurement of Progress

A large body of work explores various techniques for measuring progress toward SDG 11 and the SDGs in general. Several groups have applied spatial data analysis to monitor and evaluate progress toward multiple SDGs (Bartniczak & Raszkowski, 2022; Cochran et al., 2020;

Guo et al., 2022), disaster risk mitigation, and migration (Aquilino et al., 2020; Pirasteh & Varshosaz, 2019). Other authors addressed the localization of the indicators of SDG 11 by incorporating available measurements, including indices of social, economic, and environmental development calculated from 60 local indicators in China (Wei et al., 2022), parameters of local budgets to the quality of women's life in Turkey (Gunluk-Senesen, 2021), sub-national indices for each SDG in Romania (Benedek et al., 2021), and indicators of SDG 11 directly calculated based on the relevant local data in Japan (Yamasaki & Yamada, 2022).

Some authors discussed the political frameworks for measuring the indicators of SDG 11 at the local level. Beisheim et al. (2018) indicated that transnational multi-stakeholder partnerships yield better results if they leverage local ownership. Valencia et al. (2019) showed that an integrated governance model with both horizontal and vertical collaboration between actors can provide coherence among global and regional agendas at the local level. Rozhenkova et al. (2019) argued that a city policy database that is regularly updated and available online is necessary.

2.3 Criticism of SDG 11 and its Implementation

Almost every source mentioned the lack of data as a main limitation in the implementation and evaluation of SDG 11 (Almeida et al., 2018; Arfvidsson et al., 2017; Bartniczak & Raszkowski, 2022; Martínez-Córdoba et al., 2021; Patel et al., 2017). Satterthwaite (2016) argued that the success of SDG 11 directly depends on the availability and accessibility of robust data, and Elsey et al. (2016) underlined the need for data to plan and allocate resources to address urban inequalities.

According to Mohd Khalid et al. (2020), the limited capacity of actors to collect data, inadequate coordination among governments and institutions, and limited financing cause

significant problems in SDG implementation, especially in developing countries. Simon et al. (2015) claimed that none of the five cities they studied had complete, straightforward, and appropriate data on indicators available. Patel et al. (2017) found consistent SDG 11 implementation as requiring reconfiguration of governance systems because capacity in data collection and analysis is so highly variable among cities.

Another point receiving substantial criticism is the relevance and clarity of SDG 11 targets and indicators. Valencia et al. (2019) claimed that efforts to achieve some of the targets, for example, 11.5 and 11.b, addressing disaster preparedness, competition, or conflict, have been very challenging to achieve. They argued that many governments' indicators address neither the quality of policy nor the effectiveness of implementation. Furthermore, excessive focus on disasters diverts attention from smaller but more frequent impacts that, over time, result in severe social and economic damage. Simon et al. (2015) criticized indicator 11.2 of SDG 11 (the proportion of the population having convenient access to public transportation), arguing that this indicator should include topography, physical obstacles, and safety issues like lighting and open paths.

Šilhankova et al. (2017) argued that in practice, indicators are often a tool for competition between jurisdictions, allowing them to highlight strengths and hide weaknesses in international comparisons. According to Hansson et al. (2019, p. 230), because of the need to reduce the vagueness of indicators and avoid confusion in the implementation of SDG 11, local actors should be allowed to select indicators “that fulfill the criteria of easy measurement or collection, appropriateness, convenience, and relevance to current conditions and policies and programs.”

SDGs were criticized for a one-size-fits-all approach and for not considering different national and local capabilities and circumstances. For example, Naeem et al. (2018, p.17) argued

that one city cannot directly implement the planning and policies of another site; instead, those policies need to be adjusted “according to local conditions and available resources.”

Beyond these implementation challenges, scholars have also questioned whether the SDGs adequately address environmental justice. Menton et al. (2020, p. 1622) argue that “environmental justice is largely absent from the goals, targets, and indicators” and that the SDGs fail to incorporate “an explicit justice focus.” More fundamentally, the authors contend that the SDGs often pursue sustainability within existing economic and political systems rather than addressing the structural drivers of inequality and environmental degradation. Menton et al. further conclude that environmental justice is a prerequisite for sustainability and that, without it, achievement of the SDGs may indeed be impossible.

Despite such criticisms, most authors agree that intersectional and comprehensive SDGs like SDG 11 are, in fact, very helpful in consolidating resources and addressing complex issues of global concern. The presence of critical voices means that there is still room to improve the SDG 11 framework and practices of implementation within specific national and local contexts.

3. Materials and Methods

This study reviewed SDG good practices in the UN database and collected quantitative data about SDG 11 good practices submitted by all types of actors. I also developed the previously mentioned classification system to analyze the data on the implementation of SDG 11 within different contexts. Finally, I used descriptive statistics to illustrate findings from this review and sought to spell out implications and recommendations.

An inter-agency review team of experts in sustainable development from across the UN system curated the UN SDG Good Practices Database. To collect these cases, the UN conducted two open calls. The purpose of these calls was to highlight examples of good practices, including

those that could be replicated or scaled up by others across the globe. Each received over 700 submissions from national governments, regional offices of the UN, and other stakeholders through an online web portal. From the first open call in 2018 and 2019 (Open Call 1), experts selected 511 cases as meeting the criteria for good practices (UNDESA, n.d.-a), and from the second open call from 2020 to 2021 (Open Call 2), they selected 464 more (UNDESA, n.d.-b). Of those 975 cases, the UN experts identified 336 good practices (34.4%) as those addressing SDG 11 (186 practices in Open Call 1 and 150 practices in Open Call 2).

I reviewed all 336 good practices marked as addressing SDG 11 and categorized them according to the following criteria:

1) Geography of submitted good practices: what country produced each practice and whether these nations represented (i) developed economies, (ii) economies in transition, and (iii) developing economies. This classification was developed by UN entities (UN, 2019b).

2) Actors addressing SDG 11: whether institutions carrying out the good practice were (i) national governments and their agencies; (ii) regional (sub-national) governments and agencies; (iii) municipalities and city-level government agencies; (iv) public agencies; (v) UN entities, including regional offices and programs; (vi) civil society (non-government) organizations; (vii) international development institutions; (viii) private companies; and (ix) other actors not mentioned in the categories from (i) to (viii). For each good practice, the UN has identified one main responsible entity employing these categories.

3) Progress toward SDG 11 targets: specific targets that the good practice addressed of the ten SDG 11 targets. For example, 11.1 - Affordable housing, 11.2 - Sustainable transport system, and 11.7 - Access to green and public spaces, etc. Since very few practices directly stated which targets of SDG 11 they addressed, I identified targets based on my own analysis of

the content, objectives, implementation activities, and results of individual submissions. Many practices addressed more than one target.

4) Topical areas of implementation: fields of urban development addressed by good practices, for example, management, inclusiveness, and transportation. The specific field of urban development is emphasized based on the content of good practices after reviewing the Introduction, Objective, Implementation of the activities, and Results/Outputs/Impacts sections of good practices. Some good practices emphasized more than one area of implementation, in which case all were included.

5) Scale of action: (i) international, (ii) national, (iii) regional (sub-national), (iv) large cities with a population of 200,000 and over, and (v) small cities with a population under 200,000. They are determined by the actors who submitted those practices in geographical coverage and/or regional sections of the UN SDG good practices.

Finally, I used descriptive statistics to analyze trends and patterns within the good practices database and drew upon the literature to spell out implications and recommendations. I did this keeping in mind that the SDGs represent just one step in a long process of developing global consensus around sustainable development directions and will undoubtedly be improved upon by further generations of goals and indicators. Laying the groundwork now for stronger and more useful tools in the post-2030 period is an urgent need.

4. Findings and Discussion

4.1 Geography of Submitted Good Practices

Out of 193 countries that approved the SDGs and 2030 Agenda, 86 submitted good practices for the implementation of SDG 11, including 24 developed countries, 55 developing countries, and seven countries in transition (see Table 1.1).

Table 1.1*Geographical Locations Submitting Four and More Practices*

First Open Call (186 responses)		Second Open Call (150 responses)		Both Open Calls (336 responses)	
Source	Practices (%)	Source	Practices (%)	Source	Practices (%)
European Union	43 (23.1%)	European Union	39 (26.0%)	European Union	82 (24.4%)
Brazil	32 (17.2%)	China	11 (7.4%)	Brazil	37 (11.0%)
Japan	16 (8.6%)	India	10 (6.7%)	Mexico	20 (6.0%)
Mexico	11 (5.9%)	Mexico	9 (6.0%)	China	18 (5.4%)
China	7 (3.7%)	Great Britain	6 (4.0%)	Japan	17 (5.1%)
India	7 (3.7%)	USA	5 (3.4%)	India	17 (5.1%)
Argentina	5 (2.7%)	Brazil	5 (3.4%)	Great Britain	10 (3.0%)
Great Britain	4 (2.2%)	Russia	5 (3.4%)	USA	8 (2.4%)

Sixty-three countries submitted good practices during the first open call and 56 during the second open call. European Union countries submitted more than any other geographical region, with Spain (14), Belgium (11), and France (8) contributing the most. The USA and other Anglophone countries were notably underrepresented in their contributions, as were countries from sub-Saharan Africa.

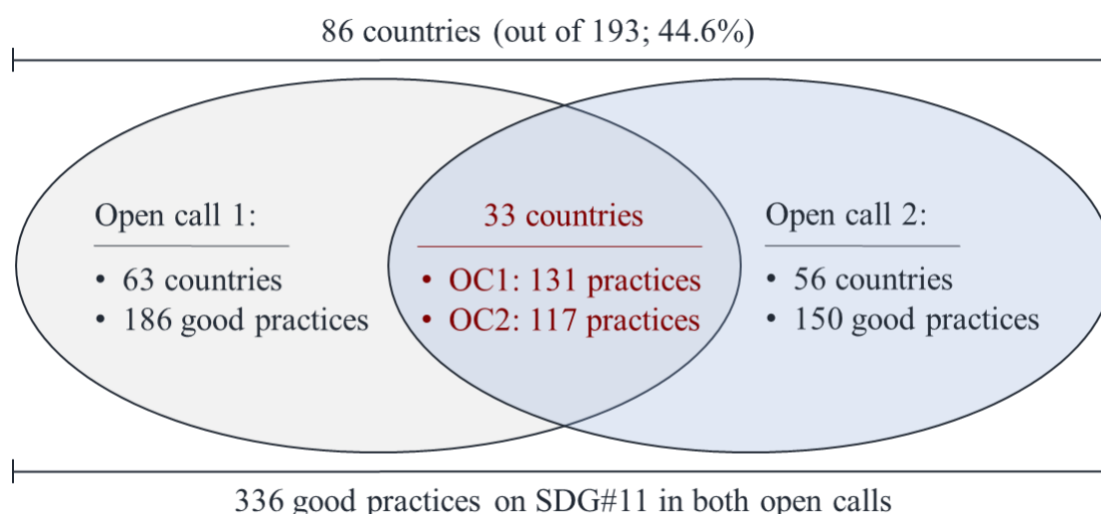
Developing countries submitted 202 of 336 good practices (60.1%), while developed countries submitted 120 (35.7%), and those with economies in transition submitted 14 (4.2%). This breakdown was almost the same during both open calls, which seems reasonable considering that developing countries face the issues of the SDG 11 scope much more frequently than developed countries. Only 33 countries (17.1% of those that approved the 2030 Agenda) submitted good practices during both open calls (Figure 1.1), thus reflecting a commitment to continuously address SDG 11 implementation.

Eleven of these 33 nations are developed (Belgium, Great Britain, Japan, Sweden, USA, etc.), while 21 are developing (Argentina, Brazil, China, India, Mexico, Turkey, etc.), and one is in transition (Russia). Even more remarkable is that those 33 nations collectively submitted

73.8% of the total good practices.

Figure 1.1

Distribution of Good Practices by Countries and Open Calls



Overall, 107 of 193 countries that adopted the 2030 Agenda have not submitted any good practices for SDG 11, including 85 developing countries (36 countries from sub-Saharan Africa), 12 developed countries, and 10 countries with economies in transition. This relatively low and uneven response appears to reflect the slow growth of global coordination on sustainable urban development. Other likely reasons for low response rates include a lack of resources, data, political commitment, and lingering disempowerment of some countries from a legacy of colonialism and imperialism (Langan, 2017), as well as the relatively short time frame between SDG adoption in 2015 and these UN calls. If such low response rates continue in the future, strong efforts to increase coordination, funding, and technical assistance around SDG 11 would seem appropriate.

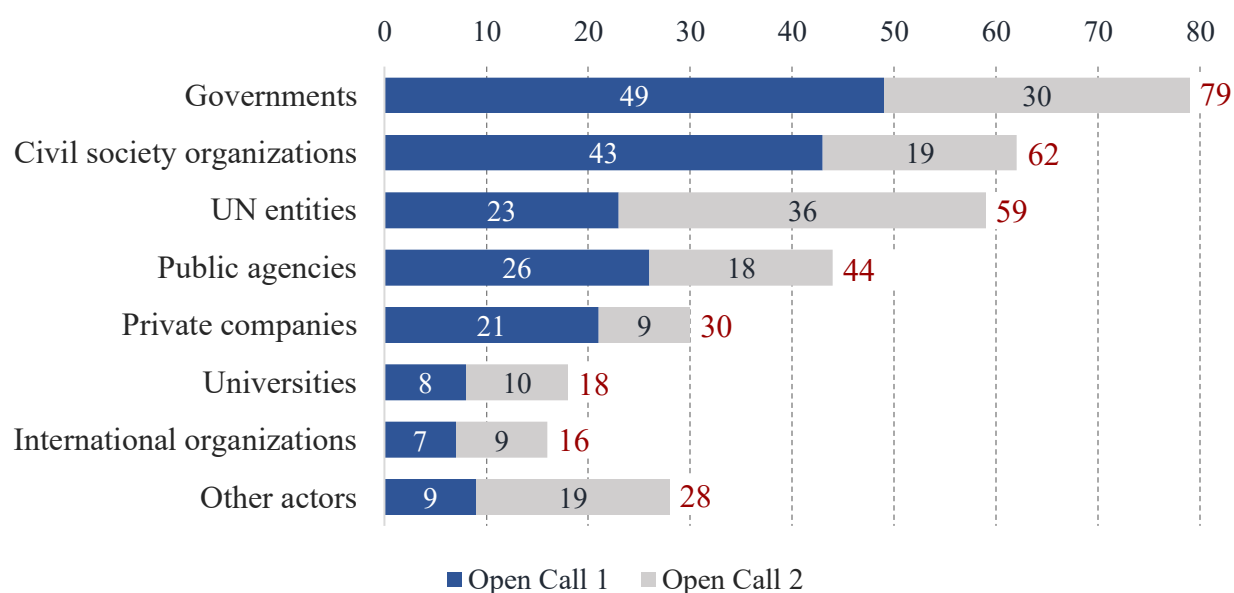
4.2 Actors Addressing SDG 11

Out of 336 SDG 11 good practices, national, regional, or local governments submitted 79

(23.5% of the total), followed by civil society organizations (62 practices, or 18.5%), and UN entities (59, or 17.6%) (Figure 1.2).

Figure 1.2

The Distribution of Good Practices by Actors



The distribution of submissions across scales of government was relatively even. National and sub-national authorities submitted 27 good practices each, and municipalities submitted 25. However, during the second open call, national and subnational responses fell by more than half compared to the first open call, while responses from municipalities increased slightly (14 compared to 11). A potential explanation is that at the beginning of this period, national and sub-national authorities sought to establish a general framework for SDG implementation within national agendas and strategies, while once this framework was established, municipalities were encouraged to take more specific action.

The initiation of action at a national level seems to have been a common pattern. For example, after 2015, the Government of Benin developed a tool to quantify the impact of each national ministry on the SDGs. That tool analyzed the extent and depth to which each ministry's

annual working plan included SDGs within budget allocations. About 6,000 activities were mapped and analyzed according to (i) their nature, (ii) how well they could embed the corresponding SDG indicators, and (iii) their potential to be localized (UNDESA, n.d.-c). The Ministry of Planning and Development coordinated this exercise and submitted the tool as a good practice for the first open call. Next, the national government distributed 49 priority targets to each of the country's 77 municipalities along with recommended actions to achieve them based on local contexts and issues (UNDESA, n.d.-d). The General Directorate for the Coordination and Monitoring of the SDGs, a special task force established to coordinate efforts, then submitted that as a good practice for the second open call.

Governments took the initial lead in several other countries as well. Slovakia clustered SDGs around six national priorities with measurable outcome indicators integrated from the national to local levels and involving players in each stage (UNDESA, n.d.-e). Costa Rica integrated SDGs into their national strategies and tools with open online citizen participation (UNDESA, n.d.-f). Germany transferred SDGs to the local level by designing specific local objectives, targets, and indicators (UNDESA, n.d.-g). The Guatemalan government provided local officials with advice and training to integrate the 2030 Agenda into local development plans (UNDESA, n.d.-h).

Some other examples of local (municipality-level) governments took the initiative. In Heidelberg city, Germany, the municipal Housing Action Program addressed some challenges of affordable housing, livable neighborhoods, and land-saving planning for starter households, families with children, and seniors (UNDESA, n.d.-i). In Rwanda, the Masterplan 2050 of Kigali City integrated more equitable and flexible approaches to make informed decisions about effectively utilizing the city's resources (UNDESA, n.d.-j). The reforestation program of Rio de

Janeiro, Brazil, built “a natural barrier that contributes to the reduction of landslides, creating resilience, and providing a better quality of life for its citizens” (UNDESA, n.d.-k, para. 3).

UN entities became much more active within the second open call than in the first open call, increasing the good practices submitted from 23 to 36. That increase may have happened due to the urging of UN Secretary-General António Guterres, who called for “ambitious actions by all stakeholders” because the “global efforts to date have been insufficient to deliver the change we need, jeopardizing the Agenda’s promise to current and future generations” that launched a “Decade of Action,” an initiative to strengthen existing efforts in addressing SDGs (UN, 2020, p. 2). UN entities and affiliates led many such efforts relating to SDG 11. For example, in Indonesia, the World Meteorological Organization helped to enhance a coastal flooding forecast and early warning capability system (UNDESA, n.d.-l). In Guinea-Bissau, UN-Habitat helped to improve the urban development plan of the city of Bissau (UNDESA, n.d.-m). This initiative aimed at integrating the revision of Bissau’s urban development plan with national and global plans through a participatory approach to the most pressing challenges. In Nepal, the UN-Habitat supported the initiation of cleaning the debris and renovating the pond, De Pukhu, to create an open public space with traditional arts for women and youth (UNDESA, n.d.-n). In Chad, UNESCO explored the Lake Chad Basin due to biological shrinkage that pushed people to move out or join poaching groups (UNDESA, n.d.-o).

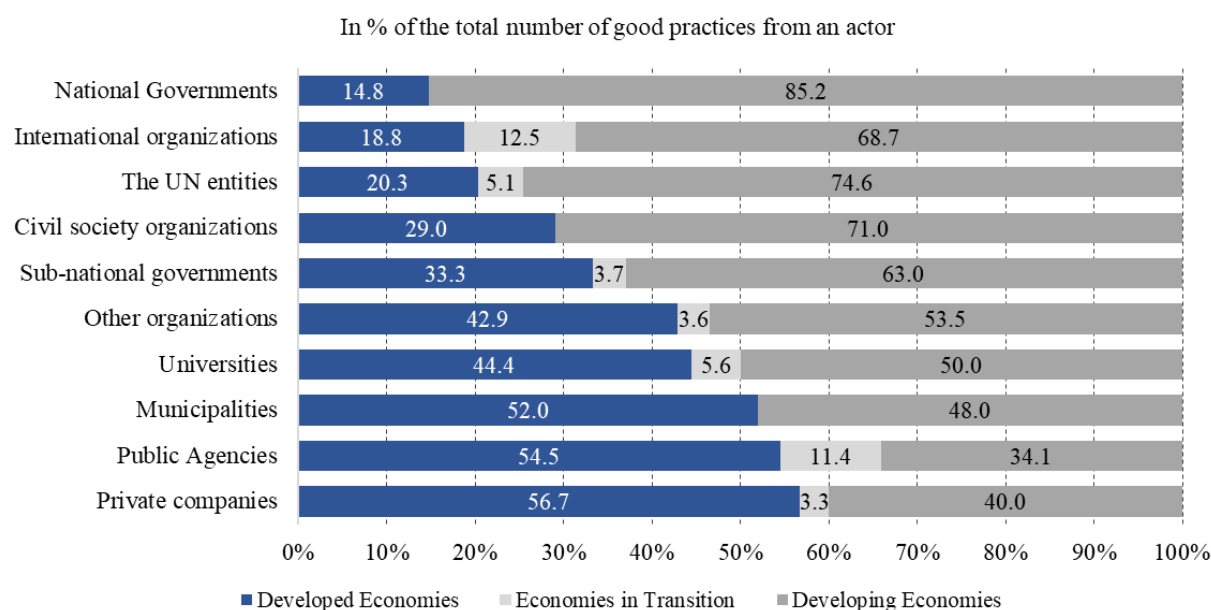
Private companies contributed 8.9% to the total number of good practices. Often, these players contributed specific technologies and skills to SDG 11-related projects (Scheyvens et al., 2016). Some examples include: in Austria, the planner company Arenas Basabe Palacios developed a residential block naturally integrated into the environment through the collaboration of all agents in this process (UNDESA, n.d.-p), Miyakoda Construction Co., Ltd. reconstructed

an old wooden railroad station as a tourist attraction for a remote town in Japan (UNDESA, n.d.-q), and General Incorporated Association Oiden Sanson Center developed a partnership between farmers, hunters, and restaurants in Japan to control the population of wild boars and consuming their meat (UNDESA, n.d.-r).

The contribution of actors varied by country because of their types of economies (Figure 1.3). Although the contribution of municipalities was almost equal between developed and developing countries, national and sub-national governments, along with the UN entities, international institutions, and civil society organizations, played a more active role in addressing SDG 11 in developing countries. This is to be expected given that the missions of these organizations are often to support developing nations. On the other hand, private companies and public agencies played an active role in the good practices of developed countries.

Figure 1.3

Contribution of Actors in the Implementation of SDG 11 by Types of Economies

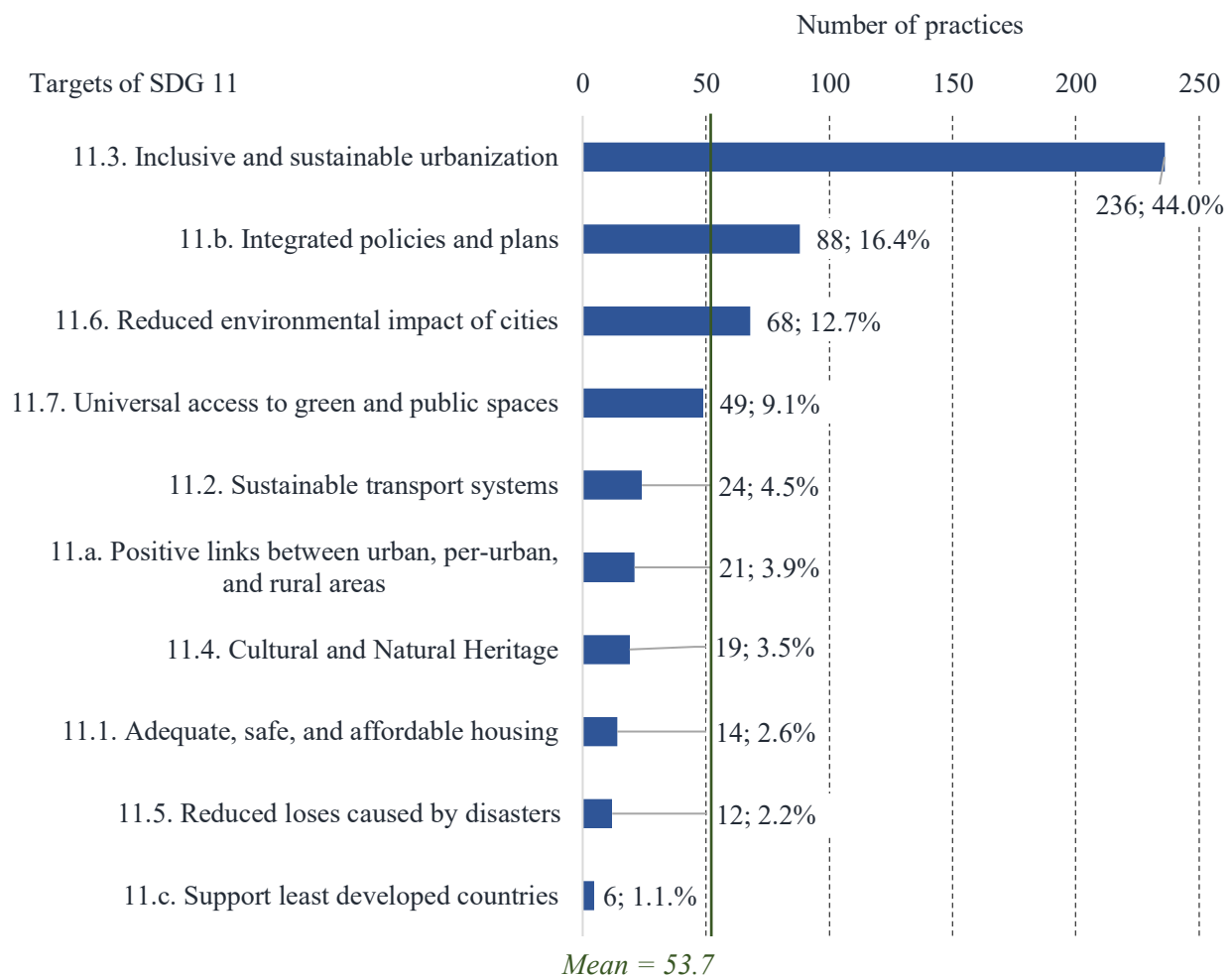


4.3 Progress toward SDG 11 Targets

Good practices submitted to the UN emphasized some SDG 11 targets more than others (Figure 1.4). 82% addressed SDG 11 targets of inclusive and participatory planning (11.3), integrated policies and plans (11.b), environmental impact (11.6), and safe and inclusive green and public spaces (11.7).

Figure 1.4

The Distribution of Good Practices by the Targets of SDG 11



In contrast, relatively few addressed targets related to supporting least developed countries (11.c), reducing the damage from disasters (11.5), and adequate, safe, and affordable housing (11.1). I note that the same order of targets is maintained between developed and

developing countries in the distribution of good practices by targets of SDG 11 and types of economies (Appendix A.1).

During the second open call, the number of good practices addressing sustainable urban planning, including resource efficiency, adaptation to climate change, and resilience to disasters (11.b) increased, while the number of good practices addressing sustainable transport systems (11.2), protecting natural and cultural heritage (11.4), and affordable and safe housing (11.1) fell. This may reflect a growing concern with climate topics. In general, linking specific projects to SDG 11 targets is difficult. The UN targets are expressed in language that is often vague and overlaps categories; targets 11.3, 11.b, and 11.6 could include almost any topic related to sustainable urban development. Because of these problems, the current set of targets seems widely disregarded. For example, Koch and Krellenberg (2018, p. 1) report that “only a few of the original targets and indicators for SDG 11 are used in the German context.”

4.4 Topical Areas of Implementation of Good Practices

This study classified the good practices into 28 categories developed through the literature review based on their primary focuses (Appendix B.1). Not surprisingly, most addressed planning (18.4%), inclusiveness (15.6%), capacity building (11.9%), and management (11.9%). However, while progressing from the first open call to the second open call, the focus of many good practices shifted from planning to action. Most of the good practices from the second open call addressed inclusiveness (21.9%), capacity building (20.0%), a healthier environment (10.6%, including carbon emission and other climate-change-related issues), and management (9.4%), and only 7.5% addressed planning.

Although the list of areas of implementation is relatively inclusive, a couple of areas were notably lacking. None of the best practices specifically mentioned environmental justice or

climate change. This is likely because best practices related to these topics were submitted under other UN SDGs. This may mean that reporting of such areas needs to be better linked to SDG 11.

After disaggregating good practices by focus area and actor type, the study found that governments, public agencies, and civil society organizations most often addressed planning and management (73% of practices in each group). Civil society organizations, private companies, and public agencies addressed reducing waste most often (84.6% of practices cumulatively), far more than municipalities (7.7%) and governments at the national and sub-national levels (no practices). UN entities, civil society organizations, and universities contributed almost half of the good practices in capacity building (47.9%). International organizations submitted the highest portion of good practices in wildlife protection (42.9%). UN entities, international organizations, and universities contributed all of the good practices in disaster control.

Considering the distribution of focus areas addressed by each actor, the study found that civil society organizations most often addressed the issues of inclusiveness (24.4% of practices) and planning (15.4%). In turn, the UN entities most often addressed inclusiveness (18.8%) and capacity building (15.9%).

Some clustering occurred in the distribution of focus areas by the types of economies. In particular, developing countries contributed around 95% of good practices addressing access to green and public spaces, 83% in disaster control, and 80% in water supply. Developing countries also submitted all the good practices addressing human rights, transportation, energy, infrastructure, sport, and technology. On the other hand, developed countries contributed the majority of good practices addressing wildlife conservation (57.4%), food supply (54.5%), and air quality (50.1%). Thus, questions arise around the prioritization of the most pressing issues between developing and developed countries. All issues should ideally be addressed by both. It is

perhaps natural that developing countries should prioritize issues connected with basic infrastructure and services, but reasons for other priority differences are less clear, and more research may be needed to determine why countries at different points of economic development have these different foci.

The good practices of developed countries were usually more process-oriented and technology-based than those of developing countries. Usually, they provide system-forming and data-driven tools to help solve the problems of global concern or cover gaps in knowledge and policy rather than directly resolve specific issues. For example, the Urban Data Platform of the European Commission collected data on 60 indicators from about 800 urban areas across Europe to support decision-making with information on indicator status and trends (UNDESA, n.d.-s). To support regional actors in SDG implementation, the German Council for Sustainable Development, an advisory board to the Federal Government, organized four Regional Hubs for Sustainability Strategies to link SDG-related activities across governmental entities by sharing knowledge, experience, and data. The Federal Government provides 17 million euros to support such communication “in a manner which is otherwise virtually impossible in a federal state” (UNDESA, n.d.-t, para. 1).

Conversely, actors from developing countries usually focus their good practices on problems of day-to-day concern (a problem-solving approach). For example, one project in India intended to make a local river free of solid waste and disease-causing microorganisms. Volunteers and students led by a civil society organization removed over 300 tons of garbage from the riverbed and planted 1,000 trees on the riverside, improving the habitat for 130 bird species (UNDESA, n.d.-u). In Brazil, the Travessia (Crossing) program provided door-to-door transportation to more than 2,000 residents with special needs in 28 municipalities, allowing

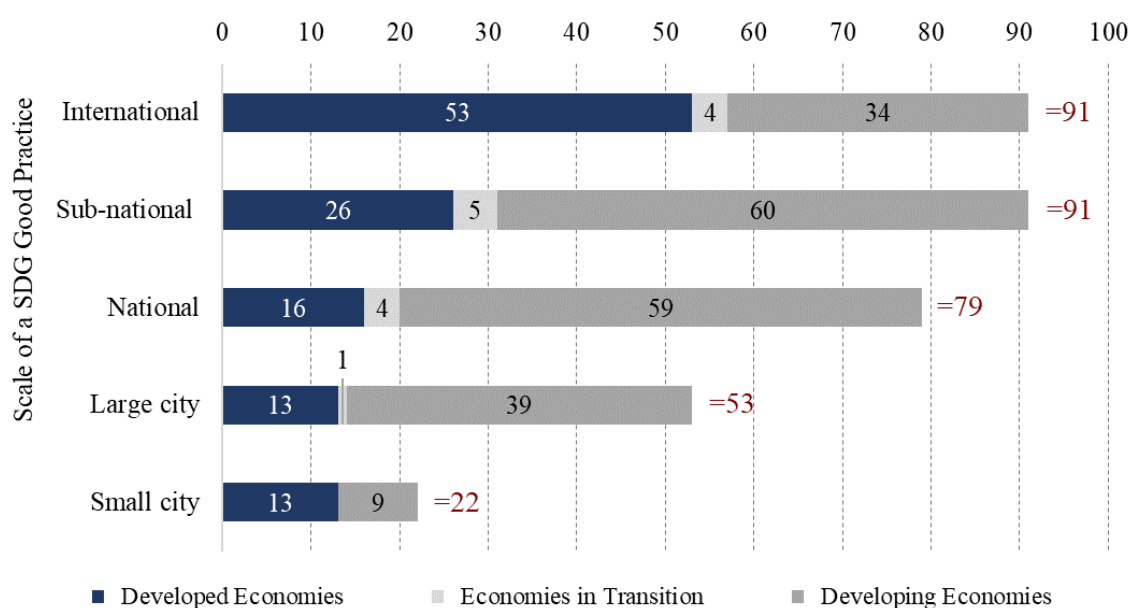
them to access education, health, work, and leisure services (UNDESA, n.d.-v). In Mexico, the International Fund for Animal Welfare launched its “Casitas Azules” program to help community members keep their dogs and the surrounding wildlife safe, distributing dog houses and predator-free chicken coops to disadvantaged households (UNDESA, n.d.-w).

4.5 Scale of Action

Most good practices addressed SDG 11 at international (27.1%), national (27.1%), and regional levels (23.5%). The number of good practices with international effects significantly increased in the second open call (likely because of the general increase in good practices from UN entities), while the number of good practices with impacts exclusively on the municipal scale decreased from 55 to 20. In part, this may be because UN entities most often addressed SDG 11 in ways that had international, national, and sub-national impacts, whereas civil society organizations addressed SDG 11 at more local scales (Figure 1.5).

Figure 1.5

The Distribution of Good Practices by Scale and Types of Economies



The distribution of good practices by the scale of coverage and types of economies demonstrated that developing countries mainly submitted good practices at the regional and national levels and in large cities. Developed countries realized good practices at an international scale, and they addressed a small number of practices at large and small city levels.

In addition, I analyzed the distribution of good practices by scale and actors (Table 1.2). Public agencies contributed the most to international-scale actions (to some extent, because of the European Commission and its bodies). In turn, municipalities and private companies developed almost 60% of good practices addressing SDG 11 in small cities.

Table 1.2

The Distribution of Practices by Scale of Coverage and Actor

##	Actor	The Scale of Good Practice Effects					In Total
		International	National	Regional	Large city	Small City	
1	Civil society organizations	11	17	18	15	1	62
2	UN entities	25	15	14	3	2	59
3	Public agencies	25	8	4	4	3	44
4	Private companies	8	4	10	1	7	30
5	National governments	3	19	5	-	-	27
6	Sub-national governments	-	-	20	6	1	27
7	Municipalities	-	-	4	15	6	25
8	Universities	7	5	2	4	-	18
9	International organizations	8	1	4	1	2	16
10	Other actors	4	10	10	4	-	28
Total (good practices)		91	79	91	53	22	336

Likely, local authorities and agencies in charge of the SDGs implementation considered those challenges to best fit the municipal scale. They did not count this local scale as a part of efforts in line with a global guideline for peace and prosperity for people and the planet, the 2030 Agenda.

On the other hand, the fastest-growing urban agglomerations today are cities with fewer

than one million inhabitants. Thus, it is expected that the number of good practices related to the contexts of large and small cities will grow in an ongoing “Decade of Action,” and the focus will gradually shift from a “big picture” to more local and specific practices.

Conclusion

The study revealed multiple patterns within SDG 11 good practice submissions collected during the first two UN open calls. First, although a majority of good practices were submitted by developing countries, only 55 of 140 such nations made submissions. These countries face large urban sustainability challenges and usually have fewer resources available than more developed nations because of the legacies of colonialism and imperialism. Efforts are needed by the global community (especially historically colonizing nations) to fund and support SDG 11 efforts in developing countries, including assisting with data collection and knowledge sharing.

Second, only 33 countries (17.1% of those that approved the 2030 Agenda) submitted SDG 11 good practices during *both* open calls. This seems to indicate that a relatively small number of countries continuously address SDG 11 and prioritize sharing their experiences. The corollary recommendation would be to improve the visibility of UN calls, support the implementation and evaluation of SDG 11 programs, and reward those countries that initiate these programs and participate in the global sharing of information.

Third, public sector agencies submitted the most SDG 11 good practices, which is to be expected given that governments have the most direct mandate to improve urban sustainability. However, the percentage of good practices submitted by the public sector was much larger in developing countries than in developed ones, where private companies, universities, and other organizations played a larger role. This may reflect a stronger civil society and more active private sector in developed countries, but it may also imply the need for governments in wealthy

nations to take SDG 11 more seriously as a centerpiece of urban policy.

Fourth, good practices most frequently addressed SDG 11 targets of inclusive and participatory planning (11.3), integrated policies and plans (11.b), environmental impact (11.6), and safe and inclusive green and public spaces (11.7). Relatively few addressed issues of affordable and safe housing (11.1) and sustainable transport (11.2). The latter targets are written to emphasize social equity dimensions, and equity-related dimensions of SDG 11, such as affordable housing, likely need greater emphasis worldwide. That being said, many SDG 11 cover a broad scope of issues and arguably lack focus, and I recommend that follow-on UN frameworks improve targets' wording and focus.

Fifth, after a detailed disaggregation of good practices by focus area, I found that most addressed issues of planning, inclusiveness, capacity-building, and management (about 58% of good practices cumulatively, out of 28 categories). At their best, such tools increase societies' ability to solve problems of global concern. Such ability is particularly needed in the developing world, which has less emphasis on these focus areas. However, a focus on tools can also distract from efforts for on-the-ground change as participants undertake process studies, model-building, theory production, and speculative technology development. Given the urgent need for action on climate and sustainability, it would seem important for all types of projects to focus as directly as possible on changing conditions.

Finally, most good practices addressed issues in ways that had international, national, or regional impacts. This would seem generally positive, given that urban sustainability issues extend globally—a sign that “thinking globally and acting locally” is becoming a more common practice worldwide.

Overall, both open calls of the UN can be seen as producing much useful data related to

SDG 11. However, response rates were relatively low, particularly from developing countries, and the level of detail in individual responses varied widely. Some submissions contained sufficient details for analyses, while others just superficially described the initiatives. For example, those submissions did not include information about (i) implementation of the project/activity; (ii) results/outputs/impact; (iii) enabling factors and constraints; (iv) sustainability and replicability. Also, I noted previously that UN staff may have placed submissions emphasizing environmental justice or climate change under other SDGs; these may need to be better linked to SDG 11 since they also affect cities. The analysis points to the need for better and more systematic reporting on SDG implementation globally, more focus on SDG 11 dimensions related to social equity, and a more active public sector role in implementing and reporting on the SDGs in developed countries.

As follow-on research, further evaluation of specific good practices through in-depth case study methods would be useful to both scholars and practitioners. Another promising area of research would clarify relationships between SDG 11 and its targets to enhance planning, monitoring, and progress evaluation (this would likely be useful for all SDGs). Finally, I suggested that clarifying the classification, selection, and systematization criteria of good practices within further open calls would contribute to a shared understanding of SDG implementation.

Chapter 2. How Is SDG 11 Linked with Other SDGs? Evidence from the United Nations Good Practices

Abstract

UN SDG 11 is linked with the 16 other SDGs to varying extents. Studying these relationships can provide insight into the strengths and weaknesses of the current SDG framework and set the stage for improvements to the next version. I analyze data from the UN database of 221 “good practices” for SDG 11 submitted between 2018 and 2021 to determine the most and least frequent linkages between SDG 11 and other SDGs, as well as differences in such linkages between developed and developing countries. I find SDG 11 most closely associated with SDG 17 (Partnership for the Goals) and SDG 13 (Climate Action). This shows actors’ perceptions of the centrality of international partnerships and climate action in addressing urban sustainability challenges. Connections with SDG 7 (Affordable and Clean Energy), SDG 2 (Zero Hunger), and SDG 16 (Peace, Justice, and Strong Institutions) were surprisingly weak, given the role of clean energy in addressing the climate crisis, the prevalence of poverty and hunger within cities, and the importance of institutions. Developing countries more frequently linked SDG 11 with SDG 5 (Gender Equality) and SDG 6 (Clean Water and Sanitation), showing a focus on basic infrastructure and gender equity dimensions of sustainability. Developed countries associated SDG 11 more strongly with natural resources, environmental sustainability, and economic production. These findings suggest that more specific targets, indicators, and international support related to energy, poverty, hunger, and institutions may be needed within post-2030 iterations of SDG 11.

1. Introduction

In 2015, the UN adopted the 2030 Agenda for Sustainable Development, a global guiding document for “achieving sustainable development in its three dimensions—economic, social and environmental—in a balanced and integrated manner” by pursuing “a comprehensive, far-reaching and people-centered set of universal and transformative Goals and targets” (UN, 2015, p. 1). At the core of the 2030 Agenda are 17 SDGs. Each SDG represents a specific field within the holistic concept of sustainable development and has associated targets and indicators.

Cities play a crucial role in the implementation of the 2030 Agenda. Over half of the global population resides in urban areas, a share projected to reach 70% by 2050 (UN, 2018). Expanding urban populations put pressure on housing, food systems, air and water quality, freshwater supplies, waste management, ecosystems, public health, and many other dimensions of sustainability (Nabiyeva et al., 2023).

SDG 11 includes 10 targets and 15 indicators covering a broad range of urban issues, from housing and infrastructure to cultural and natural heritage (UNDESA, n.d.-x). As of 2023, Brunei Darussalam was the only country out of 187 with available data that claimed to have met all SDG 11 indicators. Fifteen more nations were generally on track. The rest were moving slowly, stagnating, or even falling back in terms of SDG 11 implementation (SDSN, 2023).

In this chapter, the study analyzes how SDG 11 interacts with the other SDGs. I first summarize the literature on connections between the SDGs in general and between SDG 11 and other SDGs. Next, I introduce the dataset of the frequency distribution of links between SDG 11 and other SDGs, based on data from 336 SDG Good Practices collected by United Nations agencies around the world during two open calls in 2018-2021. I summarize findings on the most frequent and least frequent linkages between SDG 11 and other SDGs as reflected by this self-

reported data, and on differences in those frequencies between developed and developing countries. Finally, I discuss potential implications, which include the need for more specific targets and indicators related to energy, poverty, hunger, and institutional strength within the post-2030 iterations of SDG 11.

2. Literature Review

2.1 The SDGs as an Interlinked System

Within the complex enterprise of sustainable development, the UN SDGs can be seen as a “mutually supporting package” designed to optimize co-benefits and minimize trade-offs of the 2030 Agenda (Mantlana & Maoela, 2020, p. 353), “a system of synergetic reinforcement” (Pradhan et al., 2017, p. 1177), and a set of fundamentally interdependent global objectives for unfolding the potential of sustainable development (International Council for Science [ICS], 2017). Understanding SDG interlinkages is important for two reasons: (i) because no individual SDG can ensure advancement toward a sustainable future, and (ii) because a well-connected framework can bring more substantial changes to policies and institutions (Le Blanc, 2015; Mantlana & Maoela, 2020; Nilsson et al., 2016; Peters, 2015; Pradhan et al., 2017; Tosun & Leininger, 2017).

2.2 Interlinkages between SDG 11 and Other SDGs

Some SDGs are more interconnected to the rest of the goals than others. Le Blanc (2015) places SDG 11 within the middle of the pack with six to eight strong interconnections. According to Le Blanc (2015), SDG 12 (Responsible Consumption and Production), SDG 10 (Reduced Inequalities), SDG 1 (No Poverty), and SDG 8 (Decent Work and Economic Growth) have more than ten interlinkages with other SDGs. Misselwitz and Salcedo Villanueva (2015) argue that the urban dimension of the SDGs is much broader than the scope of SDG 11, being

present either explicitly or implicitly within ten other SDGs and 51 SDG targets out of 169.

Other sources indicate potential linkages between SDG 11 and all 16 other SDGs.

Within the literature, this study found 15 authors who analyzed interlinkages between SDG 11 and other SDGs. These links were identified at the level of indicators, targets, and/or SDGs. In this study, I charted a total of 64 potential linkages between SDG 11 and other SDGs (Appendix A.2). For example, SDG 1 (No Poverty) was commonly seen as related to SDG 11 in that poverty is a major issue within cities, and reducing it is a common goal of urban planning.

Most authors describe links between SDG 11 and other SDGs as a positive correlation. For example, reliable and sustainable infrastructure targets 9.1 and 9.4 of SDG 9 (Industry, Innovation, and Infrastructure) play a fundamental role in efforts for resilient urban livelihoods of SDG 11 (Mantlana & Maoela, 2020). However, Vijayapur and Shashidhar (2021) found negative correlations between SDG 11 and SDG 10 (Reduced Inequalities) and SDG 12 (Responsible Consumption and Production). Tosun and Leininger (2017) also found a negative correlation between SDG 11 and SDG 7. For example, boosting consumption for growth within SDG 8 (Decent Work and Economic Growth) counteracts waste reduction SDG 11 and climate mitigation SDG 13 (Climate Action).

Describing interlinkages with SDG 11, the Independent Group of Scientists appointed by the UN Secretary-General, which produced the Global Sustainable Development Report 2019, “The Future is Now—Science for Achieving Sustainable Development,” indicated that SDG 11 impacts all other SDGs while receiving influence from all SDGs. However, this report shows important gaps in knowledge regarding relationships between SDG 11 and SDG 1 (No Poverty), SDG 3 (Good Health and Well-being), and SDG 5 (Gender Equality) (UN, 2019a). MacDonald et al. (2018) identify SDG 17 (Partnership for the Goals) as a means for achieving SDG 11 by

involving local and international organizations and motivating investment, resulting in savings for local governments. Vladimirova and Le Blanc (2016) argue that UN reports pay limited attention to the two-way linkages between SDG 11 and SDG 4 (Quality Education), mentioning as an example that higher literacy leads to better preparedness for disaster risks in urban areas, while urbanization has a positive effect on access to education.

Some countries have integrated SDGs into their national sustainability strategies in ways that emphasize their interlinkages. For example, the Government of Switzerland conceived the Urban Development, Mobility, and Infrastructure focus area as a thematic cluster of SDG 11 and SDG 9 (Industry, Innovation, and Infrastructure) addressed jointly (Swiss Confederation, 2016). Qatar's National Development Strategy on the SDGs attempted to address public safety and security issues by clustering SDG 11 with SDG 16 (Peace, Justice, and Strong Institutions) (Tosun & Leininger, 2017; UN, 2017).

2.3 Synergies and Trade-Offs between SDGs

The concept of synergies and trade-offs dominates the discourse investigating interlinkages between SDGs. According to the ICS (2017, p. 7), understanding this “is crucial for achieving long-lasting sustainable development outcomes.” Synergy means that progress on one SDG favors progress on others. For example, introducing school meals addresses SDG 2 (Zero Hunger) while simultaneously promoting SDG 3 (Good Health and Well-Being) and SDG 4 (Quality Education) (Tosun & Leininger, 2017). In contrast, trade-offs occur when progress on one SDG contradicts progress on others, as, for instance, when boosting consumption for economic growth within SDG 8 (Decent Work and Economic Growth) counteracts SDG 12 (Sustainable Consumption and Production Patterns) and SDG 13 (Climate Action) (Nilsson et al., 2016).

Scholarship suggests that analyses of SDG synergies and trade-offs should also consider environmental justice implications. Menton et al. (2020) argue that interactions among SDGs may generate both environmental justice and injustice depending on how costs, benefits, and decision-making power are distributed. For example, they discuss wind energy development in Oaxaca, Mexico, where renewable energy projects supported sustainability objectives while simultaneously generating conflicts over land access, participation, and local livelihoods. Therefore, evaluating SDG interlinkages requires consideration of who benefits, who bears environmental risks, and whose interests are represented in decision-making processes.

Previous studies indicate that synergies occur more frequently and are stronger than trade-offs among all SDGs (Fuso Nerini et al., 2018; Mantlana & Maoela, 2020; Nilsson et al., 2016; Pradhan et al., 2017; Weitz et al., 2014; Weitz et al., 2018). Regarding SDG 11, various sources described (i) synergies with seven SDGs and (ii) trade-offs with six SDGs (Fuso Nerini et al., 2018; ICS, 2017; Mantlana & Maoela, 2020; Pradhan et al., 2017; Weitz et al., 2018) (Table 2.1).

Table 2.1

Synergies and Trade-Offs between SDG 11 and Other SDGs in the Previous Studies

Other SDGs	SDG 11	
	Synergies	Trade-offs
SDG 1 (No Poverty)	+	
SDG 2 (Zero Hunger)	+	+
SDG 3 (Good Health and Well-Being)	+	
SDG 7 (Affordable and Clean Energy)	+	
SDG 8 (Decent Work and Economic Growth)		+
SDG 9 (Industry, Innovation, and Infrastructure)	+	
SDG 13 (Climate Action)	+	+
SDG 14 (Life Below Water)	+	+
SDG 15 (Life on Land)		+
SDG 16 (Peace, Justice, and Strong Institutions)		+

For example, the bi-directional effects between SDG 11 and SDG 14 (Life Below Water) include both (i) synergies through coastal and marine management, settlement planning, onshore and offshore infrastructure development, and restoration and conservation of coastal ecosystems, and (ii) trade-offs through water pollution generated by growing cities (ICS, 2017). Mantlana and Maoela (2020) clustered SDG 11 with SDG 2 (Zero Hunger) and determined that they have 81% co-benefit and 19% neutral positive interlinkages with SDG 9 (Industry, Innovation, and Infrastructure).

According to Valencia et al. (2019), SDG 11 reflects both synergies and trade-offs between its targets due to the multiple and complex interactions within its key areas. For example, efforts at increasing housing (target 11.1) can help create more inclusive urbanization (11.3) but can also lead to the conversion of green areas (11.7) and farmland (11.a) into built environments, negatively affecting the livelihoods of farmers, disturbing local ecosystems, and pushing food production further away from consumers.

2.4 Interlinkages between SDGs in the Context of Developing and Developed Countries

Several authors argue that national policies need to adjust SDG implementation according to the level of development, available resources, and local conditions and circumstances (Naeem et al., 2018; Nilsson et al., 2016; Tosun & Leininger, 2017; Weitz et al., 2018). For example, Koch and Krellenberg (2018) found that few of the original targets and indicators of SDG 11 were relevant to the German context. Germany had already met or nearly achieved indicators related to the built-up area, transport infrastructure, and change in open space per capita; the country is also far ahead of the SDG targets and indicators related to energy consumption, transport, and housing affordability. In a similar vein, Vladimirova and Le Blanc (2016) argued that most of the flagship UN reports had a strong focus on developing countries

and said relatively little about developed countries. These authors claimed that if the SDGs represented an agenda applicable to all countries, the perspective had to integrate different regions and contexts more consistently. Laumann et al. (2022) ranked SDG 11, SDG 13 (Climate Action), and SDG 17 (Partnership for the Goals) as highly important across many country groupings. For developing countries, these authors prioritized interlinkages between SDG 11 and SDG 1 (No Poverty), SDG 4 (Quality Education), SDG 8 (Decent Work and Economic Growth), SDG 5 (Gender Equality), and SDG 16 (Peace, Justice, and Strong Institutions) (Laumann et al., 2022). Thus, I assumed that interlinkages between SDGs in developed and developing countries might differ because of differing needs and national implementation frameworks.

3. Materials and Methods

3.1 Data

To investigate interlinkages with SDG 11, I utilized the UN SDG Good Practices dataset collected through two open calls, the first in 2018-2019 (OC1) and the second in 2020-2021 (OC2) (UNDESA, n.d.-a; UNDESA, n.d.-b). Each submission contained a brief description of an SDG-related initiative and its implementation, beneficiaries, resources, timeline, and evaluation. Actors indicated which SDGs their initiative addressed upon submission (Nabiyeva et al., 2023).

An Inter-Agency Review Team of 30 experts in sustainable development from across the UN system reviewed more than 1,400 self-reported good practices submitted by various actors. It approved 511 initiatives from OC1 and 464 initiatives from OC2 to include in the SDG Good Practices dataset. Of these, 186 and 150 practices respectively addressed the implementation of SDG 11 (34.4% of the total of both open calls). Developing countries submitted 202 of 336 good practices addressing SDG 11 (60.1%), while developed countries submitted 120 good practices (35.7%), and those with economies in transition contributed 14 good practices (4.2%).

Twenty-three SDG 11 good practices addressed that goal exclusively. This group was not relevant to the analysis, which focuses on interconnections between SDG 11 and others, and so I eliminated it. This relatively small proportion decreased from 21 in the first Open Call to just two in the second. These submissions appeared to ignore the widespread emphasis on SDG interconnections. For example, Pradhan et al. (2017, p. 1177), like other sources, stress that “no SDG can individually move forward to address the global sustainability challenge of ensuring human well-being, economic prosperity, and environmental protection.” Meanwhile, 92 submissions addressed all 17 SDGs, and the study eliminated these as well. These projects were less specific, mainly building general capacity for 2030 Agenda implementation, increasing awareness of the SDGs, or establishing political and methodical frameworks for their implementation. The number of those practices was stable between the two open calls (44 and 48, respectively). Examples included a Kigali City 2050 masterplan in Rwanda (UNDESA, n.d.-j) and a local SDG platform in Japan (UNDESA, n.d.-y).

The remaining 221 submissions addressing SDG 11 in combination with one or more other SDGs formed the data sample for this study ($N = 221$). Table 2.2 displays the frequency distribution of the interlinkages between SDG 11 and other SDGs.

Table 2.2

Frequency Distribution of the Interlinkages by SDGs and Open Calls

SDG 11	Other SDGs associated with SDG 11 ²																	Total
	1	2	3	4	5	6	7	8	9	10	12	13	14	15	16	17		
OC1	48	27	48	47	48	51	33	57	38	42	53	49	19	43	37	59	699	
OC2	47	35	49	40	43	33	23	44	35	51	46	55	17	35	24	59	636	
Both OCs	95	62	97	87	91	84	56	101	73	93	99	104	36	78	61	118	1,335	

² Because many good practices addressed several SDGs, the total number of interlinkages between SDG 11 and other SDGs is much greater than the total number of good practices under review.

I should note that this dataset has some limitations. First, the SDG Good Practices are self-reported data, and there might be tendencies for entities to focus on some SDGs and types of practices more than others. Second, the UN experts screening the submissions may have introduced biases in terms of accepting those submissions as good practices. Third, the UN's promotion and communication efforts may have reached some countries and institutions more effectively than others, thus influencing the geographical mix and content of submissions. Because of these things, the UN dataset does not necessarily represent all SDG 11 initiatives. However, it is the dataset available for analysis, and the UN is the entity that originally developed the SDGs and is most responsible for promoting them through its agencies and programs around the world.

3.2 Data Analysis

After establishing the dataset of 221 good practices addressing SDG 11 and at least one other SDG, but not all, I characterized the countries submitting these as developed, developing, or in transition based on the official UN classification (UN, 2019b). I then tabulated the total number of interlinkages between SDG 11 and other SDGs and the average proportions of interlinkages per submission and used chi-square tests to analyze differences in distribution, including by type of economy. These methods are described in greater detail in Appendix B.2.

4. Findings and Discussion

4.1 Interlinkages between SDG 11 and Other SDGs

Table 2.3 demonstrates the proportions of interlinkages arranged from the highest to the lowest. On average, SDG 11 was associated with six other SDGs per practice, showing the complex nature of sustainable urban development. Actors frequently consider it embedded in higher-level, more comprehensive, multisectoral initiatives, as represented within SDG 17

(Nilsson et al., 2016). This finding coincided with the one by Le Blanc (2015) that most SDGs have interlinkages with six to eight other SDGs.

Table 2.3

Proportions of the Interlinkages by SDGs and Open Calls

SDG linked to SDG 11	OC 1		OC2		Both OCs	
	Inter-linkages	% of the total	Inter-linkages	% of the total	Inter-linkages	% of the total
SDG 17 (Partnership for the Goals)	59	8.4	59	9.3	118	8.8
SDG 13 (Climate Action)	49	7.0	55	8.6	104	7.8
SDG 8 (Decent Work and Economic Growth)	57	8.2	44	6.9	101	7.6
SDG 12 (Responsible Consumption and Production)	53	7.6	46	7.2	99	7.4
SDG 3 (Good Health and Well-Being)	48	6.9	49	7.7	97	7.3
SDG 1 (No Poverty)	48	6.9	47	7.4	95	7.1
SDG 10 (Reduced Inequalities)	42	6.0	51	8.0	93	7.0
SDG 5 (Gender Equality)	48	6.9	43	6.8	91	6.8
SDG 4 (Quality Education)	47	6.7	40	6.3	87	6.5
SDG 6 (Clean Water and Sanitation)	51	7.3	33	5.2	84	6.3
SDG 15 (Life on Land)	43	6.1	35	5.5	78	5.8
SDG 9 (Industry, Innovation, and Infrastructure)	38	5.4	35	5.5	73	5.5
SDG 2 (Zero Hunger)	27	3.9	35	5.5	62	4.6
SDG 16 (Peace, Justice, and Strong Institutions)	37	5.3	24	3.8	61	4.6
SDG 7 (Affordable and Clean Energy)	33	4.7	23	3.6	56	4.2
SDG 14 (Life Below Water)	19	2.7	17	2.7	36	2.7
In Total (interlinkages % of the total)	699	100.0	636	100.0	1,335	100.0
Mean (interlinkages per SDG)	43.7	-	39.8	-	83.4	-
Median (interlinkages per SDG)	47.5	-	41.5	-	89.0	-

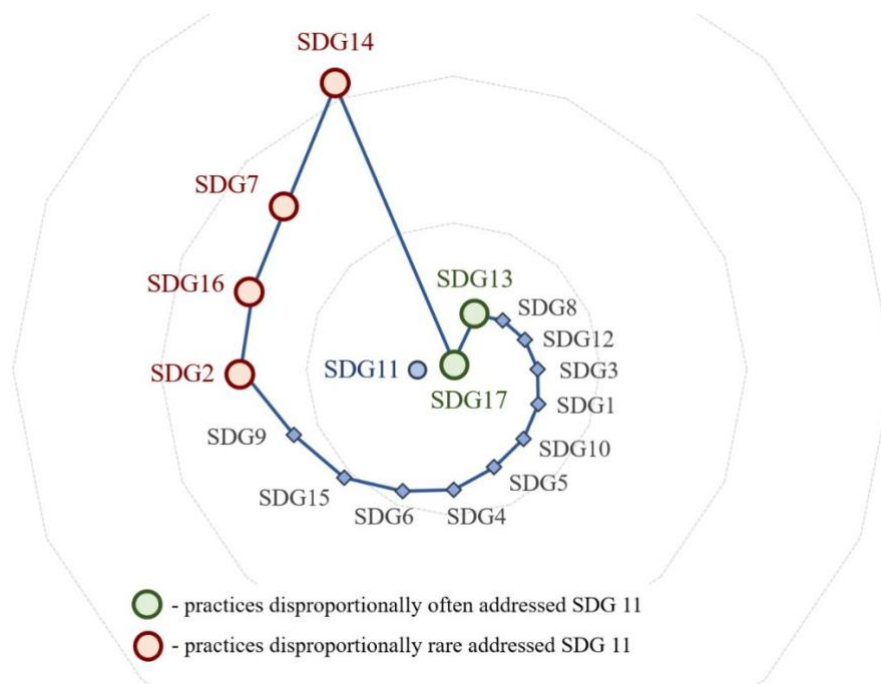
To examine the significance of differences in the numbers of interlinkages between SDG 11 and other SDGs, I conducted a one-sample *chi*-square test for the hypothesis of equal proportions. The *chi*-square was significant, $\chi^2(15, N = 1,335) = 80.92, p < 0.001, \alpha = 0.05$, illustrating a statistically significant difference in the distribution of interlinkages by SDGs from what I would expect, hypothesizing the equal distribution of the interlinkages by SDGs. Next, I used standardized residuals as a follow-up test to specify a source of significance for the critical

$|R| = 1.96$. The follow-up test revealed that the interlinkages between (i) SDG 11 and SDG 17 (Partnership for the Goals) ($R_{17} = 3.78$) and (ii) SDG 11 and SDG 13 (Climate Action) ($R_{13} = 2.25$) occurred significantly more often than the interlinkages of SDG 11 with other SDGs.

Figure 2.1 illustrates the frequency and statistical significance of reported relationships between SDG 11 and other SDGs in the UN dataset.

Figure 2.1

Statistically Significant Interlinkages between SDG 11 and other SDGs



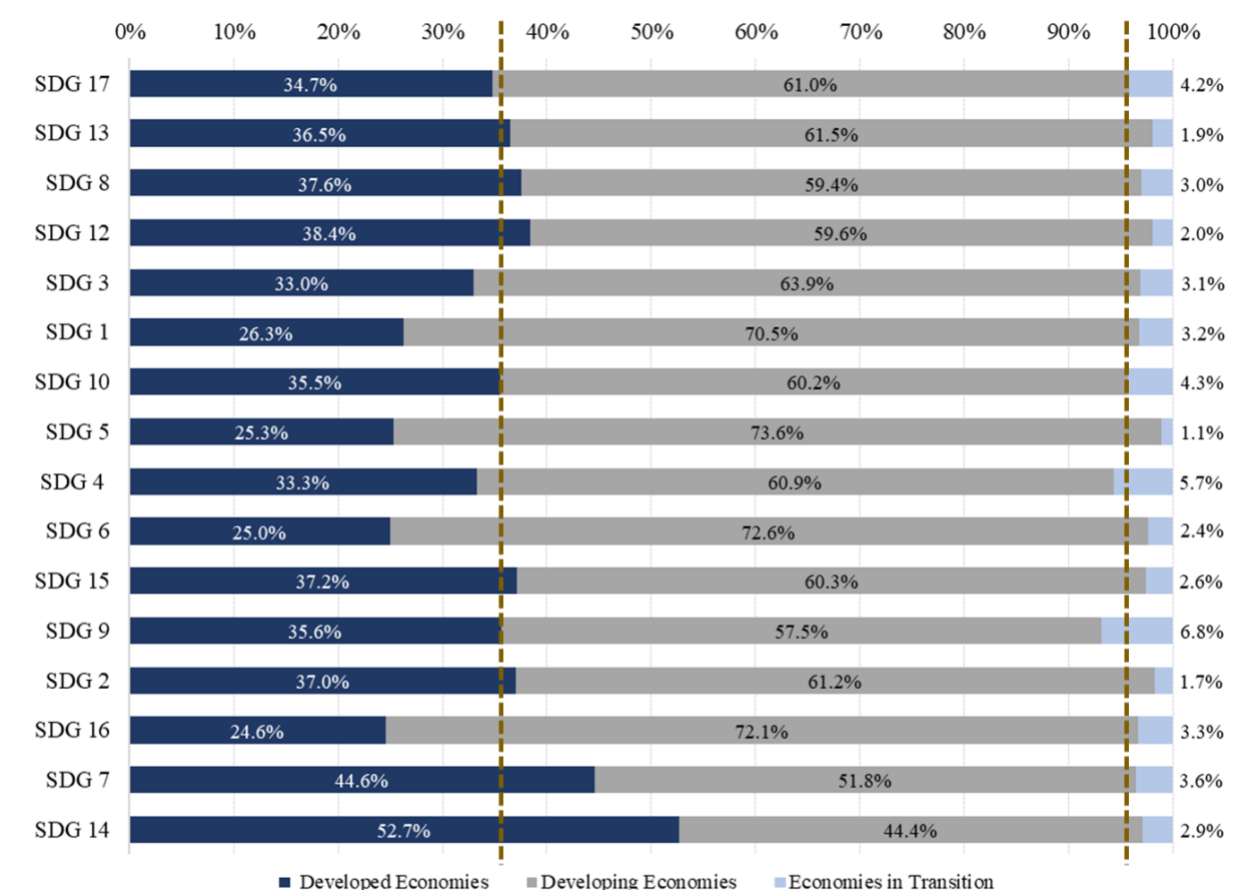
On the other hand, the interlinkages of SDG 11 with SDG 14 (Life Below Water) ($R_{14} = -5.19$), SDG 7 (Affordable and Clean Energy) ($R_7 = -3.00$), SDG 16 (Peace, Justice, and Strong Institutions) ($R_{16} = -2.46$), and SDG 2 (Zero Hunger) ($R_2 = -2.35$) occurred significantly less than with other SDGs. Besides those shown in Figure 2.1, the differences in the frequency distribution for the interlinkages of SDG 11 with other SDGs were not statistically significant ($|R| < 1.96$).

4.2 Interlinkages between SDG 11 and Other SDGs by Types of Economy

Figure 2.2 illustrates the proportions of the interlinkages between SDG 11 and each of the other SDGs by type of economy.

Figure 2.2

Proportions of the Interlinkages of SDG 11 and Other SDGs by Types of Economy



- the proportions of the good practices submitted by developed economies (35.7%), developing economies (60.1%), and economies in transition (4.2%) from the entire data set of 336 good practices addressing SDG 11.

As can be seen, developing countries frequently linked the implementation of SDG 11 with SDGs related to social and equity issues, and developed countries linked SDG 11 with SDGs that tended toward economic and environmental dimensions.

Because the point of interest was the difference in the proportion of interlinkages between developed and developing countries, the study excluded from the analysis seven good practices submitted by the countries with economies in transition (with 43 interlinkages in total).

As a result, I got a sample of 214 good practices submitted by developed and developing countries, indicating 1,292 interlinkages between SDG 11 and other SDGs.

The *chi*-square test did not show a statistically significant difference in the distribution of the SDG 11 interlinkages with other practices for submissions of developed and developing countries.

4.3 Most Frequent Interlinkages between SDG 11 and Other SDGs

Even though the actors submitting good practices connected SDG 11 with ten out of 16 other SDGs approximately equally, they chose to link it more often to SDG 17 (Partnership for the Goals) and SDG 13 (Climate Action). This coincides with findings from previous studies, which claim that (i) SDG 17 is tightly positively connected with SDG 11, (ii) both of these SDGs are highly important across many country groupings, and (iii) multi-stakeholder partnerships are crucial for achieving SDG 11 because of the need for sophisticated implementation structures to ensure collaborative actions (Laumann et al., 2022; MacDonald et al., 2018; Weitz et al., 2014; Weitz et al., 2018). I could add that partnerships are intrinsically natural for urban areas, given their dense population and more sophisticated social, cultural, and physical landscapes. Many submissions specified a participatory approach and inclusiveness as crucial elements of their “goodness” for promoting SDG 11 and sustainable development in general. For example, the participation model of Helsinki, Finland, allowed 38,000 city employees to contribute to decisions on public funds allocation by voting for the proposals most relevant in their fields, thus affecting millions of euros of public investment (UNDESA, n.d.-z).

It is also natural that SDG 11 should be closely linked to SDG 13 (Climate Action), since cities contribute over 70% to the global emission of greenhouse gases, and the climate crisis is arguably the leading sustainability challenge currently. Laumann et al. (2022) detail interlinkages

between SDG 11 and SDG 13 (Climate Action) by the impact of urbanization, air pollution, and urban population on climate change. The findings also aligned with the claim that climate change was inextricably linked to the achievement of all other SDGs (Nilsson et al., 2016; Tosun & Leininger, 2017).

4.4 Least Frequent Interlinkages between SDG 11 and Other SDGs

SDG 14 (Life Below Water), SDG 7 (Affordable and Clean Energy), SDG 16 (Peace, Justice, and Strong Institutions), and SDG 2 (Zero Hunger) had significantly fewer interlinkages with SDG 11 than observers should expect according to the hypothesis of equal proportions.

City governments might not view oceans and other large bodies of water (the focus of SDG 14) as central to their policy concerns. However, more than 90% of urban settlements are coastal, and cities enter about 17 million metric tons of plastic into the ocean annually (UN, 2023). The ICS (2017) highlighted a broad range of bi-directional effects between SDGs 11 and 14. Substantial educational efforts appear necessary to help local authorities take these connections more seriously.

The lack of a stronger connection with SDG 7 (Affordable and Clean Energy) is also surprising. Cities require enormous amounts of energy in order to function; this energy use is connected closely to greenhouse gas (GHG) emissions and climate action. This finding reinforces two previous studies indicating rare links between SDG 11 and SDG 7 (Affordable and Clean Energy) (Pradhan et al., 2017; Tosun & Leininger, 2017). The relatively small number of targets and indicators for SDG 7 may contribute to this situation; SDG 7 includes just five targets (out of 169 for all SDGs) and six indicators (out of 230), while, for example, SDG 17 (Partnership for the Goal) comprises 19 targets and 24 indicators. This lack of connection may therefore be an artifact of the way SDG 7 is framed, suggesting that a rethinking of SDG 7 may

be needed in the future.

Previous studies have mentioned that target 16.6 (effective institutions) generates positive interlinkages between SDG 11 and SDG 16 (Peace, Justice, and Strong Institutions) (Laumann et al., 2022; Le Blanc, 2015; UN, 2019a; Weitz et al., 2014). Also, problems of crime, violence, and insecurity seem to be the main urban challenges around the world. So, it is surprising that more submissions did not link these two. Likewise, the submissions rarely mentioned SDG 2 (Zero Hunger) within the context of sustainable urban development actions, even though poverty and hunger are widespread problems in cities, especially in the developing world. The global community may wish to highlight these two issues more highly within future versions of SDG 11.

4.5 SDG 11 Interlinkage Differences between Developing and Developed Countries

The study did not identify a statistically significant difference between developing and developed countries in the frequency distribution of interlinkages between SDG 11 and other SDGs for the confidence level $\alpha = 0.05$. However, if I increase the confidence level to $\alpha = 0.10$, which is a frequent practice in social sciences, some differences do appear. In particular, developing countries addressed SDG 11 in combination with SDG 14 (Life Below Water) less often than developed countries, despite the fact that the ocean provides developing countries with about 11% of their gross domestic product compared to less than 2% in developed countries (UN, 2023). Globally, more than three billion people rely on the ocean for their livelihoods through tourism, trade, fishing, or other jobs, and the vast majority of those people live in developing countries. Developing countries also produce the most plastic waste, contaminating the ocean. Quite likely, developing countries face more pressing needs for their limited urban sustainability resources than addressing ocean pollution, and may not have developed institutions

allowing them to take action on this front. The international community may wish to raise the profile of ocean-related urban sustainability challenges and provide additional support in the future.

If I increase the confidence interval to $\alpha = 0.15$, then two other linkage differences appear. Developed countries less frequently addressed urban sustainability in relation to gender issues, SDG 5 (Gender Equality), and freshwater quality, SDG 6 (Clean Water and Sanitation). One of the possible explanations for this difference is that issues targeted by SDG 5 and SDG 6, though still important for industrialized nations, are less common and pressing there than in developing countries.

Finally, although significance levels are relatively low, the analysis generally supports the claims by Laumann et al. (2022) that developing countries more strongly link SDG 11 with SDG 1 (No Poverty), SDG 4 (Quality Education), SDG 5 (Gender Equality), and SDG 16 (Peace, Justice, and Strong Institutions). Contrary to those authors, this analysis finds that actors from developed countries are more frequently linked to SDG 11 with SDG 8 (Decent Work and Economic Growth) than those from less industrialized countries.

Conclusion

The analysis of the 2018-2021 SDG Good Practices data confirmed the highly connected nature of the SDGs within the 2030 Agenda and identified specific interlinkages between SDG 11 and the other SDGs.

From 221 good practices addressing SDG 11 in combination with some but not all other SDGs, I found that actors most frequently linked sustainable urban development actions with climate change and institutional partnerships. I also found that they least often linked these efforts with promoting clean energy, conserving the marine biosphere, and reducing hunger. The

lack of connection with the latter SDGs is surprising and can potentially be addressed by rethinking the framing and targets of future iterations of the SDGs, and by global efforts at education and assistance related to these topics. For example, SDG 11 does not have a specific target or indicator related to energy; this seems a major lack given the importance of transitioning energy systems to renewable sources to prevent further global warming and the large role of energy within urban economies and social welfare. Likewise, no SDG 11 target or indicator specifically mentions hunger or access to safe and healthy food systems. This also would seem to be a need within a more holistically framed UN urban sustainability goal.

Even though our analysis did not reveal a statistically significant difference in the proportion of SDG 11 interlinkages with other SDGs between developed and developing countries, some patterns appear to exist at less stringent levels. Developed countries more frequently linked urban actions to conserving the ocean than developing countries, whereas developing countries paid more attention to gender equality and access to clean water and sanitation.

Future research could explore these issues with new data sets as those become available or could investigate cause-and-effect relationships between actions toward SDG 11 and those involving other SDGs through more in-depth qualitative case studies. Researchers might also explore how the SDG framework might be enhanced in its next iteration to improve the balance between the various urban dimensions of sustainability, for example, to give more weight to clean energy, water system impacts, and hunger within cities. Finally, interlinkages between other SDGs can be explored using our methods and data sources to gain additional insight into how various actors position their sustainable development initiatives within the framework of the 2030 Agenda.

Chapter 3. Open Government Data as a Tool for Planning and Sustainability in U.S. Cities

Abstract

OGD can play a key role in the sustainability planning of cities by fostering transparency, encouraging public participation, facilitating collaborative decision-making, and tracking progress. This study examines OGD's role in relation to municipal OGD portals, policies, plans, and sustainability performance in 19 U.S. cities ranked in the Sustainable Cities Index 2024 (SCI 2024). The methods included document, portal, and website reviews, content analysis, descriptive statistical analysis, and interviews with OGD and planning experts. Overall, the study found that municipal OGD initiatives are still in their infancy. An analysis of OGD portals in 19 U.S. cities revealed disparities in (i) breadth of portal content, (ii) the structure of governance, (iii) user-friendly support, and (iv) equitable user access between high- and low-ranked sustainable cities, shaping their ability to support urban planning and advance progress toward SDG 11. No city consistently integrates OGD across planning documents. Only nine of the 19 cities identified a role for OGD in their planning documents, and municipal OGD policy focuses on government transparency. Experts highlighted the importance of open data in promoting public participation. However, direct connections between OGD and municipal policy, for example, to help assess progress toward policy goals, are limited. Experts identified several barriers to OGD implementation, including low awareness, limited skills, and underuse of data. Municipal use of OGD appears to be generally correlated with cities' success with sustainability policies, but there is little systematic development of sustainability indicator sets. To improve OGD effectiveness, this study proposes more extensive communication with diverse data users, public training classes and workshops, a focus on key datasets of action-oriented policy relevance, improved standardization of data, and stronger integration of OGD into city plans.

1. Introduction

OGD can play a crucial role in addressing urban challenges by increasing transparency, engaging the public, fostering data-driven decision-making, fighting corruption, and providing quantitative measurement of progress toward sustainability goals (Berrone et al., 2016; Davies & Perini, 2016; Jaakola et al., 2015). According to the Open Data Handbook (n.d.), OGD can be defined as public data that anyone can freely use, reuse, and redistribute. Typically, cities set up online portals to provide this data. The concept of OGD emerged in the early 2000s, with pioneering national initiatives such as the United Kingdom (data.gov.uk) and the U.S. (data.gov), which was launched in 2009 as part of President Obama's Open Government Initiative (U.S. Government, 2009). Data.gov started with just 47 datasets, but now it hosts nearly 312,000 datasets, collected from over 100 federal agencies (Data.gov, n.d.). Cities like Washington, D.C., San Francisco, and New York were among the first cities to adopt open data portals, which are typically organized by categories such as transportation, environment, housing, and public safety, and provide visualization tools and downloadable files for users (Hendler et al., 2012).

The UN's report, "A World That Counts: Mobilizing the Data Revolution for Sustainable Development," underscores the need for an "open data revolution" to monitor progress, hold governments accountable, and advance sustainable planning (Independent Expert Advisory Group on a Data Revolution for Sustainable Development [IEAG], 2014, p.2).

Making municipal data publicly available also has many economic benefits for both the public and private sectors. Cities like Beijing and Helsinki have leveraged e-governance to improve public services (World Bank, 2015). Beijing's smart traffic system, powered by open data, has reduced congestion by 60%, doubled or even tripled road capacity, shortened driving times by 45%, increased vehicle efficiency by 50%, and decreased fuel consumption by 15% (Liu & Peng, 2014). Launched in 2010 by the City of Helsinki, the Helsinki Region Infoshare

open data service—winner of the 2013 European Union Prize for Innovation in Public Administration—offers over 1,100 open datasets and a collection of around 100 applications, including BlindSquare, Service Map, and Travel Time Matrix, with users in more than 50 countries (Jaakola et al., 2015). The United Kingdom government estimates that public sector information generates £1.8 billion in direct benefits and £6.8 billion in total annual impact, while McKinsey & Company (2013) estimates that OGD use across seven economic sectors could create \$3 trillion to \$5 trillion in annual value worldwide. In Spain, around 4,000 people are employed in OGD initiatives, generating between 330 million and 550 million euros annually from data reuse (ONTSI, 2012; World Bank, 2013). The Knight Foundation identified 500 U.S. companies that utilize OGD, including well-known platforms like Yelp and Zillow (The GovLab, 2014; Yadav et al., 2017).

However, creating truly useful OGD initiatives to assist with sustainable urban development is not easy. This is due to obstacles in assembling and updating datasets, challenges in framing and presenting data in user-friendly ways, difficulties in connecting data to poorly articulated or changeable policy goals, and the inherently political nature of municipal data. Open data initiatives are also relatively recent, with most having been initiated within the past 10-15 years. In this study, I examine the nature and evaluation of OGD portals based on four criteria and how local OGD initiatives in 19 U.S. cities relate to OGD policies, plans, and sustainability performance. The study addresses the following research questions: How do OGD portals vary across cities, including (i) the breadth of portal content, (ii) structure of governance, (iii) user-friendly support, and (iv) equitable user access, and how do these differences influence progress toward SDG 11? Do OGD initiatives meet the intentions of OGD policies? Do general plans and sustainability/climate action plans use OGD initiatives as planning tools? How does

OGD correlate with sustainability performance?

While previous studies have examined various aspects of OGD and the role of data in planning, for almost two decades, no analysis has been conducted to determine if OGD initiatives fulfill the objectives of policies. Despite the importance of high-quality data for supporting planning, interrelations between OGD initiatives, cities' general plans, and sustainability/climate action plans are still underexplored. This study provides information to support local OGD initiatives in the U.S. and other countries worldwide. The findings of this study will be useful for city-level officials responsible for OGD and sustainability planning, as well as for many others striving to make their cities more prosperous, equal, and environmentally friendly places.

2. Literature Review

2.1 Data within City Planning

Urban and regional planning has always relied on systematic collection and analysis of data, for example, about land, types and quality of housing, population demographics, transportation flows, environmental resources, social disparities, and economies. In the late 19th and early 20th century Patrick Geddes (1915) famously emphasized careful observation and survey as the precondition to planning; his mantra of survey, analysis, plan still encapsulates the process that many public agencies follow, and open data portals can be seen as the modern equivalent of the Outlook Tower that he proposed as a physical place where the public could come observe and learn about the urban region.

Although early planning pioneers such as Frederick Law Olmsted (1856), Ildefons Cerdà (1867), Ebenezer Howard (1902), Daniel Burnham and Edward Bennett (1909), and Jane Addams (1990) had origins in many different disciplines, good information was central to their

creative proposals for society. With the rise of the social sciences in the middle of the 20th century, planning became ever more data-driven, often at the expense of vision and advocacy. According to Walter Isard (1974), a proponent of the mid-20th-century sub-discipline known as regional science, “The typical regional scientist wants to surround himself [sic] with research assistants and a computer for a long time in order to collect all the relevant information about the problem, analyze it carefully, try out some hypotheses, and finally reach some conclusions and perhaps recommendations (Lahr, 2000).”

Critics such as Jane Jacobs (1961) pointed out the myopia that data and objectivity-obsessed planners with little real-world experience often succumbed to, emphasizing first-hand qualitative analysis of how people used urban environments. Others, such as David Harvey (1990) and Manuel Castells (1978), emphasized analysis of power within society. These forms of knowledge do not fit as neatly into databases, though there are still ways to ground them on quantifiable information. Writers such as Foucault (1972), Flyvbjerg (2002), Forester (1989), and Fainstein and Fainstein (1979) developed nuanced analyses of ways that information is manufactured, manipulated, obscured, and distorted within social processes, often to benefit those with power at the expense of others.

As planning moved into the new millennium and systemic problems such as climate change mounted, sustainability became a more important objective. Planning at the municipal government scale is crucial to sustainability because this is the scale at which many day-to-day environmental, social, and economic development decisions are made. Wheeler (2021, p.289) argued that focusing on sustainability objectives within urban planning documents “provides a way to think systematically through a long-term approach to local planning and to reconcile objectives of economy, environment, and equity.” The UN (2015) approval of the SDGs in 2015

established a set of global goals for planning, each containing targets and indicators. This framework lends itself to an increasingly standardized data set for cities. While working for over two years to develop a proposal for the SDGs, the Open Working Group on SDGs, composed of 30 UN member states, stated, “In order to monitor the implementation of the SDGs, it will be important to improve the availability of and access to data and statistics disaggregated by income, gender, age, race, ethnicity, migratory status, disability, geographic location, and other characteristics relevant in national contexts” (World Bank, n.d.).

2.2 Open Government Data

OGD is information from public sector agencies that is available to the public free of charge, reusable without restrictions, and is platform-independent, machine-readable, and often de-identified (Open Data Handbook, n.d.; Attard et al., 2015; Meschede & Siebenlist, 2021; Reiche & Höfig, 2013; Verhulst & Young, 2017; OpenGovData, n.d.; Chignard, 2013). OGD can be freely accessed, modified, and shared by anyone for any purpose. The philosophical roots of open data can be traced back to sociologist Robert K. Merton, who promoted the “common pot” idea—treating scientific knowledge as public property to be shared freely for the common good (Merton, 1973). Later, Elinor Ostrom, a Nobel Prize winner in Economics, emphasized the unique characteristics of the information commons. Ostrom noted that these commons are similar to public goods: “...their use by one person does not impede their use by others” (Chignard, 2013, p.1). Furthermore, she stated that “these are public goods of a new kind: not only does their use not deplete the common stock, but it enriches it” (Chignard, 2013, p.1). In short, the collaborative use and sharing of open data can generate enhanced economic, social, and environmental outcomes.

In recent decades, the open data concept has become increasingly widespread due to theoretical and technological developments (Data.gov, n.d.). In 2007, a group of activists known as the Open Government Working Group outlined the concept and principles of open data, defining OGD as a public good that should be available to all (OpenGovData, n.d.). Partially based on their proposal, President Obama launched several OGD initiatives in 2009, including the Memorandum on Transparency and Open Government, which established three cornerstone principles of OGD (U.S. Government, 2009): “My Administration is committed to creating an unprecedented level of openness in government. We will work together to ensure the public trust and establish a system of transparency, public participation, and collaboration” (The White House, 2009).

The Obama Administration’s Open Government Initiative expedited the implementation of OGD policies by issuing the Open Government Directive, requiring federal agencies to release high-value datasets, develop transparency plans, and launch the federal data portal Data.gov, supported by funding for agency-level data infrastructure (The White House, 2009). For example, former Federal Chief Information Officer Vivek Kundra highlighted the value of open government initiatives, stating that dashboards enable the public to track government projects “just as easily as they can monitor the stock market or baseball scores”; his review of \$27 billion in over-budget IT projects resulted in \$3 billion in savings (Kundra, 2010, p.1). Despite this progress, The Regulatory Review published that funding for Data.gov, IT Dashboard, and other open-data tools in 2011 was cut by about 75%, from \$34 million in 2010 to \$8 million (Jackel, 2011). Nonetheless, by 2025, more than 140 OGD portals had been launched, collectively hosting over 312,000 datasets (Data.gov, n.d.).

Many recent studies emphasize the importance of high-quality public data for effective

urban planning. According to Simon et al. (2015), cities that use timely, disaggregated, and locally relevant data are better positioned to monitor sustainability targets and design effective policies. However, their analysis of five diverse cities—Bangalore (India), Cape Town (South Africa), Gothenburg (Sweden), Greater Manchester (United Kingdom), and Kisumu (Kenya)—revealed that data gaps, inconsistencies, and limited local capacity often hinder progress toward urban sustainability. Satterthwaite (2016) and Patel et al. (2017) similarly argue that data capacity varies widely across cities and is often insufficient. Specifically, based on their analysis of Cape Town’s engagement with SDG 11, Patel et al. (2017) concluded that success depends on access to robust data and governance reforms that align urban planning with global sustainability agendas. Likewise, Satterthwaite (2016, p.8) highlighted the need for “co-production of the SDGs,” involving contributions from multiple sectors, with local governments playing a critical role in ensuring coherence and coordination. Davis et al. (2015, p.1) further emphasized that “indicators are both a form of knowledge and a technology for governance,” shaping—and being shaped by—political decision-making, public understanding, and institutional practices.

Good public data is particularly important for sustainability planning, given that this often involves ambitious goals such as ending GHG emissions and improving social equity. Both the public and decision-makers need to know exactly how a jurisdiction is doing in these regards. Arfvidsson et al. (2017), analyzing the data environments of Cape Town and Kisumu under SDG 11, found that city governments often lack baseline data on informal settlements, transport, and waste management, making it difficult to track SDG 11 progress. Similarly, Koch et al. (2019) identified data limitations, planning constraints, and coordination challenges across fifteen German cities, emphasizing the need for localized governance and transparent processes. Klopp

and Petretta (2017) pointed to the lack of standardized, open, and comparable data, along with insufficient support for inclusive local monitoring of SDGs. Other barriers include weak institutional capacity, poor coordination, and limited funding (Mohd Khalid et al., 2020), as well as ethical, technical, and privacy concerns tied to data-driven technologies (Bachmann et al., 2022).

OGD can significantly support sustainability planning in cities. According to Berrone et al. (2016), Davies & Perini (2016), and Jaakola et al. (2015), open data is associated with the efforts of governments to foster transparency, improve accountability, fight corruption, support environmental goals, and strengthen public service delivery. Additionally, de Castro Neto et al. (2017), Mutuku and Colaco (2012), and Ubaldi (2013) expanded that OGD potentially can promote better city governance and more effective management of existing infrastructure by enhancing transparency, analysis, and planning in decision-making, reinforcing citizen engagement and participation, fostering co-creation and collective intelligence, and supporting innovative, data-driven products and services. Ahlgren et al. (2016) emphasize that open access to data fosters unexpected ideas, theories, and innovations that contribute to sustainability. Similarly, Ojo et al. (2015) argue that OGD empowers cities to advance sustainability across economic, environmental, and social dimensions. Ruijer et al. (2020) add that the effective use of open data requires people-centered engagement and continuous dialogue to integrate public knowledge into sustainability planning.

2.3 The Challenges of Open Government Data

While open data offers many benefits, it also presents several challenges. According to Janssen et al. (2012), these barriers can be categorized across six areas: institutional structures, task complexity in handling data, use and participation in the open data process, legislative

constraints, information quality, and technical challenges. Kitchin (2013) outlined four critiques of open data, including that it lacks a sustainable financial model, promotes a politics of the benign and empowers the already empowered, lacks utility and usability, and facilitates the neoliberalization and marketization of public services. Later, Attard et al. (2015) identified five main challenges in OGD initiatives: technical, policy-related, financial, organizational, and cultural. This study integrated three key challenges associated with OGD initiatives from the literature, including (1) institutional and technical barriers, (2) limited awareness of potential benefits, and (3) concerns about the quality and trustworthiness of information.

First, Janssen et al. (2012) pointed out that simply publishing large volumes of data does not guarantee institutional transparency or accountability without proper use and engagement. Users seek “answers to their questions, services, and other added values that can be created from open data,” which the authors classify as political and social, economic, and operational and technical benefits, including greater citizen participation, innovation, improved administrative efficiency, and more informed public policymaking (Janssen et al., 2012, p. 265). According to Zurada and Karwowski (2011) and Zuiderwijk and Janssen et al. (2013), a high volume of data can hinder analysis and make it more difficult to draw meaningful conclusions. Additionally, data are often published on portals in a non-standardized manner, leading to significant variation in semantics (how meaning is constructed, conveyed, and understood), standards, and overall schema. Technically, if appropriately designed, the search functions of OGD portals can improve discoverability and help users locate relevant information and datasets. However, these functions can also obscure certain datasets when data providers are reluctant to share them. Helbig et al. (2012, p.9) reported that many open data platforms are too technically focused, amounting to “little more than websites linked to miscellaneous data files, with no attention to the usability,

quality of the content, or consequences of its use.” Janssen et al. (2012) argued that the result is a set of open data sites that operate more as data holdings or dumps, lacking the qualities expected in a well-organized and maintained data infrastructure. For example, Bates (2012) argues that in the United Kingdom, the open data movement gained limited political attention until large corporations actively promoted it and began aligning with austerity policies and the shift toward market-driven public service delivery.

Second, according to Gurstein (2011), the lack of awareness of OGD’s benefits, low data literacy, technical barriers, and insufficient incentives can prevent effective use by those who need it most. O’Connor (2015) highlighted that, even when some groups use OGD for limited purposes, frequent users of OGD portals tend to be highly educated, civically engaged individuals with strong data analytics or programming skills. Therefore, as noted by Kitchin (2013), Gurstein (2011), and Harrison et al. (2012), OGD does not necessarily support equal public engagement or promote the common good equitably. Instead, it often reinforces existing power structures and privileges those with the skills and resources to extract value from data. Open data, in this context, does not inherently lead to democratization (Gurstein, 2011; Johnson, 2014). For example, in Karnataka, India, the digitization of land records—promoted as a “pro-poor” initiative—ultimately disenfranchised the poor and facilitated land and wealth transfers to the wealthy, who had the means to access and exploit the data (Slee, 2012, p.1).

Third, policymakers prefer making data openly available without showing what is done with that data. According to Janssen et al. (2012, p. 261), “[O]nly data that is relatively safe is publicized and dropped in the large pile,” and “some of [the data holders] even hope that the data will not be discovered in this pile.” On top of that, Dawes and Helbig (2010) argued that cities tend to delay opening their data to avoid criticism for its poor usability, weak application

of stewardship principles, lack of data feedback and improvement mechanisms, and inadequate metadata. As a result, Helbig et al. (2012) concluded that many local OGD portals have low and declining traffic because they do not encourage the use or facilitate users and are limited by data management practices, agency efforts, and internal politics. Mutuku and Colaco (2012) emphasized the need for review and editing of open data to ensure balance, quality, usability, and impact. McDermott (2010) and Darbshire (2010) also highlight the lack of oversight mechanisms to ensure that data are proactively disclosed and regularly reviewed for accuracy, relevance, and completeness. For example, Peled (2011) found that just five of 169 participating agencies accounted for 99.37% of all published datasets, while 30% of agencies had not uploaded any data for over a year. As Kitchin (2013) notes, open data projects should receive greater critical attention as complex socio-technical systems shaped by diverse stakeholders and competing agendas. Yet, many governments still lack clear frameworks and procedures for evaluating OGD implementation. For instance, the U.S. Open Government Directive did not include mechanisms to assess agency OGD plans or their outcomes. Huijboom and van den Broek (2011), in their analysis of OGD initiatives in Australia, Denmark, Spain, Great Britain, and the United States, found that only the latter two countries had evaluated their open data policies, and none had assessed the broader economic or social impacts. Summarized in the literature, the benefits and criticisms of the local OGD initiatives are illustrated in Figure 3.1

Figure 3.1

Benefits and Criticism of the Local OGD Initiatives

Benefits from the local OGD initiatives	Criticism of the local OGD initiatives
Stimulate economic growth	A large amount of data of little interest to users
Combat corruption	Nontransparent decisions on data disclosure.
Empowering citizens to participate in decision-making	Data is never neutral technologically, politically, or socio-culturally

Enhance governance, transparency & accountability	Information quality often is not trusted
Encourage innovation and new products	Little awareness of potential use and benefits from OGD

2.4 Measurement of OGD Quality, User-Friendliness, and Relevance

There is no single, universally accepted framework for evaluating the quality and effectiveness of the OGD. However, several previous studies attempted to develop specific criteria and categories to describe, compare, and rank OGD initiatives. Those studies are provided in Appendix A.3 Depending on the purpose of the studies, the authors attempted to assess OGD within the following characteristics: data quality, including accuracy, completeness, currentness, granularity, and the number of datasets. Data trustworthiness, including traceability, data collection policies and methods, sources, and descriptions of datasets. Data accessibility, including searchability, available formats, visualization, machine processability, data use restrictions, and others.

Lourenço (2013) analyzed seven international OGD portals from the perspective of their transparency and impact on accountability. They found that the portals under review, while currently functioning as “simple data repositories”, have the potential to evolve their functionality and organizational structure to support community engagement for better accountability.

Zhu & Freeman (2019) explored the OGD portals of 34 U.S. municipal government agencies, focusing on users’ potential interactions and experiences with the data. They found that, although the portals generally performed well in providing access to governmental data, they did not help users understand and engage with data.

Thorsby et al. (2017) developed an index-based scale to describe OGDs of 37 U.S. cities. The authors found that the city’s population size and its association with regional consortia

significantly explained the variation in the indices. However, they also concluded that the portals were still in a very early stage of development and needed to enhance user help and analysis features, such as data visualization, to improve data understanding.

Vetrò et al. (2016) proposed a set of indicators to measure the quality of open data in two Italian Open Data portals, using a cell of the dataset as the unit of measurement. The authors found that the centralized OGD released at the national level, with strong quality controls, resulted in better understandable, more accurate, traceable, and current data than the OGD from the municipal decentralized portal, which had less stringent quality controls. On the other hand, the decentralized OGD of the municipal portal had a greater extent of completeness.

In 2017, Bloomberg Philanthropies launched the What Works Cities Certification program to promote well-managed data practices and support data-driven decision-making for safer, healthier, stronger, and more sustainable cities. As they stated, the purpose of the certification program was “to make every dollar count, budget equitably and effectively, and better engage their communities” (What Works Cities, n.d.-a, para. 2). The local governments’ widespread recognition of this initiative is a testament to its potential; since its inception, the program has certified 250 cities with a population of over 30,000 in North, Central, and South America. The What Works Cities Certification program outlined eight foundational good practices along with the corresponding criteria for data-driven, well-managed city governance. One of those foundational practices is open data, promoting informed decision-making, transparency, and robust resident engagement with four elements of sustainable open data systems: (1) open data policy, (2) open data portal, (3) user guidance for open data, and (4) a mechanism for users’ feedback about open and shared data (Results for America, n.d.). These four elements are considered below in order.

An open data policy means the local government has a publicly available, codified policy committed to transparency and the proactive public disclosure of its data and data practices. For example, Baton Rouge, Louisiana, published a detailed, well-organized, 20-page-long Open Data Policy Administrative Handbook. The handbook describes the roles and duties of the officials from the mayor-president to the data coordinator in each department, the complete metadata, and the data protection, prioritization, quality assessment, and management processes. Before being approved, the city submitted the policy draft for public feedback and conducted user interviews to refine it. Additionally, the annual open data report assesses progress toward achieving the city's goals, identifies further priorities, and establishes a publication timeline for the following year (City of Baton Rouge, n.d.).

An open data portal refers to a central, publicly accessible online location for publishing open data by the local government, along with supporting analytic services. The OGD portal, located in Tempe, Arizona, has achieved national platinum status, a testament to its robust data and experience in promoting efficient and transparent service delivery. For example, in 2023, Tempe accomplished several goals through public participation in the city's OGD portal by providing shelter services to 66% of the population in need and removing 52 tons of debris and over 3,200 tons of vegetation (What Works Cities, n.d.-b). Arlington, Texas, has incorporated the "Your City at Work" performance dashboard to empower residents by providing real-time information on 87 measures for the city's programs and services (What Works Cities Certification, 2023).

OGD portals serve as centralized platforms that enhance transparency, accessibility, and public engagement by providing diverse datasets and interactive tools. OGD holds significant potential to advance progress toward SDG 11 by improving data availability and supporting the

use of urban sustainability indicators. Despite challenges in ensuring data quality, usability, and contextual relevance, the potential of OGD to drive positive change is promising. In the absence of a standardized evaluation framework, user-centered design and governance practices remain crucial for maximizing the OGD's impact.

User guidance should provide both internal and external users with clear instructions on how to access, analyze, engage with, and utilize the city's open and shared data. For instance, the Data User Guide by Pittsburgh provides detailed metadata for each dataset and describes why the data was collected, the business processes, how to use it, applicable standards and software, suggested applications for the data, and other details helpful for data users (Western Pennsylvania Regional Data Center, n.d.).

Users' insights about OGD help local governments track and document feedback from internal and external users, incorporating user needs into the design and implementation of OGD, analytics services, and transparency practices. For example, the GovEx Center for Government Excellence at Johns Hopkins University has developed a community engagement playbook that helps cities engage residents and community groups in data efforts. The playbook describes the tools, case studies, and good practices to inspire meaningful engagement with diverse stakeholders (The Center for Government Excellence, n.d.).

While previous studies have examined various aspects of OGD and the role of data in supporting sustainable development, this review of the literature reveals several important limitations that underscore the need for this study. First, although high-quality data are essential for achieving the SDGs and supporting sustainable urban development, the connections between OGD and policies, cities' strategic plans, and the 2030 Agenda and SDG 11 remain underexplored. Second, although several studies have identified characteristics of successful

OGD initiatives, they have generally not situated their analysis within the broader context of the 2030 Agenda or SDG 11. To my knowledge, no existing studies have systematically examined OGD as a tool to support the implementation of SDG 11. Third, with the exception of a few case studies on local data use, there is limited research on how OGD initiatives can directly contribute to or enhance the implementation of SDG 11 at the city level.

These gaps highlight the lack of empirical, comparative research that connects OGD efforts to sustainability goals, particularly within a structured global framework like SDG 11. To address this, the study offers new insights by utilizing recent empirical data from 19 U.S. cities; examining evaluations of OGD portals, OGD policies, current strategic plans within the SDG 11 framework, and OGD between cities ranked high and low in sustainability. From a practical perspective, this study provides evidence to support data-driven decision-making for the development of local OGD initiatives, with relevance to cities in the U.S. and globally. The findings will be valuable for city officials involved in strategic planning, sustainability programs, and open data development, as well as other stakeholders seeking to create more equitable, prosperous, and environmentally resilient urban environments.

3. Materials and Methods

3.1 Sample and Data Sources

Since the objective was in large part to understand the implications of OGD for sustainability planning and to compare OGD systems in cities doing better or worse on this goal, I examine the 19 U.S. cities ranked in the Arcadis SCI 2024 report (Appendix B.3). This report assessed 100 cities worldwide based on 67 indicators of social, environmental, and economic dimensions of sustainable development (“pillars” according to Arcadis’ language).

While numerous other sustainability rankings exist with varying outcomes, I chose SCI 2024 for several reasons. It is an independent, up-to-date international assessment containing

many of the world's most sustainable cities. It highlights a set of relatively high-performing U.S. cities (though by no means all; Portland, Austin, and Minneapolis, for example, are not represented). SCI 2024 is widely recognized, with other ranking systems referencing its data. In recent iterations of the ranking, Arcadis has implemented a fourth pillar of “progress” to measure changes over time across the three other pillars of sustainable development.

Among the 19 U.S. cities sampled for the 2024 SCI, global sustainability rankings ranged from 35 to 78 (see Appendix C.3). For this group of cities, I examined five main types of data: the OGD portals themselves; local OGD policies; municipal general plans; municipal sustainability and climate action plans; and interview data from OGD and planning experts. Appendix C.3 provides a detailed table listing all 19 cities and links to each city's OGD portal, general plan, sustainability or climate action plan, and OGD policy documents.

To examine whether OGD initiatives meet the intentions of OGD policies, I reviewed the relevant portals and policies. I obtained the policies from either the official OGD portals or the websites of their respective oversight agencies. I likewise obtained general plans from city websites. 18 out of 19 cities have general plans (also known as comprehensive or master plans). Pittsburgh was the only city without one. Most have their general plans downloadable as a single electronic document. On the other hand, San Francisco and Miami publish their general plans as a set of interconnected web pages by element. Finally, I obtained sustainability and climate action plans in the same way. All 19 cities have sustainability and/or climate plans online that emphasize diverse aspects of sustainability. For example, Dallas emphasizes the environmental dimension of sustainability planning in its Comprehensive Environmental and Climate Action Plan. In addition to climate initiatives, New York City addressed the categories of equity, economic growth, and resilience in its One NYC 2050: Getting Sustainability Done plan (The

New York City Mayor’s Office of Climate and Environmental Justice, 2023). Los Angeles focuses on “combating climate change” and “promoting equity and sustainability” in its Green New Deal plan (City of Los Angeles, 2019, p. 7). Washington, DC, has two plans: the Clean Energy DC Climate and Energy Action Plan and Sustainability DC.

The study used semi-structured interviews with city officials to examine experts’ perspectives on OGD, refine the findings on the relationship between OGD and urban planning, and identify potential strategies for improvements. The interviews included open-ended questions addressing organizational and functional aspects of OGD and planning. To recruit participants, I sent invitation letters along with a questionnaire to the official email addresses of OGD and planning offices in the 19 cities. Ten officials from seven cities agreed to participate. The respondents included OGD managers and coordinators responsible for developing policies and strategies, an OGD coordinator, a planning expert involved in disclosing and publishing OGD, an expert promoting OGD initiatives, and an IT expert providing technical support. This diverse group of participants ensured a variety of perspectives on the topic. Due to confidentiality requirements, I have not disclosed the names and positions of interviewees.

3.2 Data Collection and Analysis

The analysis of cities’ OGD began by reviewing the nature of current OGD portals in 19 U.S. cities to provide an evaluation of these portals. I examined how local OGD portals differ across cities in their evaluation based on four criteria and how these variations may influence sustainable urban development. Specifically, I examine how OGD portals vary across cities in terms of (i) breadth of portal content, (ii) structure of governance, (iii) user-friendly support, and (iv) equitable user access, and how these differences impact SDG 11 (see Table 3.1). Particularly, the study sought to determine the extent to which cities intend to make information

accessible to users, engage communities, and be relevant to sustainability.

Table 3.1

The Four Criteria of the OGD Portals

#	Criteria	Measurement of Criteria
1.	Breadth of Portal Content	
1.1	Data Categories	Extent of data grouped into organized categories
1.2	Data File Formats	Availability of accessible file formats (CSV, JSON)
1.3	OGD Implementation Approaches	Variety of applications and their intended purposes
1.4	Range of Datasets	Scope of datasets available on the portal
2.	Structure of Governance	
2.1	Chief Officer	Identification of a primary contact or data officer
2.2	Mayor's Office Involvement	Degree of involvement from the mayor's office
2.3	OGD Team	Defined roles of the OGD team
2.4	Committee or Advisory Board	Role of committees or advisory groups in OGD governance
3.	User-Friendly Support	
4.1	Data Inventory	Searchable list of available datasets
4.2	User's Guide	Materials to help users navigate and understand the data
4.3	Educational Resources	Access to training sessions or courses to use the data
3.	Equitable User Access	
3.1	Data Request Tool	Availability of tools for users to request missing datasets
3.2	Share your Works	Options for users to share work created using OGD
3.3	Support Center	Presence of user support or help centers
3.4	Participation in Data Research	Opportunities for public involvement in data research
3.5	Blog/ Social Media	Public platforms to share and promote data engagement
3.6	Open Data Week	Hosting events for community engagement
3.7	Feedback Mechanisms	Mechanisms for users to provide feedback or suggestions

The breadth of portal content refers to the organization of OGD into categories and file formats and emphasizes the variety of datasets and data types available through the portal. The governance and oversight structure refers to the organization responsible for managing OGD, which may include a Chief Data Officer, the Mayor's Office, a dedicated OGD team, or a committee. User-friendly support, which includes guidelines, materials, and tools that facilitate an understanding of OGD. Equitable user access and participation focus on promoting active participation in utilizing OGD, including data requests, support centers, blogs, and more.

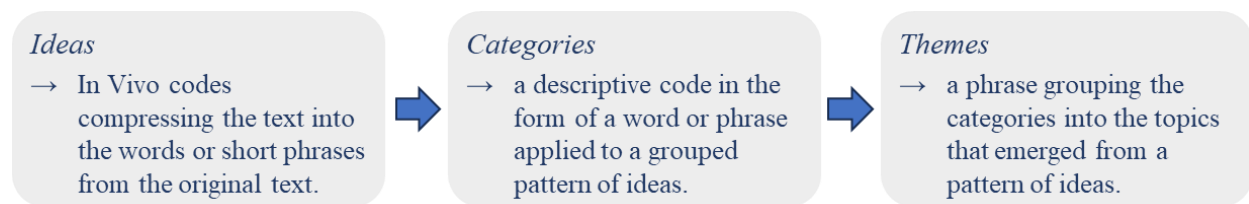
According to the SCI 2024 report, the top half of cities refers to the nine highest-ranked U.S. cities, while the bottom half refers to the nine lowest-ranked. The sample included all 19

U.S. cities evaluated in the SCI 2024, representing the complete U.S. subset of the 100 cities included in the global ranking. The 19 U.S. cities included in this study were ranked between 35 and 78, placing them approximately in the second and third quartiles of the SCI 2024 index. The median rank among the sample was 66, represented by Phoenix (Arcadis, 2024). To analyze the data, I divided the sample into two groups: high-ranked sustainable cities (ranks 35–65) and low-ranked sustainable cities (ranks 67–78). It is important to note that due to the small sample size, further research is needed to validate these findings. Only descriptive statistical analysis was used to assess differences between the two groups.

In the analysis of cities' OGD policies, I began by examining expected goals or purposes. I used a three-cycle coding process to identify themes (see Figure 3.2).

Figure 3.2

Coding Procedures



The study categorized the main intentions of cities' OGD policies into eight categories, indicating the purposes of these initiatives (see Figure 3.8). An analysis of topic frequencies identified three main themes: (a) enhanced government operations, (b) community benefits, and (c) public participation. To gain a comparative perspective, the study interviewed experts to find their expectations of OGD initiatives in OGD policies. Finally, the study analyzed the outputs of how OGD initiatives met the intentions of OGD policies.

To examine whether general plans, sustainability plans, and climate action plans use OGD initiatives as planning tools, I conducted a content analysis of these documents for each of

the 19 cities. Specifically, I searched for the terms “open data,” “open government data,” and “OGD” and recorded the frequency and context of each occurrence. This analysis was used to assess whether planning documents explicitly reference OGD and how they describe its role in supporting planning, decision-making, and policy implementation. The results help answer the research question of whether OGD initiatives are integrated into municipal planning processes.

Finally, I compared high-ranked (San Francisco, New York City, Los Angeles, Boston, and Chicago) and low-ranked (Pittsburgh, Baltimore, Tampa, Miami, and New Orleans) U.S. cities within the SCI 2024 framework to examine how characteristics of OGD policies correlate with success in sustainability planning. I applied the root search term “sustain” to assess how frequently sustainability is mentioned within planning documents from those cities.

To identify potential strategies for better linking OGD with planning and sustainability, I analyzed interview material in light of the other data and the literature, proposing strategies to enhance OGD integration into sustainability planning processes.

4. Findings and Discussion

4.1 The Nature and Evolution of OGD Portals

A qualitative review of 19 U.S. city open data portals reveals significant variation in how cities design and structure their platforms. All portals function as searchable catalogs, enabling users to browse datasets by categories such as transportation, housing, public safety, or city finance. However, the consistency and usability of these platforms differ greatly—some offer well-maintained, regularly updated datasets with user-friendly visualizations, while others lack clear metadata, timely updates, or intuitive interfaces. Most cities, such as Seattle, Dallas, and Chicago, offer curated landing pages with dashboards, featured datasets, and thematic groupings that highlight the most relevant, most viewed, or recently added data. These portals also include

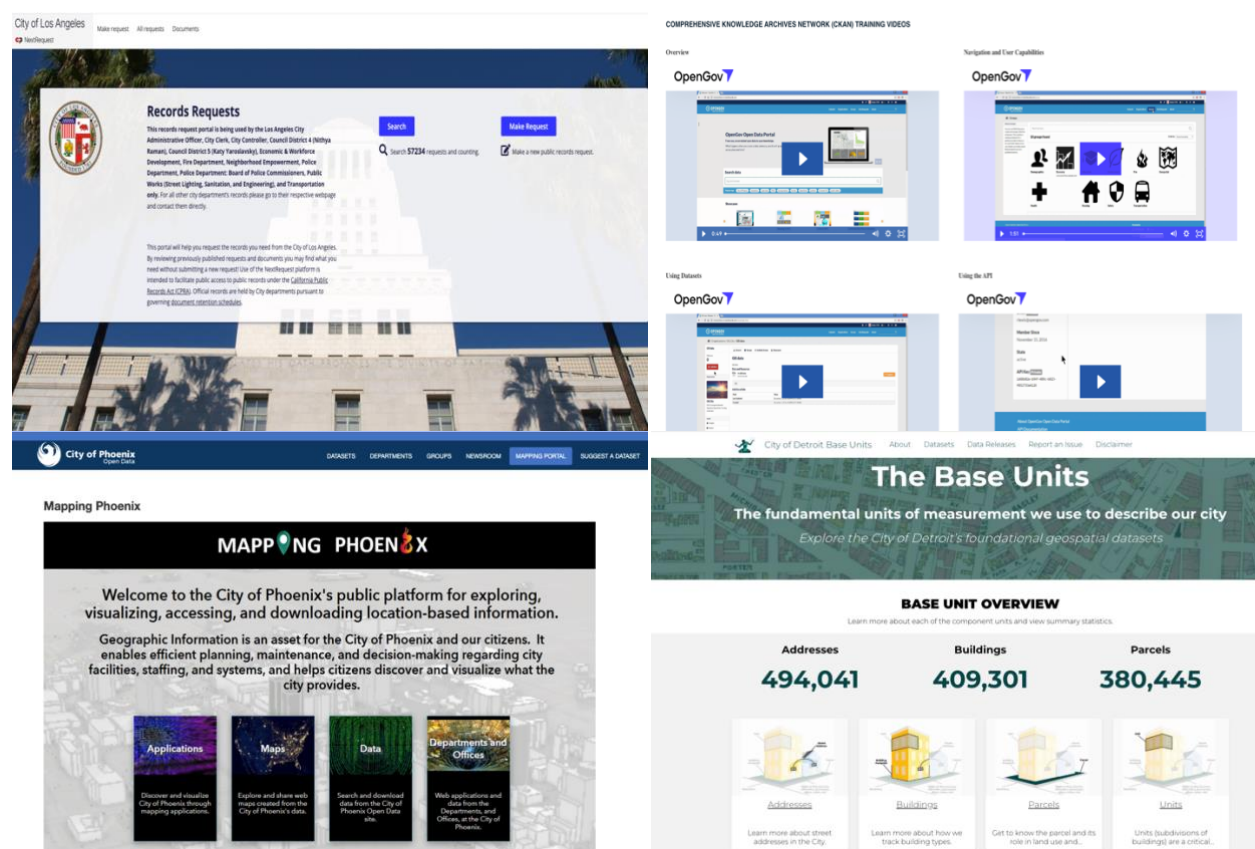
user-friendly tools such as search bars, category filters, and introductory text to guide users.

High-performing examples, New York, San Francisco, and Washington, D.C., go further by incorporating project galleries, case studies, glossaries, event announcements, support features (e.g., Q&A, appointment scheduling), performance metrics, documentations of planning and policy, and comprehensive data inventories. In contrast, Tampa and Miami present more basic designs, offering minimal context or interactive features, primarily listing data by departments.

Several cities also offer unique or specialized features that extend the functionality of their portals (see Figure 3.3).

Figure 3.3

Examples of Specialized Features of OGD Portals in Los Angeles, Boston, Phoenix, and Detroit



For example, Los Angeles includes a data Records request tool with over 57,000 searchable entries. Boston’s portal features a Tips section that includes Comprehensive knowledge archives of training videos. The City of Phoenix offers a dedicated Mapping Portal that provides access to applications, interactive maps, and spatial data. Detroit’s updated open data portal features Base Units datasets organized by addresses, buildings, and parcels. For example, Houston’s Open Finance section includes data on budgets, payroll, checkbook-level transactions, and financial reports, allowing users to monitor city expenditures. Such features demonstrate that some OGD portals are evolving into practical tools to support urban planning and sustainability. By improving accessibility, contextual clarity, and user engagement, portals can better support local efforts to achieve SDGs.

According to the Sunlight Foundation, a nonpartisan nonprofit organization founded in 2006 to promote transparency in government, by 2018, more than 100 U.S. cities, counties, and states had launched open data portals and adopted related policies (Sunlight Foundation, n.d.). Many of these efforts were shaped by federal initiatives under the Obama Administration that required public access to “high-value” datasets (Stone, 2018). In 2010, these early programs were supported by a \$34 million federal budget and philanthropic contributions. However, federal support decreased substantially starting in 2011, with the Electronic Government Fund reduced by approximately 75%, from \$34 million to \$8 million (Jackel, 2011). This shift placed the financial responsibility on local governments and contributed to a decline in academic attention as fewer new initiatives emerged.

Larger and wealthier cities, such as Los Angeles and New York, have institutionalized open data by integrating it into municipal budgets, hiring dedicated staff, and forming vendor partnerships. For example, New York City used the Socrata platform to manage its open data

portal, with an annual cost nearing \$400,000 (New York City Council Committee on Technology, 2024). These cities transitioned from federal grants to stable local funding, using open data to advance goals related to equity, environmental sustainability, and digital service delivery. In contrast, financially constrained cities like Detroit and Baltimore launched their portals with initial federal or foundation support in 2010. Although their OGD portals remain active, limited funding has stalled upgrades and long-term sustainability. These cities often depend on nonprofit partners or overstretched municipal departments to keep their portals operational (Stone, 2018).

Despite the growing number of municipal open data portals, many of the OGD portals examined in this study fall short in providing accessible, policy-relevant sustainability indicators. Key measures, such as GHG emissions, vehicle miles traveled (VMT) per capita, mode share, housing affordability, recycling rates, and pollution trends, are often difficult to locate or entirely absent. These types of indicators are central to SDGs, particularly SDG 11, and should ideally be prominently featured in local open data platforms. Their availability would not only enhance transparency but also offer a meaningful benchmark for evaluating municipal progress toward stated sustainability objectives. However, making such data publicly accessible poses political challenges, as it could expose policy shortfalls and hold local leaders more directly accountable. Still, institutionalizing access to these indicators remains a critical objective for urban planning and open government reform.

4.2 Evaluation of OGD Portals Based on Four Criteria

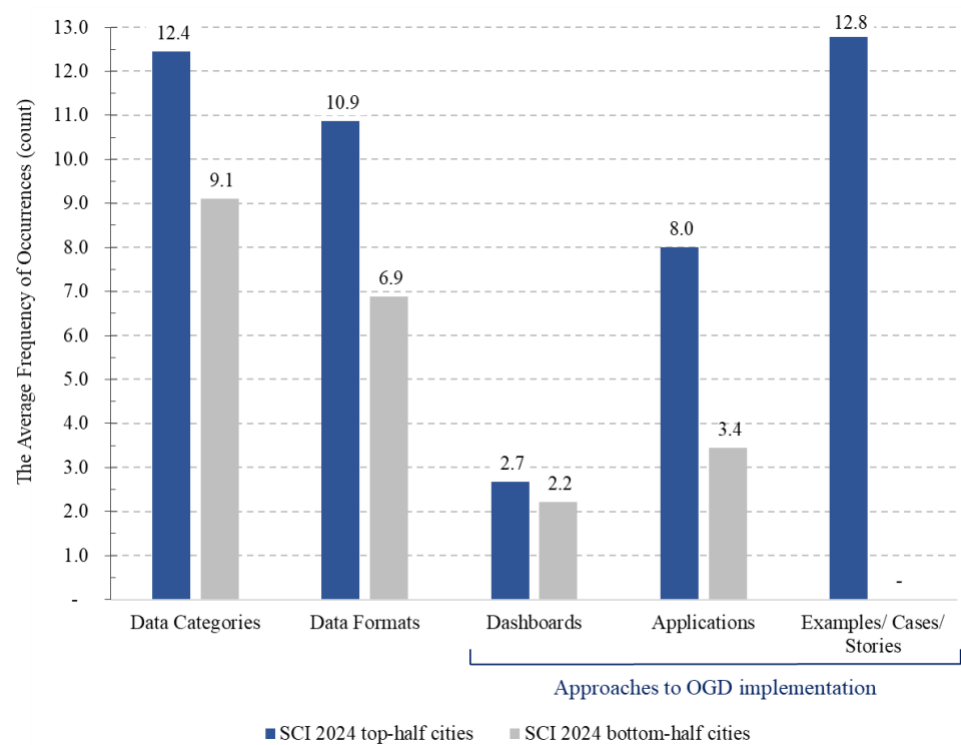
OGD portals address progress toward SDG 11 among 19 U.S. cities differently. To support this analysis, this study evaluated OGD portals of 19 U.S. cities according to four criteria: (i) breadth of portal content, (ii) the structure of governance, (iii) user-friendly support,

and (iv) equitable user access. I explored what differentiates the nine high-ranked sustainable cities from the nine low-ranked sustainable ones, with Phoenix positioned on the boundary between these two groups, and how these contrasts influence SDG 11.

i) Breadth of portal content includes data categories, data file formats, approaches to implementing OGD, and a range of datasets in the portals of 19 U.S. cities (see Figure 3.4).

Figure 3.4

Breadth of OGD Portals Content of High and Low-Ranked Sustainable Cities



The data categories ranged from three in Tampa to 21 categories of OGD in Washington, DC. Comparing the top-ranking cities, which averaged 12 categories, and the low-ranking sustainable cities, which averaged 9, revealed a difference in category breadth. On average, cities offered 11 data categories aligned with SDG 11 topics, including environment, city government, health, food, recreation, safety, housing, culture and education, climate change, economy, and transportation.

The study reveals that a variety of data formats, from a single CSV in Tampa to 18 in Boston, significantly enhance functionality. The high-ranked sustainable cities offered an average of 10.9 formats, compared to 6.9 in the low-ranked cities (see Figure 3.4). This diversity is not just a statistic, but a practical advantage that supports diverse user needs and enhances the usability of the data.

The breadth of OGD implementation refers to dashboards, applications, and case studies that demonstrate the use of open data. Across the 19 U.S. cities, I identified 279 examples of OGD implementation, including 53 visual dashboards (19.0% of all identified examples), 104 applications addressing city challenges (37.3%), and 122 case studies or projects (43.7%). The high-ranked and low-ranked sustainable cities showed notable differences in these elements, averaging 2.7 versus 2.2 dashboards, 8.0 versus 3.4 applications, and 12.8 versus 0 case studies or projects per city, respectively (see Figure 3.4). These findings suggest that the availability of visual tools, diverse applications, and case studies varies substantially across cities, influencing the capacity of OGD portals to support sustainable urban development.

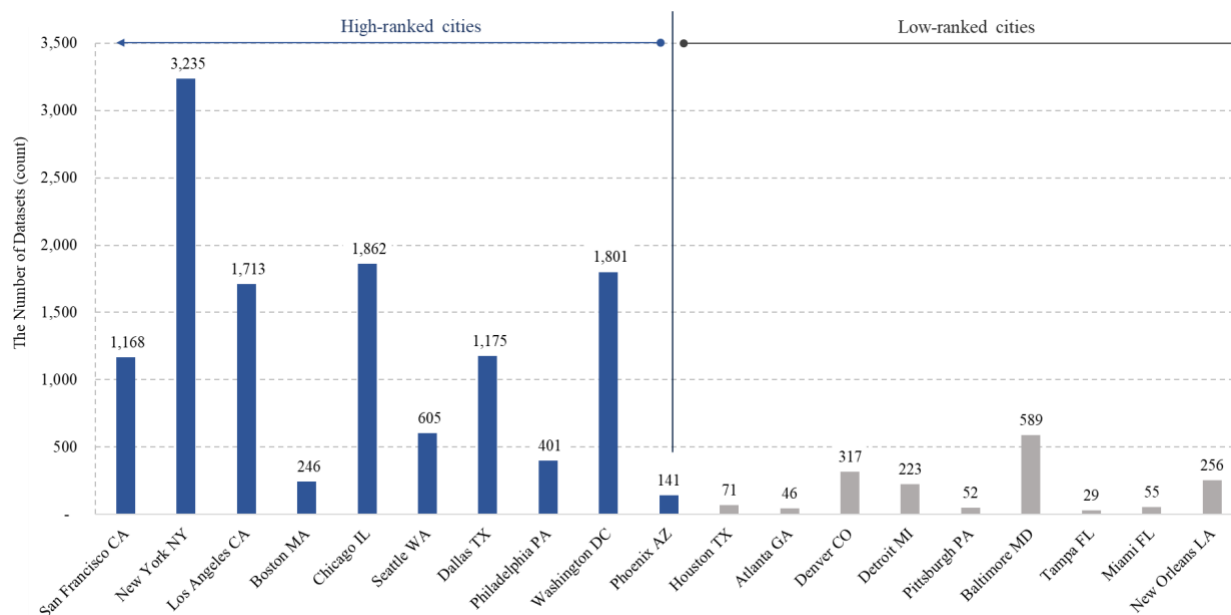
Not all cities develop dashboards, applications, or case studies on the use of OGD. Of the 19 cities analyzed, only seven have dashboards, ranging from 17 in Washington, DC, to two in New Orleans. Ten cities provide applications, from 64 in Washington, DC, to one in Houston. Notably, it's the seven top-ranking sustainable cities that stand out, offering case studies that demonstrate the practical application of OGD, showcasing the potential benefits of OGD utilization. City dashboards vary in purpose, content, and usability. For example, in Washington, D.C., there are several dashboards, such as the 911 Performance Dashboard, which displays responder data but uses unclear abbreviations that can confuse users. The Planting by Ward dashboard supports greening initiatives; however, it only lists tree counts and work orders

without including timeframes or tree species. Also, the Economic Intelligence Dashboard highlights key indicators, but many of these indicators are outdated. Seattle’s City Demographics Dashboard consists of the Race and Social Equity Index, which consolidates demographic, socioeconomic, and health indicators into a single score. In contrast, the City Contract Search Dashboard requires users to apply specific filters, which can make it less user-friendly.

The range of datasets is uneven and shapes the capacity of OGD portals (see Figure 3.5). Notable differences in dataset availability and portal capabilities exist between high-ranked and low-ranked sustainable cities. Large cities like New York (139) and Chicago (37), as well as other large cities such as San Francisco (65) and Washington, DC (63), have a high number of datasets. It is crucial to address the disparity in dataset availability and ensure equal access to OGD.

Figure 3.5

Number of Datasets on the OGD Portals, Grouped by Sustainable City Ranking



Implementation of OGD that emphasizes timeliness, ease of use, user needs, and public participation better serves community needs. For instance, the Detroit transportation application

provides real-time access to schedules, delays, and arrival times for all routes and bus stops. The Detroit Neighborhood Improvement Tracker enables users to search for demolition activity data by address easily. Additionally, New York City has 25 case studies of civic-led initiatives aimed at addressing everyday issues, such as NYC Restaurant Violations, Crash Mapper, and the Open Sewer Atlas. The city collaborates with companies, NGOs, and academic institutions to enhance public participation. Noteworthy examples include the Participatory Budgeting initiative, which enables residents to vote on projects in 60% of districts, and a school data project that tracks incidents of bullying and harassment.

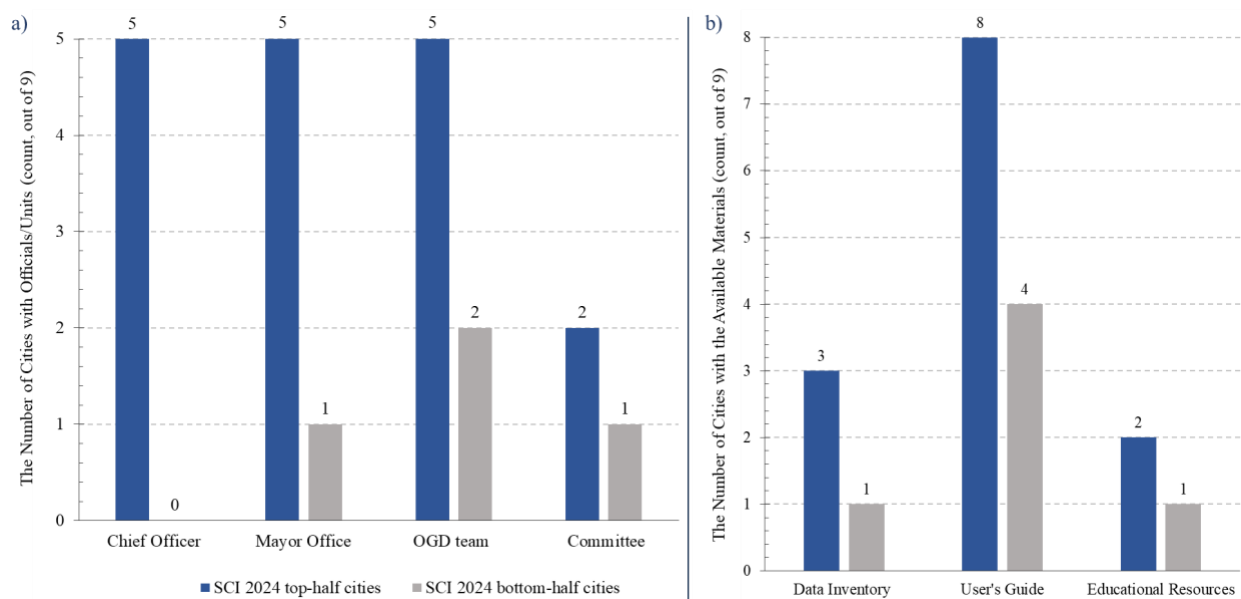
Overall, the breadth of portal content encompasses a wide range of sustainability topics, featuring interactive maps, charts, and filters that provide users with access to multiple aspects of urban life. While cities maintain relatively up-to-date dashboards and applications, a focus on the number of visual tools does not necessarily reflect their effectiveness. Updates alone in applications do not guarantee user engagement. Some dashboards cover various topics, include multiple departments, and use abbreviations that may confuse or overwhelm users. Others offer only aggregated or limited data, often lacking clear explanations. Ultimately, the most effective tools prioritize timely updates, ease of use, users' needs, and importantly, community involvement, making everyone feel included and integral to the process of urban sustainability.

ii) The structure of governance and user-friendly support criteria illustrated in Figure 3.6. Specifically, key players of the OGD portals, such as the Chief Officers, the City Mayor, the OGD team, and the Committee, who are responsible for the proactive management of OGD (Figure 3.6a). As demonstrated in the analysis, only five of the high-ranked sustainable cities—New York, Boston, Seattle, Philadelphia, and Washington, cite a Chief Officer responsible for OGD initiatives. Similarly, five high-ranked sustainable cities (San Francisco, Los Angeles,

Boston, Seattle, and Dallas) mention the role of the mayor in their portals, a stark contrast to the single low-ranked sustainable city (Baltimore). Five highly ranked sustainable cities, such as San Francisco, New York, Boston, Seattle, and Philadelphia, underscore the importance of OGD teams, while only Atlanta and New Orleans do so among the lower-ranked cities. The formation of dedicated committees is a rare occurrence, with Philadelphia and Washington, DC, standing out as the only cities with active OGD committees, and Detroit being the sole low-ranked sustainable city with an advisory committee.

Figure 3.6

Governance Structure and User-Friendly Support Criteria



Cities manage OGD systems in varied ways, all of which are part of a greater, cooperative effort. In New York, the Office of Technology and Innovation collaborates with city agencies to release datasets, manage the platform, and promote data use under the Chief Technology Officer. Philadelphia promotes transparency by listing OGD team members and their roles, including experts in geospatial tools and technology-related initiatives that address civic and environmental needs. Boston links its portal to the Mayor, Analytics Team, and

Department of Innovation and Technology to enhance services through data. Seattle provides information on elected officials who back OGD efforts. Washington, DC, and Detroit involve advisory groups, comprising public representatives and external stakeholders, to guide transparency and ensure high-quality, accessible data. Incorporating diverse voices into OGD governance strengthens accountability and supports more sustainable outcomes citywide.

iii) User-friendly support includes data inventory, user guides, and educational resources (see Figure 3.6b). Creating a dataset inventory is a crucial OGD requirement for tracking citywide data systems and identifying valuable datasets. San Francisco offers an inventory with 1,183 rows (23 columns), making it the most viewed (16.7K) and downloaded (56.1K) dataset on its portal. New York provides an interactive inventory dashboard with filters by agency, update time, and more. Washington, DC, organizes its inventory by data sensitivity and includes searchable, interactive features. Among low-ranked sustainable cities, only New Orleans has a prominently placed inventory with similar search options. Overall, only four cities treat dataset inventories as strategic assets, as well as user guides (see Figure 3.6b).

Comprehensive user guides enhance both data discoverability and informed engagement. All high-ranked sustainable cities—except Philadelphia—offer various guide options. San Francisco provides resources like “Be in the know,” “Explore city data,” and a “Documentation” section with guides on data standards, visualization, and dataset explainers. New York includes a ‘Getting Started’ section with step-by-step tutorials, while Boston offers training videos on navigation and dataset use. In contrast, five low-ranked sustainable cities, such as Houston, Atlanta, Pittsburgh, Tampa, and Miami, lack such resources.

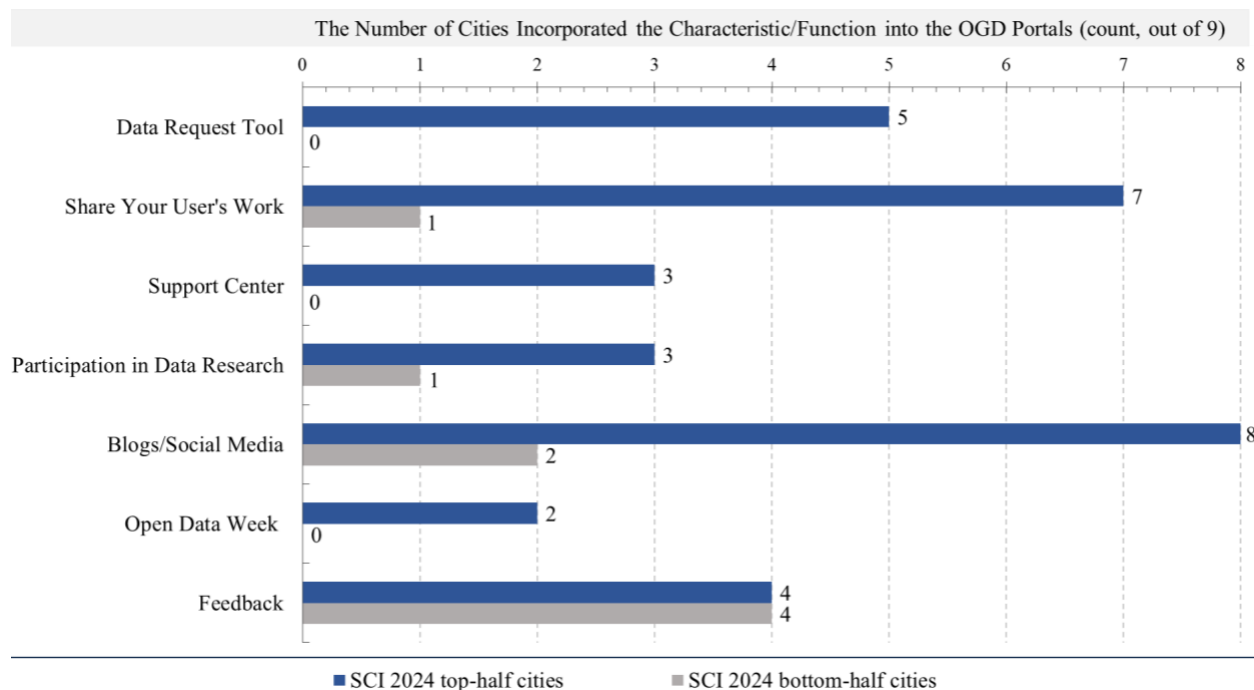
Another key difference in sustainable city portals is the availability of educational resources to build users’ skills. San Francisco, New York, and Baltimore offer OGD-related

classes. New York outlines class details, including content on OGD history, dataset use, filtering, visualization, and tools for advanced users. San Francisco’s Data Academy provides a course catalog, calendar, and instructor open to all users. Baltimore offers data literacy training with no prerequisites and includes credit for city employees, covering topics such as coding, Python, and software development.

iv) Equitable user access and participation criteria include the data request tool, sharing users’ work, the support center, involvement in data research, blog/social media engagement, Open Data Week activities, and feedback (see Figure 3.7).

Figure 3.7

Equitable User Access and Participation



Five of the high-ranked sustainable cities provide data request tools to support users who encounter challenges. For instance, San Francisco offers a public records request link, a support team email for assistance, and the option to book office hours with DataSF for personalized help. Impressively, Los Angeles allows users to submit records requests and access over 56,000

previously requested records. Dallas hosts an Open Records Center where users can request specific datasets and track the status of their requests.

Seven of the high-ranked sustainable cities—San Francisco, New York, Boston, Seattle, Washington, Philadelphia, and Los Angeles—allow users to showcase OGD-based apps or projects on their portals. For example, Los Angeles provides a Google Form for users to suggest datasets they would like to add. Only three of the highest-ranked sustainable cities—San Francisco, New York, and Boston—offer support centers for OGD-related inquiries, whereas no lower-ranked sustainable cities provide such services. Furthermore, three high-ranked sustainable cities and one low-ranked city host research initiatives or competitions to enhance user engagement. For instance, Detroit organizes city visualization contests and art galleries through its portal, showcasing the work of GIS professionals, students, and enthusiasts.

Most high-ranked sustainable cities utilize platforms like Medium blogs and GitHub to promote OGD, although follow-through is often limited. For example, San Francisco and Los Angeles aim to empower data use but have only a few dozen followers and outdated posts. Baltimore’s blog includes four documents from 2022. Seattle’s GitHub, intended to make city-generated data publicly accessible, has zero posts and hasn’t been updated since 2018. While cities express good intentions to engage users, these efforts often fall short due to a lack of sustained activity.

Open Data Week is a vital initiative that promotes public engagement and transparency. Washington, DC, and New York host Open Data Week events, including talks, exhibitions, workshops, and conferences focused on civic innovation. These activities enhance transparency, informed decision-making, and inclusive participation, thereby supporting sustainable development.

Feedback is an underused tool for user engagement. Only four of the high and low-ranked sustainable cities offer feedback options, which vary in visibility and format. For instance, Chicago provides an email link, San Francisco asks users to rate the helpfulness of the page, Boston uses a Google Form, and Detroit offers a detailed user survey. Many cities fail to incorporate feedback, a crucial aspect of meaningful community engagement essential for sustainable urban development.

OGD portals across 19 U.S. cities vary widely in content, governance structure, user support, and equitable access—differences that directly influence progress toward SDG 11. High-ranking sustainable cities tend to offer broader datasets, more robust user-support tools, and stronger commitments to equity, participation, and accountability. In contrast, lower-ranked cities often lag in data availability and user-centered features. These disparities affect how effectively cities leverage OGD to advance sustainable urban development.

An evaluation of 19 OGD portals identified key criteria to improve datasets and portal usability in support of SDG 11. One critical issue is the design of search functions, which often hinders data discoverability. Well-designed search tools can help users efficiently locate relevant datasets; however, poorly implemented features or a lack of incentives to improve backend systems can lead to important data being overlooked. For example, the Boston and Phoenix portals do not allow users to filter datasets by view type, limiting their ability to explore data efficiently. In another case, searching for the same keywords, such as “flood vulnerability,” in San Francisco and New York revealed that although both cities have relevant datasets, differences in how data is tagged and organized caused some datasets to be missed in search results.

Numerous scholars have highlighted the lack of monitoring for the proactive disclosure

of user-relevant data and the inadequate assessment of published datasets by official bodies. For instance, the Chicago Park District's Facilities Work Order Management system was intended to be updated weekly but has not been updated since 2012, illustrating the need for consistent and timely data maintenance. Some portals include datasets marked as outdated or historical, with no corresponding recent data available. Additionally, many datasets lack complete descriptions, often failing to explain column headers with unclear abbreviations and acronyms, which diminishes data accessibility and usability.

There are concerns about incomplete transparency in OGD. Agencies often release only summary data from completed programs and projects or insert isolated metrics into large datasets without context. They lack detailed information that would help users understand the specific insights of each program. Furthermore, they provide no breakdowns by neighborhood, demographic groups, recipients, or other meaningful classifications. For example, the City of Phoenix publishes data on the American Rescue Plan Act Funding from 2021 to 2024, but it lacks the granularity required to support SDG 11 indicators. Additionally, some datasets are duplicated across different years, prioritizing quantity over quality; for instance, Seattle publishes "Paid Parking Occupancy" as five separate datasets covering 2018 through 2022. To support better-informed decision-making, cities need to adopt a transparent, detailed, and user-oriented data format.

The breadth and effectiveness of OGD implementation depend on prioritizing timeliness, user needs, practical usability, and participatory approaches. To achieve this, city governments should engage diverse stakeholder groups to incorporate public perspectives into how data is organized and used to support sustainable urban development. Involving a broader range of voices ensures that open data addresses real community needs and fosters more inclusive,

transparent, and responsive city sustainability planning. To truly support sustainability and equity, cities must consistently prioritize empowering all community members. This involves offering transparent data to users alongside clear guidance and education for power users, equipping them with the skills needed to understand data, increase awareness, and effectively utilize relevant tools. Only through systematic and ongoing support can open data initiatives foster meaningful community participation and drive tangible progress toward SDG 11.

4.3 Relation to OGD Policies

Open data policies varied widely between these 19 cities. Four do not have OGD policies at all. Policies vary in depth across the remaining 15. Typically, these policies set forth the purpose, goals, and principles of local OGD initiatives, as well as the roles of city government agencies and committees involved in open data. They also outline the responsibilities of senior officials and units, specify the format of information, and indicate the frequency of publications. For example, New York City and San Francisco publish their OGD policies online and include additional detailed documents on their portals, such as the Open Data Policy, Data Standards Handbook, Data Visualization Guide, and Data Standards Guide-(City and County of San Francisco, n.d.). In contrast, other cities, like Dallas and Phoenix, have very brief policies. Dallas City's Open Data Policy, adopted in 2021, consists of only three sections: an overview, the purpose, and guidance on data publishing.

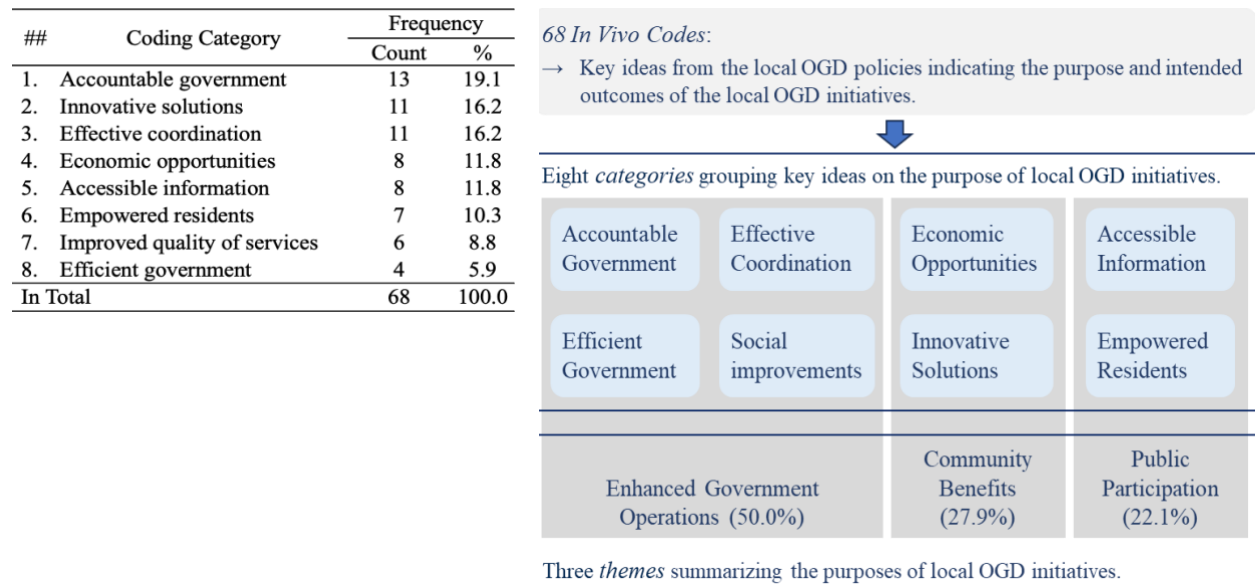
Only two (13.3%) out of 15 cities provided real-life cases of using OGD policies (Appendix D.3). Los Angeles OGD policy stated, "Open data and analysis have already been the hallmark of the successful application of COMPSTAT in the Los Angeles Police Department, spurring innovation and producing dramatic and tangible reductions in crime each year for the past decade," highlighting the role of community collaboration in driving these

outcomes (Garcetti, 2013). Similarly, New Orleans' OGD policy referenced an implemented initiative that made neighborhood blight data publicly accessible, enabling residents and community groups to analyze the data and collaborate with the city. This partnership strengthened the city's efforts with neighborhood groups and residents, advancing blight remediation and demonstrating the potential of open data to support community-driven solutions (City of New Orleans, 2016).

Three primary themes emerged from the In Vivo analysis of OGD policies: (a) enhanced government operations, (b) community benefits, and (c) public participation (Figure 3.8).

Figure 3.8

Categories and Themes about the Purposes of the Local OGD Initiatives



a) OGD policies most strongly emphasized enhanced government operations, including categories such as accountable governance, effective coordination, efficient government, and social improvement, specifically mentioning steps such as mobilizing a high-tech workforce, streamlining intra- and inter-governmental communication, data protection, accurate reporting, regular publications, and cost-efficiency analyses. Fourteen of 15 cities mentioned at

least one category of this theme in their OGD policies. In contrast, interview participants placed greater emphasis on public participation in city-level decision-making as the purpose of their OGD policy. They particularly mentioned the development of civic tools, the formation of public-private partnerships, and mechanisms for community feedback as key benefits.

b) Community benefits from utilizing the open data for innovative solutions and economic advancement were the second most popular theme among the purposes of OGD policies. Twelve out of 15 cities emphasized at least one category relevant to community benefits in their OGD policies. However, in the interviews, the respondents mentioned community benefits least frequently, compared to enhanced government operations or public participation. While the respondents generally admitted that OGD can support economic growth and innovation, they primarily linked economic benefits to developing applications based on local OGD and establishing additional economic value for a city or its businesses. “There could be a positive outcome and a business application of the data,” a data coordinator of one city said, “but keep in mind that not every dataset is economically beneficial.”

c) The respondents in the interviews most frequently mentioned public participation in city-level decision-making as the purpose of their local OGD initiatives. Specifically, they usually linked public participation to the primary social benefit of OGD for residents and the city. Although the respondents underlined the importance of the inputs from residents and local businesses on new city policies and initiatives, they noticed that the actual references to OGD in such inputs were rare. As a community engagement manager in one of the cities in the sample noted, the public does not necessarily use openly published datasets: “People do not know what OGD is and why it is important for government transparency, added to the fact that they also do not know how to use it for advocacy.”

Not all OGD policies always include all three common themes of OGD. For instance, Dallas's OGD policy focused primarily on accountable government and effective coordination but did not mention categories related to public participation or community benefits. Similarly, Baltimore's OGD policy highlighted access to high-quality data as its only theme without explicitly emphasizing categories related to enhanced government operations or community benefits.

In summary, an OGD supervisor in the city from the sample said that the initial expectations from OGD were high. However, it is still "about a one-way road transporting data from city agencies to whoever would use it for the purposes they intend." This highlights a broader pattern: OGD initiatives often fall short of the aspirations outlined in policy documents. OGD policies primarily prioritize government transparency related to data dissemination, often neglecting their core objectives of fostering public participation and promoting community benefits. Although public participation in OGD is intended to enhance decision-making and social benefits, explicit references to OGD in these discussions were rare. Crucially, OGD policies do not emphasize their relation to city plans and municipal goals or use OGD data as indicators of progress. Overall, OGD experts added, "I think we are in the infancy of the data being largely useful; as data becomes more common in decision-making, open data will certainly play a greater role in the development of the city." They observed that the actual contribution of local OGD to sustainable development remains limited and could be significantly strengthened through better policy integration.

4.4 OGD and Plans (General Plans + Sustainability/Climate Action Plans)

Seven out of 19 cities (36.8%) in the sample consistently integrated OGD with general plans or sustainability and/or climate plans (Appendix D.3).

Three specific cities incorporate OGD into their general plans—Chicago, Phoenix, and Baltimore—and mention OGD as a tool for tracking the city’s progress or aiding decision-making. This indicates that 15.8% of the cities included OGD in their general plans, which is a small percentage given that these plans are relatively new. For instance, Chicago published its general plan in February 2023, Phoenix in April 2024, and Baltimore updated it in September 2024. This suggests that a few cities update their general plans and integrate OGD systems, but still, most cities need to more specifically include OGD in their general plans.

OGD in Baltimore serves as a source of evidence to support city-level decision-making. The city’s comprehensive plan provides two best-practice examples of how local OGD initiatives can be planning tools. The first example references the “Surface Water Quality Data 1995 to 2024” dataset from the Open Baltimore data portal, which has been gathered from 35 sampling sites since 1995. This data was used as evidence of poor surface water quality to confirm the creation of a new sanitary sewer overflow wastewater system. The second example highlights the “Public Art Inventory” dataset from the same portal, which was used to represent public art installations in the city, engaging residents and community stakeholders for feedback (Baltimore City Department of Planning, 2024). Although these two examples are the only mentions of the Open Baltimore OGD portal in the 421-page document, these two examples demonstrate how OGD applications can serve as the source of evidence to support city-level decision-making on strategic initiatives. In contrast, the examples from Chicago and Phoenix mainly utilized local OGD initiatives as a tool for one-way communications on the city’s progress between the city governments and the public.

The city of Chicago’s framework plan recognizes its OGD initiative as a key tool for enhancing government transparency and improving data access for residents. According to the

plan, every Chicago resident should be able to find city records in “a user-friendly way with sufficient context to identify and understand the information” (City of Chicago, 2023, p. 44). To accomplish this, the city has outlined the following goals in its framework plan: developing “a best-in-class practice of affirmative and automated release of data” by modernizing data collection, disaggregation, and distribution systems; ensuring equitable access to data; and making it easier for people “to understand and participate in the public body processes” (City of Chicago, 2023, p. 44). Two bar charts accompanied this description of goals, illustrating the most frequently accessed datasets—such as traffic crashes and crimes, which received over 23.2 million visits between 2021 and 2022—and the city departments contributing the most datasets to the OGD portal, including Budget and Management, Public Libraries, and Public Health (City of Chicago, 2023, p. 45).

The City of Phoenix’s PlanPHX 2025 general plan highlights its OGD initiative as a tool for tracking progress toward 42 goals (City of Phoenix, 2024). However, aside from a link to the City of Phoenix Open Data web portal, no further details were provided regarding how the local OGD initiative would support the planning or implementation of these goals. It would have been beneficial if Phoenix had not only linked to the city’s open data portal but also provided links to specific datasets or visual applications of OGD that showcase progress toward each of these 42 goals.

Overall, cities rarely consider their OGD initiatives in their general plans aside from the prime role of updating the city’s progress and data repository. A lack of awareness about the potential capabilities of the local OGD initiatives, both among the city officials and the data users, may have played a part in this situation. Additionally, the lack of topical and accessible data that can be easily understood and utilized by various users could contribute to this situation.

Several interview respondents highlighted these points, noting the limited awareness of OGD among potential data users.

Only four of 19 cities (21%) – San Francisco, Los Angeles, Boston, and New Orleans – referenced OGD in their sustainability or climate action plans. San Francisco plans to utilize best practices for accountability and transparency. Based on the city’s existing data capabilities, including the DataSF OGD, the city aims to establish “robust monitoring, evaluation, and reporting (MER) systems that enable stakeholders to track key [climate and equity] metrics and understand progress” toward the targets and goals of its climate action plan (San Francisco Environment Department, 2021). The MER system aimed to follow best practices to ensure accountability and transparency, deliver relevant information, and make adjustments when needed. Additionally, the plan emphasized the need for more disaggregated data, particularly by race, to make discriminatory policies “evident across every social indicator” (San Francisco Environment Department, 2021, p. 44). However, the lack of detailed information regarding the current status of the MER system raises concerns about potential obstacles hindering its implementation. For instance, the recent mayoral change in San Francisco may lead to delays or shifts in priorities, budget constraints, or data integration challenges that could impede the city’s ability to fully achieve its goals related to accountability, transparency, and data disaggregation. More broadly, shifts in federal priorities may affect local governments’ emphasis on equity initiatives and disaggregated data collection to monitor social disparities.

The City of Boston discloses Building Energy Reports on its OGD portal to inform and support reducing energy use. In 2013, Boston enacted the Building Energy Reporting and Disclosure Ordinance (BERDO), which requires all buildings of 35,000 square feet or larger to report their energy and water use to the city annually. This information is publicly available on

the city's OGD platform. BERDO data showed that the first cohort of buildings subject to the reporting requirement reduced their average energy use by 7% between 2014 and 2017. In addition to annual reporting, buildings must either demonstrate a 15% reduction in energy use or emissions every five years or conduct a detailed assessment of options for energy reduction (City of Boston, 2019). In 2021, Boston launched BERDO 2.0 with phased GHG caps starting in 2025, backed by a \$3.5 million retrofit fund and an open-data strategy to cut emissions and energy use (City of Boston, 2023). This initiative is a strong example of how pairing policy with open data can support sustainable urban planning.

Los Angeles considers OGD as a tool for reporting municipal progress. The city's Green New Deal sustainability plan references the Los Angeles open data portals along with global platforms as tools to ensure commitment and transparency. However, the OGD portal's Environment and Sustainability Development category folder had no data available as of 2025, although this may be added in the future.

New Orleans integrates OGD to enhance transparency and support climate action. The city includes climate-related data to implement sector-based strategies for reducing community GHG emissions while monitoring key performance indicators, such as waste and recycling volumes, and energy usage. Specifically, the implementation plan outlines actions, tasks, and statuses under the "Assemble and make data available for analysis and action" section (City of New Orleans, 2017, p. 61). At the start of this process, a few waste and recycling data points were available in the Environment category of the city's OGD portal. By incorporating OGD into its climate strategy, New Orleans aims to improve transparency, facilitate data-driven decision-making, and engage the community in sustainability efforts.

To summarize, most cities did not consider their OGD initiatives as a tool to support their

sustainability and/or climate action plans. Both Los Angeles and New Orleans are cities that mention the role of OGD in their sustainability and climate action plans. They mainly utilized their OGD initiatives to accumulate data as a data repository and communicate through data regarding the city's progress, which is identified as promoting city government accountability and public participation in city-level decision-making. Interviews supported this finding. The respondents emphasized that, from the cities' perspective, the prime purpose of OGD initiatives was to provide the public with access to the city's raw data. An OGD manager mentioned, "Our goal is not to draw conclusions or promote certain interpretations from the data, but to present it in a way to the public, like dashboards, visualizations, and clean raw data, so that the public can draw their own conclusions."

Most of the respondents in the interviews recognized the substantial potential of OGD in supporting both cities' planning and sustainability. The respondents mentioned the sufficient data on sustainability issues that their cities generate and publish regularly. As one of the respondents noted, data is "a good source of evidence for decision-making by the range of actors at different levels." However, they noticed that the actual contribution of OGD to sustainable development could have been more significant. Most importantly, the city of Boston's practical, action-centered policy of utilizing OGD to inform and support cities' climate action programs can be adopted by other cities. As a city data manager said in their interview, "You need action-oriented programs that leverage data to be used to achieve sustainability objectives."

4.5 Correlation between OGD and Urban Sustainability

By comparing findings from all OGD and sustainability plans of cities ranked high and low in SCI 2024, the study examined how OGD correlates with success in sustainability planning to identify potential patterns in OGD and sustainability planning (see Table 3.2).

Table 3.2

Comparison between High-Ranked and Low-Ranked Cities

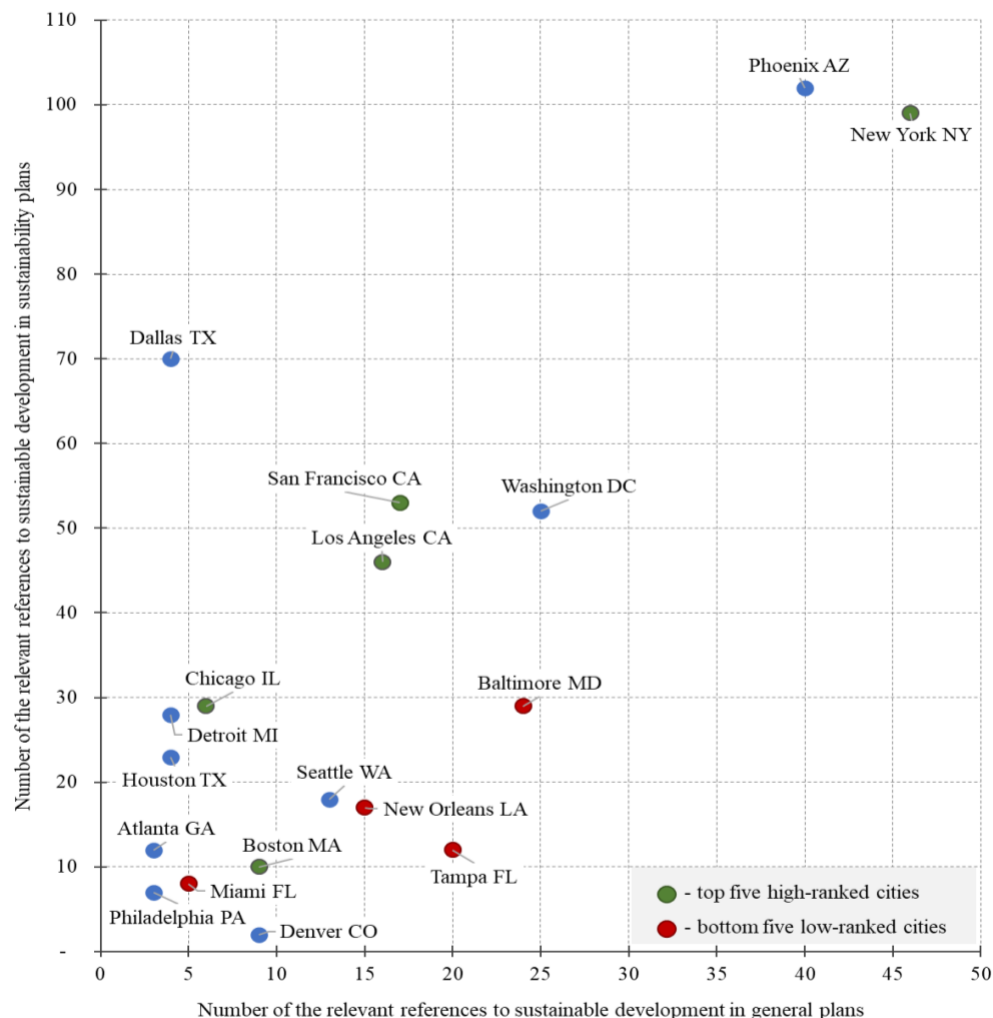
#	Subject \ Indicator	Unit	City Sample	
			High-ranked	Low-ranked
1.	General Plans (out of 18 documents)			
1.1.	Total references to sustainable development	reference	94	68
1.2.	Median relevant references to sustainable development*	reference	16	15
1.3.	Minimum relevant references to sustainable development	reference	6	4
1.4.	Maximum relevant references to sustainable development	reference	46	24
1.5.	Average page count per relevant reference to sustainable development	page	41.1	33.8
1.6.	Minimum page count per relevant reference (most frequent references)	page	6.6	17.5
1.7.	Maximum page count per relevant reference (least frequent references)	page	79.6	65.3
1.8.	General plans with reference to the local OGD initiative	document	1	1
2.	Sustainability/Climate Action Plans (out of 19 documents)			
2.1.	Relevant references to sustainable development in total	reference	237	88
2.2.	Median relevant references to sustainable development*	reference	46	17
2.3.	Minimum relevant references to sustainable development	reference	10	8
2.4.	Maximum relevant references to sustainable development	reference	99	29
2.5.	Average page count per relevant reference	page	4.4	5.7
2.6.	Minimum page count per relevant reference (most frequent references)	page	0.9	3.2
2.7.	Maximum page count per relevant reference (least frequent references)	page	8.8	13.0
2.8.	Sustainability plans with reference to the local OGD initiative	document	3	1
3.	Local OGD Policy (out of 15 documents)			
3.1.	Cities published their OGD policies online	city	5	3
3.2.	Average number of categories describing the purpose of local OGD initiatives per policy (out of eight categories in Figure 3.8)	category	5.4	4.3
3.3.	OGD initiative addresses cities' issues in OGD policies	reference	1	1
3.4.	OGD initiative addresses cities' issues in general plans	reference	1	1
3.5.	OGD initiative addresses cities' issues in sustainability/climate plans	reference	3	1
3.6.	OGD initiative addresses cities' issues in total	reference	5	3
3.7.	OGD initiative addresses cities' issues in total	cities	4	2

OGD integration in general plans was limited. Among high-ranking cities, only Chicago referenced OGD, emphasizing it as a tool for enhancing transparency and equitable public access to OGD. In contrast, low-ranking cities like Baltimore applied OGD for evidence-based decision-making, particularly in water quality assessment and public art mapping, supporting sustainability efforts in their general plans.

The scatter chart in Figure 3.9 illustrates the cities from the sample based on the count of the relevant references to sustainable development in their general and sustainability plans.

Figure 3.9

References to Sustainable Development in Strategic Plans of Cities



High-ranked cities showed more frequent and specific mentions of sustainability in their sustainability and climate action plans. Specifically, only the plans of high-ranked cities (San Francisco, Los Angeles, and Boston) contained three references to OGD, while low-ranked cities (New Orleans) had just one. On average, high-ranked cities referenced sustainability more frequently in their plans (237 references) than low-ranked cities (88 references) (see Table 3.2). For instance, Boston links policy and OGD to monitor energy reductions, and Los Angeles uses OGD to report progress. Among low-ranked cities, only New Orleans integrates climate-related OGD to track performance and guide emissions-reduction strategies. In summary, high-ranked cities better reflect the links between OGD and sustainability planning.

The link between OGD and planning is evident in the cities' OGD policies. Higher-ranked cities publish their OGD policies online more frequently than lower-ranked cities. For instance, as mentioned above, two of the five least-ranked cities do not have approved OGD policies to develop OGD in their cities. On the other hand, high-ranked cities, such as New York City and San Francisco, have published their OGD policies online and accompanied them with additional provisions for making policies, such as standards, guides, or supporting legislation.

Local OGD policies of high-ranked cities were more comprehensive regarding the purposes of their local OGD initiatives (more categories mentioned). Out of three local OGD policies of low-ranked cities, none had categories in all three themes. One city in a high-ranked city (Los Angeles) and one in a low-ranking city (New Orleans) referenced OGD in their policies. Notably, Los Angeles, a high-ranked sustainability city, was one of only two cities in the sample to mention the application of OGD in both its OGD policies and sustainability and climate action plans, with New Orleans being the other. In total, four higher-ranked cities made five references to OGD, while two lower-ranked cities contributed three, and Phoenix, positioned

between the two groups, added one. With only nine references across the 19 cities in the sample, the data suggest a tendency for higher-ranked cities to more actively integrate OGD into their sustainability planning than their lower-ranked counterparts.

4.6 Strategies to Better Link OGD to Planning and Sustainability

The data generated through OGD has significant potential to enhance sustainability planning by providing insights into urban dynamics and informing policy decisions. Cities generate and share substantial sustainability-related data, including air quality, job applications, affordable housing production, and water consumption. Additionally, nearly every resident activity—such as using taxis, making purchases, and buying homes—produces data that can be analyzed to identify trends, improve resource allocation, and optimize city services.

However, the results from the analysis indicate that OGD’s impact on planning remains limited. As one expert stated, “Currently, there isn’t much that OGD is helping to solve; rather, we contribute to OGD after our projects are completed, making the data available for further research.” Moreover, while publishing OGD technically makes it publicly accessible, it does not guarantee that the data is usable, well-structured, or beneficial for users. To overcome these challenges, strategies are needed to better integrate OGD into sustainability planning. It is important to recognize that while some cities are actively implementing certain strategies, others are only doing so partially or not at all. I have identified these challenges and strategies through the analysis of the interviews conducted.

Enhancing awareness and usability is key to achieving the goals of OGD. Respondents emphasized that a lack of understanding of OGD initiatives and limited user skills are significant barriers to practical use. As one noted, “Too many people do not know what OGD is, why it is important for government transparency, and how to use it for advocacy. Many see large data

tables and are overwhelmed by the raw data.” Experts argue that “OGD will only become more extensive and widely used by the public.” Increasing community awareness means ensuring that users understand why OGD exists, how it can address local challenges, and how it can be leveraged for advocacy. Direct strategies to improve usability include public training classes, hands-on workshops, and community engagement events where participants learn to navigate and apply OGD tools. For instance, New York City’s Open Data Ambassadors provide year-round introductory training across diverse communities to bridge data literacy gaps. New York also hosts Open Data Week, an annual festival featuring art exhibitions, in-person and virtual events, and conferences highlighting real-world applications of OGD in improving services, promoting equity, and increasing efficiency. Similarly, Detroit finds that different user groups interact with OGD uniquely, requiring tailored educational tools. In response, the city developed accessible video tutorials and launched the annual “Visualizing Detroit: The Art of Data” exhibit in collaboration with community partners. The city of Boston has an Open Data starter kit, glossary, and slides to provide a brief orientation to the platform-based use cases for available datasets. Portland’s DiscoTech initiative offers a collaborative space for exploring OGD through app development, data visualization, and metadata analysis, empowering residents to develop practical tools for their communities.

Enhancing streamlined communication and outreach for OGD is essential to increasing public engagement. This involves gathering feedback, conducting surveys, and tracking OGD usage while encouraging users to share their work. These efforts not only reflect the impact of OGD but also demonstrate how its use contributes to meaningful actions. For example, researcher Hanna Hoover used OGD to help local farmers determine which land parcels receive the most sunlight and are likely to be more profitable. Similarly, journalist Jena Brooker

leveraged blight maps and violation data to highlight challenges related to city Dollar stores and how they are being addressed (City of Detroit, 2024). Cities employ various outreach methods to connect with OGD users. San Francisco shares updates and insights through a Medium blog, while Los Angeles provides open access to public records requests. Some cities use social media, community newsletters, and OGD reports to keep users informed. Phoenix, for instance, offers a “Suggest a New Open Dataset” form, allowing residents to request specific data they need.

Identifying datasets of public interest and involving the community in deciding what OGD should publish is essential. According to Kitchin (2013) and Kitchin et al. (2015), data is not politically, technologically, or socio-culturally neutral; rather, it reflects the biases of those in power and the selectiveness of information, which can highlight strengths while obscuring weaknesses. For example, OGD coordinators noted, “...certain departments retain control over their data, citing the sensitive nature of the information or contractual restrictions, which makes it exclusive.” Another expert highlighted, “...the process of data availability and the willingness of departmental data owners to drive the selection of open data shapes the OGD of cities.” San Francisco’s OGD policy, for instance, specifies that the Chief Data Officer’s duties include ensuring that “Data prioritized for publication should be of likely interest to the public.” In some cities, decisions about what data to publish involve city officials such as the mayor, council members, or specialized committees. As discussed in the literature review, Kitchin et al. (2013), Lourenço (2013), and Harrison et al. (2012) argued that simply providing access to thousands of datasets—without considering public interest—does not necessarily increase government transparency or accountability. Users need clear answers to their questions and expect tangible services or benefits from OGD. Therefore, decisions on data publication should involve a broad range of local groups and advisory commissions to ensure the data aligns with community needs.

In another interview, a data coordinator said: “Data operations, creating data curation pipelines, and agreements on data management work at different business layers and require a group, committee, or common space for discussion, collaboration, and deliberation. It takes time and resources to get there, but [the city] has been working on that for years now.”

Cities need to expand engagement with diverse local communities. For instance, Seattle collaborates with civic tech groups, students, businesses, and advocacy organizations. San Francisco works closely with community-based organizations to refine policy recommendations. Detroit has established the GO DATA Advisory Commission, a group of volunteer members from various sectors that enhances data accessibility, scores datasets, drafts bylaws, and fosters community engagement. This advisory board, in particular, brings the community’s voice into decisions about which data should be available to the public.

Visualizing OGD is essential for making complex data more accessible, helping users interpret information, and fostering public engagement. Making data openly available without demonstrating its use limits its impact. By presenting data through apps, dashboards, and interactive tools, users can better understand trends, identify patterns, and take action based on data-driven insights. For example, Albuquerque’s “Where’s My Bus” real-time transit tracking tool helps riders monitor bus locations and arrival times. Phoenix’s “City Checkbook” provides insights into city expenditures, including vendor payments, departmental spending, and financial transactions. Washington, DC, enhances data accessibility with over 64 custom online mapping applications and more than 17 interactive visualizations that allow users to analyze city operations, goals, and business processes. Notable examples include the DC Office of Tax and Revenue’s accurate property assessment map, the DC flood risk tool, and automated bicycle and pedestrian counters, which track walking and biking trends to support infrastructure planning and

investment in new bike lanes and trails.

Action-oriented policies leveraging OGD are crucial for achieving cities' climate action plan goals. While public disclosure of OGD is vital, it alone cannot address urban sustainability planning challenges. Integrating OGD into planning through targeted policies and programs can be key to achieving climate goals. For example, Seattle's OGD portal includes the Building Energy Benchmarking Data, requiring owners of buildings over 20,000 square feet to track and report their energy performance annually. By making this data publicly accessible, residents can review information about their buildings and assess city-wide energy performance, including electricity consumption, natural gas usage, and GHG emissions. However, while disclosure raises awareness among building owners, it does not directly reduce emissions. Seattle implemented the Building Emissions Performance Standard, which establishes GHG reduction targets that building owners must meet over time, promoting energy efficiency, electrification, and a transition from fossil fuels. By aligning data-driven policies with OGD, Seattle aims to achieve carbon neutrality by 2050. Similarly, New York has set ambitious targets to reduce GHG emissions by 40% by 2030 and 80% by 2050, and Boston enacted the Building Energy Reporting and Disclosure Ordinance to minimize energy use.

Integrating OGD directly into city-level plans bridges the gap between data availability and urban planning. A crucial first step is to embed OGD into city policies, sustainability initiatives, climate action plans, and general plans by aligning OGD with goals, actions, and performance indicators. For instance, New Orleans' climate action plan for resilience includes data-driven decision-making and collaboration as one of its five main strategies. To enhance opportunities for climate solutions, the city commits to specific climate actions, such as publishing climate-related data, collaborating with partners on sector-based GHG reduction

strategies, and tracking key performance indicators like waste and recycling volumes, energy mix, and consumption. The climate action plan explicitly outlines a set of climate-related tasks, including the incorporation of climate action data into the open data policy and catalog. This structured approach, “strategies → actions → tasks,” ensures that OGD is not only published but also actively used to monitor, evaluate, and report on sustainability progress. By requiring planning staff to maintain climate-related OGD in both the open data policy and portal, the plan enforces its strategies for data-driven decision-making and collaboration. Embedding OGD into decision-making processes enhances accountability, improves sustainability target tracking, and supports evidence-based policy implementation.

Data quality and data standardization remain significant challenges for OGD. Experts pointed out that while cities have an abundance of data, the quality of this data can sometimes be lacking. As one expert explained, “We collect metrics on all sorts of things, but the relationships between the data points or the significance of what we’re collecting and why can sometimes get lost in the frenzy of simply collecting data to collect it.” Additionally, another expert noted, “...data that isn’t standardized in a way that makes it easy for us to collaborate, to ensure we’re comparing apples to apples, or even referencing the same business/community.” Moreover, “...We have a plethora of demographic-type data (gender, age, ethnicity, etc.), but it’s not formatted or asked in a way that the next steps with the data are useful.” Experts emphasized the importance of adopting a “depth in details” or “less is more” approach to data integrity and standardizing how “we view/describe businesses and neighborhoods” so that less time is spent synthesizing data due to inconsistent naming or categorization.

While OGD has significant potential to address urban sustainability challenges, its effectiveness depends on how and under what circumstances it is applied. OGD captures the

continuous interactions within a city, but it is not inherently a solution for sustainability planning. Rather than serving as a direct solution, its impact relies on shifting public and government attitudes toward data-driven decision-making. If treated as a passive data repository, OGD may hinder sustainability efforts; however, it can catalyze the addressing of urban challenges when effectively integrated into planning processes. One respondent noted, “The culture of engagement is hard to maintain, and data management systems are expensive; cities, especially smaller ones, struggle to implement open data programs and retain staff with the expertise and commitment to support them.” “I believe we had a good amount of data to understand the major sustainability issues,” noted a city-level data supervisor, “A lot of the work still needs to be managed at the city governance level.”

Conclusion

This study aimed to assess how OGD initiatives in 19 U.S. cities relate to planning, in particular for urban sustainability. I considered the user-friendliness of OGD portals, their relation to official OGD policies, their relation to plans (general plans and sustainability/climate plans), and the extent to which OGD initiatives vary among cities judged more or less successful at sustainability planning.

OGD portals across 19 U.S. cities differ significantly in content, usability, and governance, affecting their contributions to SDG 11. Cities with high sustainability performance tend to provide broader datasets, inclusive governance, user-friendly support, and equity-focused features, while lower-ranked cities often fall short in these areas. These disparities affect how effectively cities leverage OGD to promote sustainability.

No city had references to OGD in all planning (cities’ OGD policies, general plans, and sustainability and climate plans). In this empirical study, out of 19 cities in the sample, nine

cities were partially defined OGD in the policies and plans of these cities: two cities used OGD in their OGD policies (Los Angeles and New Orleans), three cities utilized OGD in their general plans (Chicago, Phoenix, and Baltimore), and four cities applied OGD in their sustainability/climate plans (San Francisco, Los Angeles, Boston, and New Orleans). I should note that only two cities met two conditions mentioned above (Los Angeles and New Orleans have references in sustainability/climate plans and OGD policies), and seven others met only one condition (in one of the plans, such as general plan, sustainability/climate action plan, and OGD policies) (Appendix D.3). The findings indicated that U.S. cities rarely linked their open data policies, general plans, and sustainability/climate action plans with OGD, even though those cities actively utilized the elements of sustainability and the corresponding vocabulary in their planning.

The open data policies of cities mostly focus on improving government transparency rather than achieving the main goals of OGD—genuine public participation and community benefits. It remains a one-way data flow, controlled by city agencies, to users who can only apply the data.

In high-ranking sustainable cities, using OGD correlates with their excellence in sustainability planning. Given that the world has four years remaining to achieve sustainability planning (as promised in the SDGs), and a lot of issues still must be resolved after more than a decade of implementation of the SDGs, actions and measurements are needed to stay on track with the progress. Therefore, I recommend better aligning their OGD initiatives and planning, specifically to support data-driven decision-making plans, policies, and benchmarking by various local actors to promote sustainable cities. Cities need to enhance public participation by increasing data accessibility and usability for residents, activists, scholars, local businesses, and

city agencies. By addressing barriers highlighted by interviewees and the document analysis, I aimed to develop potential strategies to overcome them. There are action-oriented programs improving OGD awareness, accessibility, and public engagement, leveraging OGD for planning, embedding OGD directly in city-level plans, improving data integrity, identifying datasets of public interest, and engaging diverse local representatives in OGD to meet community needs.

Chapter 4. Open Government Data Portals and Sustainable Development Goal 11: An Analysis of 19 U.S. Cities

Abstract

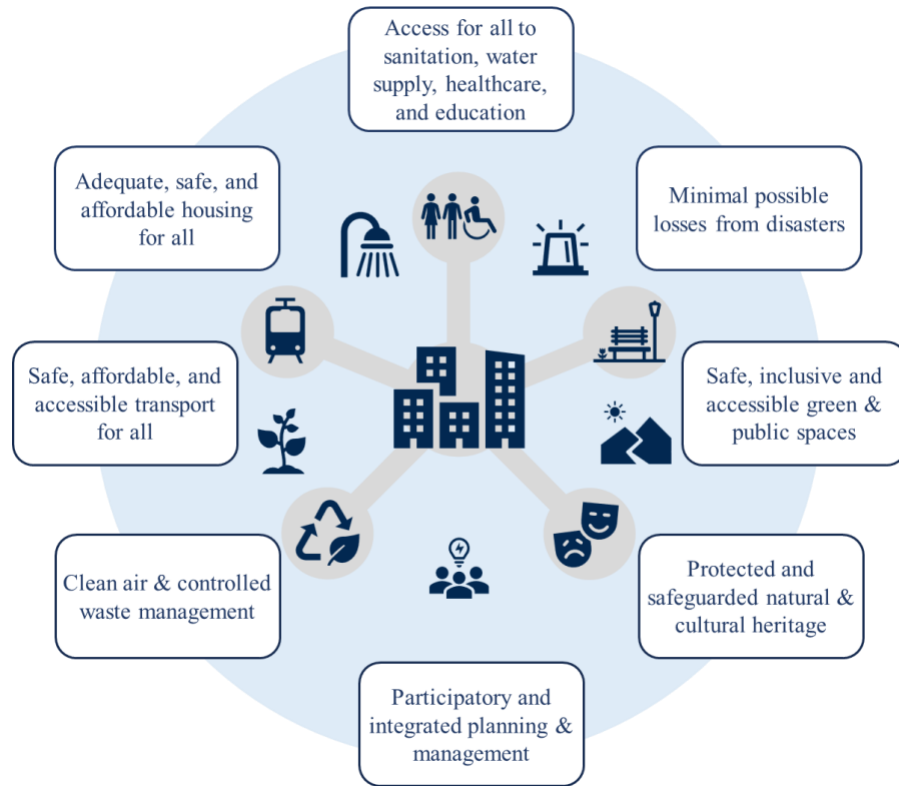
OGD portals have the potential to be powerful tools in advancing progress toward SDG 11. This study examines the extent to which U.S. city-level OGD portals support SDG 11 and proposes ways to improve these functions. Given the limitations of SDG 11, the study explores how OGD portals could adopt an expanded and revised list of indicators, which I refer to as SDG 11+, to better address sustainable urban development. The analysis focuses on 19 U.S. cities and uses content analysis of portals and descriptive statistics. First, I evaluated OGD portal search results to see how well they reflect SDG 11. Second, I developed SDG 11+ urban sustainability indicators, drawing on common indicators, widely accessible data, city-related other SDGs, and insights from the urban sustainability literature. Also, I reviewed the alignment of OGD portals to SDG 11+ indicators. Finally, I provided recommendations to improve the OGD Portal. Overall, none of the cities had data that directly addressed SDG 11 indicators, with the data aligning more closely with local goals than with the SDG 11 indicators. OGD was most available for transportation (31%) and green and public spaces targets (25%), often missing demographic and equity details. No data were available for indicators of slums (11.1.1), disaster losses (11.5.2), and infrastructure impacts (11.5.3). Notably, 86.7% of datasets came from the highest-ranked sustainable cities, while the lowest-ranked cities contributed 13.3%. Cities can apply SDG 11+, which can be more widely and practically used to achieve SDGs. Global SDGs should be informed by locally relevant indicators. Upgrading usability features, enhancing overall portal content, prioritizing data integrity, ensuring timely updates, providing more “just disaggregated” data, and adopting an “all-of-society” approach can strengthen OGD portals toward SDG 11+.

1. Introduction

SDG 11 drives global efforts to build inclusive, safe, and sustainable cities. The 2030 Agenda serves as a universal plan for prosperity and calls “to renew and plan our cities and human settlements to foster community cohesion and personal security and to stimulate innovation and employment” (UN, 2015, p.9). The 17 SDGs form the core of the 2030 Agenda, outlining what the global community considers a sustainable future for everyone. Among the 17 SDGs, SDG 11 addresses the challenges of sustainable urbanization, representing “a landmark step in the movement towards more sustainable cities and communities” (Nabiyeva et al., 2023, p. 2). According to Misselwitz et al. (2015), SDG 11 is at the core of the 2030 Agenda, as it links 10 out of 17 SDGs, 30% of targets, and 39% of indicators. As of 2024, only 17% of all SDG targets were on track, including 25% of the ten targets of SDG 11. Furthermore, 48% of the 193 countries that voted for the 2030 Agenda were significantly off track in meeting their SDG targets, and 35% indicated stagnation or regression below the 2015 level (UN, 2024). The utility of SDG 11 remains limited by weak measurement. Thomas et al. (2021) examined 484 sustainability indicators sourced from 40 indexes and online data repositories produced by academic or non-government organizations, governments, and private sector/consulting groups, and found them inadequate for evaluating progress toward SDG 11, citing the absence of benchmarks, realistic targets, and disaggregated equity measures. This highlights how indicator systems struggle to provide reliable tools for assessing urban sustainability. Within the framework of SDG 11, its targets, and indicators, a sustainable city in 2030 is expected to be democratically governed and provide an inclusive, safe, accessible, and affordable environment to all its residents. All cities worldwide strive for an ideal sustainable city model, achievable through their sustainability efforts (Figure 4.1).

Figure 4.1

A Sustainable City in the 2030 Agenda through the Lens of SDG 11



According to the UN, to meet SDG 11, a more open “data revolution” is necessary to monitor progress, hold governments accountable, and promote sustainable development, leading to “more empowered people, better policies, more informed decisions, and increased participation and accountability” (IEAG, 2014, p.6).

OGD can play a vital role in achieving SDG 11. OGD refers to information from governments that is available to the public free of charge, can be reused without restrictions, is platform-independent, machine-readable, and often de-identified (Attard et al., 2015; Davies & Perini, 2016; Meschede & Siebenlist, 2021; Reiche & Höfig, 2013; Verhulst & Young, 2017). In other words, OGD is part of cities’ efforts to enhance transparency, improve accountability, stimulate economic growth, encourage innovation, empower citizens, combat corruption, achieve

environmental goals, and provide better public services (OpenGovData, n.d.; Chignard, 2013). In 2007, the Open Government Working Group proposed eight fundamental principles for OGD, aiming to clarify its crucial role in strengthening democratic governance (complete, primary, timely, accessible, machine processable, non-discriminatory, non-proprietary, license-free). There were also seven additional principles of OGD, such as online and free, permanent, trusted, presumption of openness, documented, safe to open, and designed with public input. They argued that OGD increases civil discourse, improves public welfare, and promotes more efficient use of public resources. Because of OGD, governments can better understand the needs of their citizens, and citizens may participate more fully in their government (Open Government Data, n.d.). In 2009, President Obama signed several initiatives to promote OGD, such as the Memorandum on Transparency and Open Government and the Open Government Directive that expedited its implementation (U.S. Government, 2009). As of 2025, over 140 OGD portals have been established in the USA, hosting more than 312,000 datasets (The White House, 2009; Data.gov, n.d.).

Except for a few case studies on OGD applications for sustainable development, previous research has not systematically examined how OGD can support SDG 11. Therefore, more empirical studies are needed to understand how OGD can effectively contribute to sustainable development at the city level, particularly in advancing the 2030 Agenda and achieving SDG 11.

In this study, I attempt to define the role of OGD portals in supporting cities' efforts toward SDG 11. I examined 19 U.S. cities ranked in Arcadis's SCI 2024 report, an independent, international rating of the world's most sustainable cities, by using content analysis and descriptive statistics. First, I reviewed whether the datasets accessible through corresponding keyword searches in OGD portals align with the current SDG 11. Second, I identified and

proposed expanded SDG 11+ indicators that more accurately align with contemporary frameworks for sustainable cities. Additionally, I reviewed the relation of OGD portals to new SDG 11+ indicators. Finally, based on our analysis, I offered recommendations for improvement of the OGD portal to support SDG 11. The research question was: How well do OGD systems in U.S. cities support SDG 11? The following sub-questions guided my inquiry: Do the datasets published on the local OGD portals reflect indicators of SDG 11? Which SDG 11+ indicators and data are most useful for evaluating urban sustainability according to current sustainability frameworks?

2. Literature Review

2.1 Sustainability Indicators of Cities.

According to Malcevski (1991), an indicator is an element of the environment or a characteristic of it that, individually or in combination with other parameters, can represent environmental conditions. Vismara (1990) emphasizes that effective indicators should be representative of the targeted phenomenon, easily measurable and monitorable, reliable with minimal systematic error, and operationally useful for assessing responses, costs, and benefits. According to Carollo (2008), selected indicators should be unique, strategic, computable, and statistically monitorable to effectively represent local environmental characteristics and track future and past trends. In the report of Sustainable Seattle (1993), urban sustainability indicators are bellwether tests of sustainability and reflect something basic and fundamental to the long-term economic, social, or environmental health of a community over generations. Sustainability indicators are essential at every phase of pursuing SDGs to ensure progress can be effectively measured. According to Alberti (1996), urban indicators are essential for helping local policymakers improve their efforts toward sustainability. They serve several purposes:

systematic monitoring of urban environmental changes, early warning of urban environmental problems, target setting, performance reviews, and public information and communication.

Alberti (1996) summarized the three most important elements of local indicators: broad coverage of indicator themes, diverse interpretations of sustainability, such as environmental, health, and poverty issues, and the public's participation in the process of selecting indicators. According to Maclaren (1996), when considering the "indicator" element in the term "urban sustainability indicators," it's important to recognize that indicators are often simplified representations of complex realities. In the context of Whorton and Morgan (1975), an indicator should be understood as a tool that points to specific conditions or issues, rather than providing a comprehensive explanation. Because no single indicator can fully capture the complexity of urban sustainability, using a diverse set of indicators is often necessary to reflect its various dimensions.

The use of sustainability indicators in urban planning has a long history, shaped by influential frameworks and scholarly contributions. Campbell (1996) identified inherent tensions among economic growth, environmental protection, and social equity, urging planners to balance these priorities through integrated sustainability goals and their indicators. Beatley (2000) emphasized ecologically grounded indicators, drawing on European practices to promote compact, livable, and resilient urban design. Bell and Morse (1999) argued that sustainability indicators are inherently subjective and should be developed through stakeholder participation to ensure local relevance and legitimacy. Mega (1996) emphasized the importance of localized sustainability indicators and argued that sustainability metrics must be both locally relevant and comparable across regions to support informed urban governance and policy alignment. UN-Habitat has also played a critical role in advancing urban sustainability by promoting indicator-

based monitoring frameworks, such as Local Agenda 21, which later served as a foundation for the Millennium Development Goals (MDGs) and SDGs (UN, 1992).

The MDGs, as a predecessor of the SDGs, formed the first global blueprint, albeit with some inherited pitfalls (World Health Organization, 2018). MDGs brought both positive and negative lessons to the global development community. On the one hand, they mobilized attention to significant but otherwise neglected global issues and communicated them in a concise and easily understandable way. Other improvements included reducing levels of extreme poverty and gender disparity in general (Sumner, 2009). On the other hand, Hansson et al. (2019) identified four pitfalls of MDGs that have shaped governance in ways not conducive to sustainability: 1) little informational value of collected data; the data helped mobilize resources and political support, but was less useful in demonstrating the actual achievements and even misleading in cross-country comparisons; 2) oversimplified indicators; the simplicity was helpful for measurability, but oversimplified complex agendas, sidelining other objectives and potentially informative variables; 3) fragmented effect; targets focused individually within their respective sectors, with only limited cross-sector cooperation; 4) misleading incentives; setting too low bars in terms of the quality of progress toward MDGs. To some extent, the SDGs have inherited some of these pitfalls.

The UN SDG framework utilizes indicators to track progress, including those related to SDG 11, which focuses on sustainable cities. In 2015, the UN adopted the 2030 Agenda as “...a shared blueprint and global guideline for peace and prosperity for people and the planet” (UN, 2015, p.1). There are 17 SDGs in the 2030 Agenda, consisting of 169 associated targets and 230 indicators. According to Davis et al. (2015), these targets and indicators are intended to provide a powerful basis for informed political decision-making by fostering public awareness and guiding

the conceptualization of fundamental environmental problems and their solutions. One of the SDGs is SDG 11, which is the prime area of our interest in this research. Ten targets and 15 indicators are associated with SDG 11, covering a broad range of urban issues, from affordable housing and transportation to cultural and natural heritage. There are seven numbered indicators that I consider in this study: primary indicators used to measure progress toward an SDG target, and three letter-labeled indicators—complementary or additional indicators related to the primary target—that track policy frameworks or implementation strategies rather than direct outcomes (UN DESA, n.d.-x).

Since the mid-1990s, many cities have implemented indicators to measure urban systems and benchmark their performance against one another. Several pioneering city-level initiatives in the U.S. laid the foundation for sustainability indicator use well before the SDGs. Projects such as Sustainable Seattle Indicators of Sustainable Community tracking 40 key indicators across environmental, social, and economic realms, the Jacksonville Quality of Life Progress Report is one of the longest-running community indicator initiatives across multiple domains, such as education, health, safety, environment, economy, and civic engagement, with over 50 indicators, and the Boston Indicators Project developed community-driven frameworks to track environmental, economic, and social well-being. Other cities, including San Francisco and Portland, have incorporated sustainability indicators into their long-term planning and climate action strategies, demonstrating the evolving role of data in guiding urban development.

In the literature, scholars categorized urban sustainability indicators in several different ways. Alberti (1996) identified four key categories for linking local indicator sets based on analyses by the World Bank and the World Resources Institute: source indicators (e.g., agriculture, forests), sink indicators (e.g., climate change), life support indicators (e.g.,

threatened species), and human impact indicators (e.g., health, housing). The World Bank categorizes indicators into three types: first, individual indicators, which consist of a large number of indicators addressing various environmental concerns (e.g., OECD indicators); second, thematic indicators, which use a small set to evaluate specific environmental policies (e.g., World Development Indicators); and third, systemic indicators, where a single indicator represents a complex issue (e.g., wealth and genuine savings indicators) (Cameron, 1998).

According to Lee and Huang (2007), based on Taipei's local characteristics and expert input, 51 sustainability indicators across economic, social, environmental, and institutional dimensions were assessed from 1994 to 2004, revealing positive trends in social and environmental areas but weaker performance in economic and institutional aspects. According to Shen et al. (2011), a comparison of nine urban sustainability practices—Melbourne, Hong Kong, Iskandar, Barcelona, Mexico City, Taipei, Singapore, Chandigarh, and Pune—using the International Urban Sustainability Indicators List (IUSIL) shows that a shared indicator framework can enhance understanding of indicator selection, facilitate knowledge exchange, and improve communication across environmental, economic, social, and governance dimensions. Dizdaroglu (2015) developed a micro-level framework for assessing urban ecosystem sustainability by drawing from established initiatives such as the Organization for Economic Co-operation and Development and the U.S. Green Building Council (2008, 2009) and incorporating expert judgment methods used in indices like the Environmental Performance Index and Environmental Sustainability Index. Expert input ensures that the selected indicators reflect local priorities and environmental needs. The framework organized 23 indicators into 9 sub-categories, grouped under three core dimensions: natural environment, built environment, and socio-economic environment. According to Zoeteman et al. (2016), the Dutch national monitor “Sustainability

Balance” assesses all 403 municipalities using 90 indicators across economic, socio-cultural, and environmental dimensions. The study showed a significant impact of factors like size, spatial-economic typology, average income, and geographical position on selected indicators and overall sustainability scores. According to Verma and Raghubanshi (2018), after reviewing 341 peer-reviewed articles, they identified two types of challenges in applying urban sustainability indicators: internal challenges inherent to indicator development (e.g., methodological flaws, lack of theoretical base), and external challenges such as data scarcity, policy inertia, and lack of consensus; they also emphasized three key criteria influencing indicator application—data availability, sustainability thresholds, and a conceptual framework for selection.

Recently, data has become more accessible and real-time, often displayed through online interactive visualizations and dashboards. According to Kitchin et al. (2015, p. 7), indicators are “recurrent quantified measures that can be tracked over time to provide information about stasis and change with respect to a particular phenomenon.” Indicators help guide strategic decision-making, acting as (i) a common source of information about elements of a city and (ii) evidence that reduces uncertainty and insecurity, maintains stability, and improves the quality and quantity of discussion. The limitation is that indicators are frequently biased and do not specify the cause of problems and how to solve them.

While some sustainability indicators are relevant only within one local context, others possess core characteristics that make them more universally applicable (Maclaren, 1996). Building on this idea, Nabiyeva and Wheeler (2024, p. 296) highlighted that “national policies need to adjust SDG implementation according to the level of development, available resources, and local conditions and circumstances.” According to Howard and Wheeler (2015, p. 559), local communities “help global targets to be translated into interventions and actions that bring

about actual improvements in the lives of citizens.”

The availability and quality of data, along with relevant indicators, are pivotal in advancing sustainable development. Satterthwaite (2016) argued that the success of SDG 11 is directly tied to the availability and accessibility of robust data. Drawing on experiences from cities in the Global South, such as Kampala and Mumbai, he emphasized that many local governments lack the resources or systems to collect neighborhood-level data on housing, infrastructure, and services—data that is essential for monitoring SDG 11 targets. For example, Simon et al. (2015) argued that no draft indicators of SDG 11 were universally important, relevant, and easy to report on in terms of data availability, and no city found the entire set of draft indicators straightforward and appropriate. However, these considered cities, such as Buenos Aires (Argentina), Cape Town (South Africa), Gothenburg (Sweden), Kisumu (Kenya), Malmö (Sweden), Sheffield (United Kingdom), Greater Manchester (United Kingdom), Bangalore (India), and Shimla (India) also proposed various changes to enhance the relevance of specific targets and indicators (Simon et al., 2015), underscoring the potential impact of data analysis on policy-making.

Some sources underlined the vague framework of each SDG, which often leads to confusion and uncertainty. Likely, this vagueness emerged from the necessity to find common ground with too many stakeholders (all UN member states), with a broad range of expectations and diverse starting conditions. Valencia et al. (2019) argued that there are multiple and complex interactions within SDG 11 in the form of both synergies and trade-offs. According to Valencia et al. (2019), efforts for achieving some of the different targets may be complementary, whereas others may potentially compete or conflict with one another. On top of that, there is no one-to-one relation between most targets and indicators, and many targets cover simultaneous and

complex issues. Therefore, they cannot be reflected entirely by individual indicators or composite indices. Boundaries between SDG 11 and other SDGs are especially confusing because cities, as hot spots of sustainable development, also accommodate issues targeted by other SDGs. Thus, the urban context of the 2030 Agenda as a big picture is diffused among all SDGs, not only SDG 11.

Specifically, Valencia et al. (2019) criticized the usability of Targets 11.5 and 11.b of SDG 11, which aim to reduce the harm of disasters. They argued that the focus on disasters would divert attention from smaller but more frequent impacts that, cumulatively over time, may result in severe social and economic damage. According to the authors, Target 11.b and its indicators fail to address either the quality of policies or the effectiveness of their implementation (Valencia et al., 2019). Simon et al. (2015) criticized indicator 11.2 (the proportion of the population that has convenient access to public transport). They interviewed city officials from Gothenburg, Sweden, who considered the indicator to be of little relevance and described the transportation infrastructure, rather than whether people use the available public transport or its actual physical accessibility. According to Simon et al., this indicator should include topography, physical obstacles, and safety issues such as lighting and open paths. Overall, most sources agree that unified sustainability indicators are a vital tool for measuring progress, pooling resources, and addressing the most urgent issues. However, there is still room to improve them within specific local contexts, taking into account available capabilities and resources.

2.2 OGD Portals of Cities

According to the California Open Data Handbook, an open data portal, a searchable catalog of datasets, is a centralized platform designed to provide citizens and the government with a single location to search for and access authoritative open data from government entities

(California Department of Technology, n.d.).

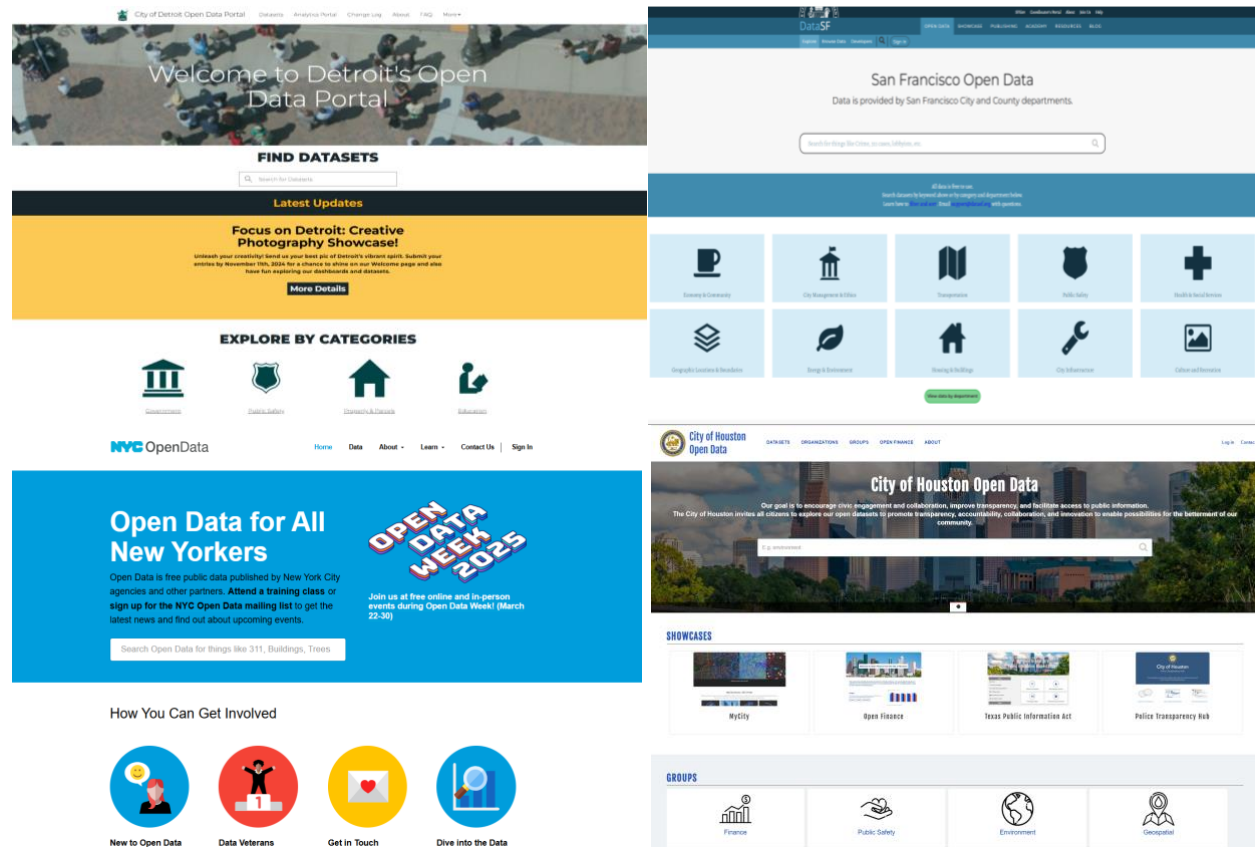
OGD portals began to emerge in the late 2000s and expanded rapidly throughout the 2010s. In the U.S., the launch of Data.gov in 2009, initiated under the Obama Administration and starting with just 47 datasets, marked a pivotal moment in federal data openness. Later that year, the White House issued the Open Government Directive, which required agencies to release previously unreleased data within 45 days, providing concrete guidance for the nascent open data movement. The 2013 Open Data Policy further accelerated growth by mandating comprehensive data inventories and public listings, expanding Data.gov to more than 115,000 datasets from 88 organizations by 2015. Today, the portal hosts more than 300,000 datasets from over 100 organizations and attracts more than a million monthly pageviews, illustrating the rapid growth and increasing public engagement with OGD in the U.S.

The OGD portal serves as a one-stop shop for data consumers, empowering the public with access to a wealth of information. Implementing OGD initiatives involves collecting datasets and removing any information that could identify individuals or sources, known as de-identification, before publishing them in central data portals or catalogs. While a data catalog typically serves as a registry of data sources, providing links, a portal acts as a single-entry point, hosting the actual data. End users can search, access, explore, or interact with the published data in various ways, putting the power of information at their fingertips. A data portal primarily serves as a centralized platform that provides policymakers, researchers, and the public with single-source access to a wide range of datasets while managing associated metadata to support data discovery and use. Additionally, multiple functions are often provided, such as data format conversion, visualization options, and query endpoints (Alexopoulos, 2013). In addition to the wide variety of information collected from citizens and institutions, modern OGD portals include

features for learning, requesting, mapping, displaying, creating, and converting published data into customized reports (see Figure 4.2).

Figure 4.2

OGD Portals of Detroit, San Francisco, New York, and Houston



The data portal, a gateway to data, is not just a tool for managing existing data. Its core purpose is to facilitate the rapid discovery and use of data, creating new value within enterprises. OGD portals, with their significant role in managing the enormous growth in both the volume and variety of available data, are a testament to this. The new value for data within enterprises often arises from unexpected or unplanned uses, as well as from their ability to combine data across divisions and systems. Typically, a data portal requires a data inventory and a portal

catalog.

Various entities, including official government organizations or citizen initiatives, can operate OGD portals. Additionally, these portals can differ in scope; some may publish data relevant to a specific administrative region, such as a city or a country. Many nations have developed local or national portals to provide access to OGD. For example, the U.S. government's central open data site offers over 312,000 datasets across various domains. It serves as a comprehensive platform for accessing federal and city data. The data.europa.eu platform gathers metadata from public sector datasets available through various national and regional open data portals across Europe. Globally, three major open data portals are in the U.S. (data.gov), the United Kingdom (data.gov.uk), and France (data.gouv.fr). Some developing countries also made significant progress in promoting open data (for example, Singapore, data.gov.sg). In New Zealand, a partnership known as Land, Air, Water Aotearoa (LAWA) openly provided data on water quality at more than 350 beaches nationwide, which has been used to inform public health initiatives and environmental policy (Alexopoulos, 2013). However, the presence of open data initiatives and their usability are still limited in the developing world.

The publications and relevant theories on OGD and urban sustainability indicators, particularly SDG 11, are still limited. As more stakeholders engage in this endeavor and form new partnerships with governments, and as more advanced technologies become available, the concept of open data is likely to evolve and become more comprehensive. There are some notable works pertinent to this topic, such as the model introduced by Wilson and van der Velden (2022), which emphasizes aligning artificial intelligence and machine learning (AI) efforts with SDGs to enhance the visibility and impact of public sector policies. However, the need to expand data quality criteria, as Park and Kim (2022) recommended, is urgent. They

suggested that these criteria should be broadened to assess non-tabular datasets more effectively, such as maps, images, and sensor data, which are commonly used in smart cities. They argued that traditional frameworks overlook key aspects, such as metadata clarity, interpretability, and machine-readability, which are essential for making these complex formats usable and effective for public decision-making. According to Alexopoulos et al. (2024, p. 1573), who studied six data portals in Bahrain, Qatar, Oman, Kuwait, the United Arab Emirates, and Saudi Arabia using a quantitative approach, highlighted that OGD related to the SDGs can support both the monitoring of current progress and the planning of future actions. Specifically, they concluded, “The examination of SDG datasets availability and the assessment of their interoperability would provide valuable insights regarding the extent to which the data are of high value.” According to Zuiderwijk and de Reuver (2021), the primary challenges to successful OGD initiatives, particularly in advancing sustainability, are functionality, support, and inclusiveness, which policymakers should address first to improve outcomes. Meuleman et al. (2022) assessed the sustainable public value of OGD using the Open Government Data Index. They found that countries with stronger OGD performance tend to achieve better sustainability-related governance, particularly in environmental outcomes, public participation, and transparency. They emphasize the integration of sustainability criteria into OGD evaluations to capture its broader public value.

2.3 The Potential Impact and Criticisms of OGD

According to Ahlgren et al. (2016), OGD facilitates sustainable development because publicly available data can be freely used by anyone, and a wide range of unanticipated sustainable ideas, theories, and innovations emerge. In that sense, Ojo et al. (2015) argued that OGD is one of the most impactful resources that cities can use in their daily operations to

provide their citizens and communities with the means to impact in different dimensions - the economy, environment, and equity, among others. At the same time, Ruijter et al. (2020) highlighted that understanding open data usage should be based on active people-centered interactions and encourage ongoing communication, utilizing public knowledge for sustainable urban development. For example, the Helsinki portal specifically focuses on identifying what data various users desire to be accessible by determining the measures of their policy, such as new forms of collaboration, improved services, and enhanced customer satisfaction. As a result, Helsinki features about 100 applications developed with its open data—showcased in its portal—including Blind Square, Biggest Polluter, and Travel Time Matrix (Jaakola et al., 2015).

According to Neves et al. (2020) and Verhulst and Young (2017), in the context of sustainable development, OGD serves four goals. They are (i) create economic opportunity (enable business creation; job creation; new forms of innovation; stimulate economic growth); (ii) help to solve complex public problems (improve situational awareness and preparedness; increase knowledge and expertise to bear on public problems; allow policymakers, civil society, and citizens to target interventions better and track the impact); (iii) improve governance (enhance transparency and accountability; improve service delivery; efficiency gains; increase information sharing within and outside city domains); (iv) empower citizens (improve participatory capacity; act as a catalyst for social mobilization).

Data is never neutral politically, technologically, or socio-culturally. According to Johnson (2015), questions of what information to collect, how to collect it, and which analytical framework to apply to present it can impact its credibility and produce a different impression of the same information. Dealing with open data, the biases of those in power, and the selectiveness of information to expose strengths and hide weaknesses are common issues that many

researchers and analysts face. Therefore, to avoid being misled by data, it is always helpful to consider the data in a broader context, taking into account its provenance (details about the origins of the data) and the interests of those who collected and made it available.

Several points of criticism regarding open data are found in the literature. First, it is crucial to understand that simply making data available does not necessarily lead to improved public governance and the empowerment of all citizens. According to Harrison et al. (2012) and Lourenço (2013), even if the data is disclosed in large amounts, is usable, and of high quality, it does not necessarily mean that the government is becoming more transparent and accountable. Similarly, Menton et al. (2020) argue that environmental justice extends beyond the traditional principles of distribution, recognition, participation, and capabilities, requiring greater attention to power relations and structural inequalities. As Kitchin (2013) mentioned, open data can further empower the empowered and reproduce power imbalances. Public sector data embeds a high degree of social privilege and values in terms of what data is generated, who it relates to, and whose interests a dataset represents and excludes. This underscores the need for responsible data generation and usage, making us all accountable.

Second, there is a lack of frameworks and procedures to assess the implementation of open data initiatives, including open government projects (Harrison et al., 2012). For example, the Open Government Directive did not provide an assessment framework for evaluating U.S. agencies' plans, their implementation, and results. Huijboom & van den Broek (2011) noted that, among the five countries analyzed in their work (Australia, Denmark, Spain, the United Kingdom, and the USA), only the United Kingdom and the USA had evaluated their open data policies. However, none of the countries had assessed their economic and social impacts. The significance of these assessments cannot be overstated, as they can provide crucial insights into

the real-world effects of open data initiatives.

Third, there is some concern regarding the procedures of decision-making on the actual data being disclosed. For example, McDermott claimed that, concerning data.gov, no overall assessment of the published datasets has been conducted. Darbshire (2010) emphasized that limited examples of monitoring the proactive disclosure of data by official or oversight bodies were found and recommended that monitoring of proactive disclosure initiatives be put in place. Patel et al. (2017) emphasized that in implementing SDG 11, more attention needs to be given to what data is important and how and where that data is generated.

There are also challenges in finding information. The more data there is, the more difficult it is to analyze and draw meaningful conclusions (Zurada & Karwowski, 2011). According to Zuiderwijk & Janssen (2013), as a result, varied data is published onto portals in a non-standardized manner, leading to significant variation in terms of semantics, standards, and general schema. Additionally, the search functions of OGD portals can enhance the discoverability of OGD, enabling users to find relevant datasets easily.

Finally, some authors have expressed concerns that there is an overemphasis on the political and technical aspects of open data initiatives, rather than the usability of the published data. According to Kitchin (2013), much more critical attention needs to be given to open data projects as complex socio-technical systems with diverse stakeholders and agendas. After reviewing several open data projects, Helbig et al. (2012) reported that many of them were actually regular websites with miscellaneous data files, but little attention was given to usability, content quality, or the consequences of their use. They concluded that many sites have low and declining traffic because they do not encourage user engagement or facilitate users, and are limited by data management practices, agency effort, and internal politics. This underscores the

need for user engagement, making the audience feel empowered and integral to the success of open data projects.

3. Materials and Methods

3.1 Data Sources

The study was conducted using two comprehensive sources: Arcadis' SCI 2024 report and the extensive content of OGD portals of 19 U.S. cities.

SCI 2024, by Arcadis, globally ranked a convenience sample of 100 cities using 67 indicators across three dimensions of sustainable development: people (social), planet (environmental), and profit (economic) (see Table 4.1).

Table 4.1

U.S. Cities Sample of the Sustainable Cities Index 2024

##	Cities, (States)	Population (2024)	SCI 2024 Rank				Overall SCI 2024
			Planet	People	Profit	Progress	
1	San Francisco CA	874,961	21	76	2	64	35
2	New York NY	8,419,000	22	74	9	72	48
3	Los Angeles CA	3,967,000	18	79	17	74	53
4	Boston MA	684,379	26	69	25	86	56
5	Chicago IL	2,710,000	48	73	6	71	58
6	Seattle WA	724,305	33	78	10	92	60
7	Dallas TX	1,331,000	70	87	3	85	63
8	Philadelphia PA	1,579,000	51	84	20	76	64
9	Washington DC	692,683	46	83	27	75	65
10	Phoenix AZ	1,633,000	50	81	26	87	66
11	Houston TX	2,310,000	82	71	7	91	67
12	Atlanta GA	488,800	53	85	30	84	68
13	Denver CO	705,576	49	82	44	69	70
14	Detroit MI	674,841	56	75	48	78	71
15	Pittsburgh PA	302,205	60	70	45	82	72
16	Baltimore MD	609,032	59	86	41	73	73
17	Tampa FL	387,916	54	77	51	89	74
18	Miami FL	454,279	66	90	36	79	76
19	New Orleans LA	390,845	79	88	34	90	78

The cities in this diverse sample varied greatly in population, ranging from 302.2 thousand to 8.42 million. Geographically, 19 cities represent 14 U.S. States and the District of Columbia. According to the statistical regions defined by the US Census Bureau, five cities are located in the West, four in the Northeast, eight in the South, and two in the Midwest regions of the USA.

This study utilized published data from the official OGD portals of cities (see Table 4.2). References to the OGD portals of 19 U.S. cities were obtained from the Data.gov portal and directly from the cities' portals.

Table 4.2

The Data Sources for the Study

##	City	OGD Portal	Local OGD Portal
1.	San Francisco CA	Data SF	https://datasf.org/opendata/
2.	New York NY	NYC Open Data	https://opendata.cityofnewyork.us
3.	Los Angeles CA	Los Angeles Open Data	https://data.lacity.org
4.	Boston MA	Analyze Boston	https://data.boston.gov
5.	Chicago IL	Chicago Data Portal	https://data.cityofchicago.org
6.	Seattle WA	Seattle Open Data	https://data.seattle.gov
7.	Dallas TX	City of Dallas Open Data	https://www.dallasopendata.com
8.	Philadelphia PA	Open Data Philly	https://opendataphilly.org/
9.	Washington DC	Open Data DC	https://opendata.dc.gov
10.	Phoenix AZ	City of Phoenix Open Data	https://www.phoenixopendata.com
11.	Houston TX	City of Houston Open Data	https://data.houstontx.gov
12.	Atlanta GA	Open Data HUB	https://gis.atlantaga.gov/?page=OPEN-DATA-HUB
13.	Denver CO	Denver Open Data Catalog	https://opendata-geospatialdenver.hub.arcgis.com
14.	Detroit MI	City of Detroit Open Data	https://data.detroitmi.gov
15.	Pittsburgh PA	Open Data Portal	https://pghgishub-pittsburghpa.opendata.arcgis.com
16.	Baltimore MD	Open Baltimore	https://data.baltimorecity.gov/
17.	Tampa FL	City of Tampa Open Data	https://opendata.tampa.gov
18.	Miami FL	City of Miami Open Data	https://datahub-miamigis.opendata.arcgis.com
19.	New Orleans LA	DataDriven	https://datadriven.nola.gov/home/

I worked with SCI 2024 for several reasons. First, it is a well-respected and independent

report. Many other ranking systems refer to their data in their reports. Second, SCI 2024 is updated regularly and includes the latest data from 2023. This is its fifth update since 2015. Also, Arcadis shares SCI 2024 openly, making it easy to compare cities. Due to these reasons, I believe the SCI 2024 ranking is current, based on reliable data, and relevant to this study. The study sampled 19 U.S. cities listed in the SCI 2024. These cities were selected based on their inclusion in the available index and because they are representative of a diverse range of urban environments in the U.S. However, it is unlikely that they represent the highest-performing sustainable cities. I do not assess the accuracy or reliability of the SCI data, as these concerns fall outside the scope of this research.

3.2 Data Collection and Analysis

To examine whether the data from official OGD portals reflect indicators of SDG 11, I conducted a content analysis by focusing on the first seven outcome-oriented targets of SDG 11 (11.1 to 11.7), along with their corresponding 12 indicators (11.1.1 to 11.7.2). I excluded the three letter-designated targets (11.a, 11.b, and 11.c) and their associated indicators (11.a.1, 11.b.1, and 11.b.2), as these targets are conceptually vague, inconsistently defined, and often lack measurable, quantitative indicators. Furthermore, they emphasize national-level linkages between urban, peri-urban, and rural areas — a scope that falls outside the city-level focus of this study.

For example, to explore whether the datasets address affordable housing in line with the SDG 11 framework, I applied the exact Target 11.1, “By 2030, ensure access for all to adequate, safe, and affordable housing and basic services, and upgrade slums.” Housing affordability is a widespread and worsening issue in major U.S. cities. Given this, each city in my sample is likely to face these challenges and should reflect them in its OGD portal through

relevant datasets. In my content analysis, I added the exact indicator 11.1.1 for Target 11.1, which is “the proportion of the urban population living in slums, informal settlements, or inadequate housing.” To identify the relevant datasets, I utilized the internal search engines of each OGD portal with the search inputs of indicator 11.1.1 “inadequate housing,” “informal settlements,” and “population living in slums,” as well as three additional words from the narrative of target 11.1 – “upgrade slums,” “basic services,” and “adequate, safe and affordable housing.” A summary of the datasets for SDG 11 in 19 U.S. cities, using the specified search keywords, is provided in Table 4.3.

The search focused exclusively on datasets, meaning that only datasets containing information directly relevant to a particular SDG 11 target or indicator were considered. I did not examine other types of documents, such as stories, maps, or reports. Additionally, I excluded datasets labeled by city portals as inaccurate or outdated, as well as those not intended for regular updates. I excluded duplicate datasets to avoid repetition. After searching for a specific term, I examined each dataset’s description and variables to determine whether it contained data relevant to the SDG 11 targets or indicators of interest.

In this assessment, I categorized the datasets into two distinct groups. “Datasets directly reflecting SDG 11” when I reached the indicator of interest in “one click” by clicking exactly on the link from the search results. “Datasets indirectly reflecting SDG 11” when I could not reach the indicator of interest in “one click.” However, I was able to calculate that indicator from the datasets I found in no more than three arithmetic operations. For example, for indicator 11.1.1 of SDG 11, I would look for the data on the population living in inadequate conditions and the total population and then divide the former by the latter (see Table 4.3).

3.3 Development of SDG 11+

Following a content review of OGD portals from 19 U.S. cities and analysis of datasets according to SDG 11 indicators, I developed a revised and expanded set of urban sustainability indicators, which I call SDG 11+ (see Table 4.4). I proposed these expanded SDG 11+ indicators by drawing on (a) commonly available city government indicators, (b) additional widely accessible data, (c) city-related targets and indicators from other SDGs, and (d) insights from the urban sustainability literature. This comprehensive approach ensures that all perspectives are considered, making the process more inclusive and the results more robust. In Appendix A.4, the study presented a detailed table of proposed SDG 11+ targets and indicators, along with a clear rationale for the proposed indicators. It clarifies each indicator of SDG 11+, offers an improvement over existing measures, and provides a rationale showing how each target contributes to achieving SDG 11.

One of the most common indicators for affordable housing in the U.S. is the percentage of households spending more than 30% of their income on housing (cost-burdened households), which appeared frequently in the datasets of the OGD portals. Globally, similar measures are used, such as income-to-rent or income-to-mortgage ratios, median house price-to-income ratios, and housing quality or tenure considerations, reflecting differences in housing markets, policies, and available data. Overall, 15 of the 19 city portals returned datasets on cost-burdened households when searching for “affordable housing.” This trend indicates that cities tend to rely on common or locally relevant indicators rather than the global SDG 11 framework.

The identification of potential SDG 11+ indicators relied on accessible data available through municipal OGD portals. Cities frequently publish datasets related to water and energy benchmarking, tree canopy coverage, parking meter occupancy, municipal expenditures, and trip mode metrics. For example, San Francisco provides the Municipal Energy

Benchmarking and Municipal Natural Gas Equipment Inventory datasets, which are mandated by local ordinances to report annual energy and natural gas usage for all non-residential buildings. Another common dataset type is annual expenditure reporting; for instance, Los Angeles publishes detailed data on expenditure categories, time periods, departmental purchases, vendor transactions, and quantities. These datasets are primarily designed to meet regulatory or administrative requirements, rather than directly addressing SDG 11 goals. Additionally, many cities reuse datasets from broader municipal and national sources, such as the U.S. Census, the American Community Survey, and various community-based surveys.

The updated SDG 11+ indicators also incorporate relevant city-related targets and indicators from other SDGs. SDG 11 is connected to 10 of the 17 SDGs, encompassing 30% of all targets and 39% of all indicators. Similarly, Nabiyeve and Wheeler (2024) identified 64 potential interlinkages between SDG 11 and other SDGs. Building on these insights, I examined sustainability-related topics such as poverty, food security, education, energy, equity, climate action, and water, aligning each with its corresponding SDG to integrate these diverse dimensions into the enhanced SDG 11+ framework. Additional SDGs are included if they represent key dimensions of urban sustainability not currently included in SDG 11 (Appendix A.4).

The literature on urban sustainability has provided key insights for identifying relevant SDG 11+ indicators. Drawing on findings from the Joint Center for Housing Studies at Harvard University (2022), which highlighted record levels of cost-burdened renters and unequal impacts on housing affordability across income groups, I identified specific SDG 11+ indicators related to affordable housing. The commonly used terms “slums,” “informal settlements,” and “inadequate housing” are often difficult to define and carry culturally relative

meanings. Therefore, I incorporated a more objective and policy-relevant indicator into the SDG 11+ “% of households spending over 30% of income on housing.” This measure captures affordability challenges across contexts, highlights variations across income groups, and enables better audience engagement by illustrating housing costs relative to household income.

Similarly, Ewing and Cervero (2017) demonstrated that greater urban accessibility and compactness are associated with reduced vehicle miles traveled (VMT). Building on these insights, I added the annual percentage change in VMT per capita as an SDG 11+ indicator. This metric also informs SDG 13, as it relates directly to GHG, car dependency, urban sprawl, and the allocation of public space to motor vehicles—all of which significantly affect urban quality of life.

While SDG 11+ indicators provide a robust starting point for cities seeking to localize and enhance their monitoring of sustainable urban goals, the feasibility and relevance of these initiatives depend on the unique priorities, data infrastructure, and community needs of each city. It is crucial to break down each indicator by factors such as gender, age, race, disability status, income, geographic area, and other relevant demographics. The proposed framework assumes this level of disaggregation for each indicator by default. This detailed analysis not only allows for more effective targeting of interventions to address disparities but also equips city planners, policymakers, and urban development professionals with the tools needed to make a meaningful impact.

The development of the expanded SDG 11+ indicators drew on a review of relevant literature to identify limitations in the existing targets and indicators of SDG 11 and to inform areas for improvement. As discussed in the literature review, Valencia et al. (2019) and Simon et al. (2015) emphasize that urban sustainability requires integrating inclusive planning and

equitable resource allocation to ensure cities meet the needs of all residents. Several authors, such as Tosun & Leininger (2017), Nilsson et al. (2016), Weitz et al. (2018), and Naeem et al. (2018), argued that SDGs need to be adjusted according to the level of development, available resources, and local conditions and circumstances. These insights, combined with findings from other studies, guided the inclusion of more dimensions—such as equity, accessibility, and policy effectiveness—within the SDG 11+ framework to better capture diverse urban sustainability challenges.

The development of SDG 11+ was followed by the application of the same search approach to determine whether datasets existed for each of the new indicators. To identify the relevant datasets, I utilized the internal search engines of each OGD portal with the same number of search inputs for each new indicator of SDG 11+. A summary of the datasets for SDG 11+ in 19 U.S. cities, using the specified search keywords and comparing with datasets for existing SDG 11, is provided in Table 4.5. Finally, the analysis of portal datasets informed recommendations to improve OGD portals and strengthen support for SDG 11.

4. Findings and Discussion

4.1 Relation of OGD Portals to Current SDG 11 Indicators

No datasets published on the portals of 19 U.S. cities directly reflect SDG 11 indicators, and the portals generally do not include any direct discussion of the SDGs. This indicates that these cities have not incorporated globally recognized urban sustainability metrics, as outlined in SDG 11, into their open data practices. Although some portals provided datasets indirectly related to current SDG 11, most cities offered limited or no datasets that could meaningfully indicate progress toward sustainable urban development. In 19 U.S. cities, a total of 495 indirect datasets were identified, reflecting SDG 11 (see Table 4.3).

Table 4.3*Summary of Search Results of Current SDG 11 Datasets of 19 U.S. Cities*

##	Cities, (States)	Datasets in Portal	Total Datasets indirectly reflecting SDG 11	By SDG 11 Targets						
				11.1	11.2	11.3	11.4	11.5	11.6	11.7
1	San Francisco CA	635	65	18	14	2	2	0	6	23
2	New York NY	2578	139	39	41	4	5	2	23	25
3	Los Angeles CA	451	25	11	4	1	2	0	3	4
4	Boston MA	251	36	0	16	2	1	1	2	14
5	Chicago IL	874	37	11	18	1	0	0	0	7
6	Seattle WA	132	21	0	9	0	0	0	1	11
7	Dallas TX	261	8	0	1	1	0	0	2	4
8	Philadelphia PA	392	4	0	0	0	0	0	4	0
9	Washington DC	1455	63	0	28	17	1	0	15	2
10	Phoenix AZ	140	36	1	3	1	3	0	4	24
11	Houston TX	72	3	0	1	0	0	0	2	0
12	Atlanta GA	47	1	0	0	1	0	0	0	0
13	Denver CO	297	8	0	2	1	0	0	3	2
14	Detroit MI	218	6	0	0	1	0	0	1	4
15	Pittsburgh PA	54	3	0	2	0	0	0	0	1
16	Baltimore MD	347	11	1	2	3	0	0	2	3
17	Tampa FL	27	1	0	0	0	0	0	1	0
18	Miami FL	44	12	0	0	5	0	0	6	1
19	New Orleans LA	196	16	2	10	0	2	0	1	1
In Total			495	83	151	40	16	3	76	126

For example, Target 11.1 of SDG 11 has 83 indirect datasets, such as San Francisco’s Affordable Housing Pipeline, organized by the number of units and income. New York offers a Rent Affordability dataset with information on units categorized by rent affordability for each building. Meanwhile, Los Angeles tracks the city’s progress toward goals of permitting 100,000 new housing units and constructing 15,000 affordable units for low-income households from the start of Mayor Garcetti’s administration through the end of fiscal year 2021. However, these datasets do not directly specify indicator 11.1.1 “Proportion of the urban population living in slums, informal settlements, or inadequate housing.” Another example, for Target 11.5, the

“New York City’s Flood Vulnerability Index” combines 12 socio-economic indicators related to various hardships individuals might face due to flooding, but it does not specify the number of people affected by disasters as required in Target 11.5 of SDG 11.

Cities lack datasets related to the existing indicators of SDG 11. For example, 11.1.1 “Proportion of urban population living in slums, informal settlements or inadequate housing,” 11.5.2 “Direct economic loss attributed to disasters in relation to global domestic product,” and 11.5.3 “(a) Damage to critical infrastructure and (b) number of disruptions to basic services, attributed to disasters” have no available data for assessment at all. This finding indicates that cities’ open data partially supports efforts related to SDG 11, while some SDG 11 indicators lack sufficient data. That raises concerns about cities’ OGD supports urban sustainability goals and questions the relevance and practicality of the current SDG 11 indicators.

The availability of datasets varied significantly across targets of SDG 11. The largest number of datasets was with Target 11.2, which focuses on affordable and sustainable transport systems, comprising 151 datasets (31% of the total). Target 11.7, which pertains to access to safe and inclusive spaces, included 126 datasets (25% of the total). For instance, Boston’s Transportation Access Plan Agreement dataset requires developers to assess the transportation conditions and address their impacts on the transportation network, including traffic signals, bike lanes, and incentives to reduce driving. Washington, DC, created an index to assess the built environment and its impact on health outcomes, including indicators such as proximity to bus and train stations, bike-sharing services, bike lanes, sidewalk quality, and parking availability. Although Target 11.2 of SDG 11 has the largest number of datasets, it lacks data addressing transportation needs for women and older persons. Similarly, Target 11.7 of SDG 11 does not include datasets that focus on open space usage by women, children, older persons, and persons

with disabilities. This underscores the significant gaps in capturing equity-focused aspects of urban sustainability, even within the well-represented targets of SDG 11. These gaps are further highlighted by the Gender Data Compass in the UN's SDGs Report 2024, which found that gender-disaggregated data were most available for indicators on demographics, migration, fertility, and reproductive health (with a score of 83) and least available for environmental indicators (23) (UN, 2024). This imbalance demonstrates how critical data limitations hinder the ability to evaluate and address equity dimensions within sustainability efforts.

In contrast, Targets 11.5 (1% of the total), 11.4 (3%), and 11.3 (8%) of SDG 11 showed the least number of datasets. For Target 11.3, no data were found on civil society participation in urban planning (indicator 11.3.2) or the ratio of land consumption to population growth (11.3.1). Some datasets were only indirectly related to Target 11.3 of SDG 11; for example, Miami's Future Land Use dataset provides land use by type but does not capture indicators such as land use efficiency or accessibility for vulnerable populations. For Target 11.4 of SDG 11, no datasets reported per capita expenditure on preserving cultural and natural heritage, disaggregated by funding source and government level. Nevertheless, some related data exist; for instance, New Orleans provides datasets on Neighborhood Conservation and Local Historic Districts. Similarly, for Target 11.5, no data were found on deaths, missing persons, or individuals directly affected by disasters, though indirectly related datasets exist, such as Boston's Climate Ready Social Vulnerability dataset, which highlights the disproportionate risks faced by certain social groups. Overall, while some cities provide partially relevant data, these datasets do not support direct measurement or tracking of SDG 11 indicators. Scholars have also raised concerns about the clarity and relevance of several SDG 11 targets and indicators (Valencia et al., 2019; Simon et al., 2015).

Most indirectly related SDG 11 datasets come from the highest-ranked sustainable cities. Of the total 459 datasets, 86.7% (398) are from the nine top-ranked cities, while the nine lowest-ranked cities contribute only 13.3% (61). New York, San Francisco, and Washington, D.C., alone account for 267 datasets, more than half of the total. In contrast, several low-ranked cities provide only one to three datasets each (e.g., Atlanta, Tampa, Houston, Pittsburgh). These findings suggest that the availability of open data correlates with a city's sustainability performance and that robust data systems can support progress toward SDG 11 goals.

In summary, cities generally lack datasets that directly measure SDG 11 indicators, and data availability varies widely across indicators. Although some open data partially support SDG 11 efforts, significant gaps remain, especially in capturing equity-focused aspects. Notably, the highest-ranked sustainable cities provide the bulk of the indirect data.

4.2 The Relation between OGD and a Potential Indicator Set SDG 11+

The following potential targets and indicators of SDG 11+ draw on commonly available indicators, additional widely accessible data, city-related targets and indicators from other SDGs, and insights from the urban sustainability literature (see Table 4.4).

As shown in Table 4.4, I present potential SDG 11+ targets and indicators designed to be specific, measurable, and inclusive. Many commonly published datasets from city OGD portals can directly serve as indicators within this enhanced SDG 11+ sustainable cities framework. Leveraging locally accessible data and adopting comprehensive approaches under SDG 11+ enable the development of more targeted and equitable policies, ultimately advancing sustainable urban development.

Table 4.4

Potential SDG 11 + Urban Sustainability Targets and Indicators

Current SDG	SDG 11+ Targets	Potential SDG 11+ Indicators
SDG 11	Affordable and adequate housing for all	-- % of households spending over 30% of income on housing
		-- Number of homeless persons per 100k residents
		-- % of new affordable housing units in the total number of new housing units
		-- % of residents living in housing with less than 97 ft ² (9 m ²) per person
	Inclusive, affordable, safe, and sustainable transport	-- % change in vehicle miles traveled (VMT) annually
		-- % of population living within 400 meters of public transport with regular service
		-- % of trips made by walking, biking, and public transit
	Sustainable land use	-- Transport-related fatalities and injuries per 100k residents
		-- Number of residents per acre/hectare of urban area
		-- % of land within neighborhood used for (a) residential, (b) commercial, (c) industrial, and (d) institutional purposes
	Participatory and democratic decision-making	-- % land cover change in metro area for farmland and open spaces
		-- % voter turnout among registered voters in local elections
		-- Number of registered NGOs, political parties, and protest events per 100k residents
		-- Number of SDGs having all indicators covered by the data from the local open data portals
	Protected cultural and natural heritage	-- Existence/strength of open government policies and standards (open meetings, conflict-of-interest, public consultation, transparent election financing, and open data)
		-- # of heritage sites with legal protection status at any scale
		-- Number of ongoing cultural heritage initiatives, programs, or community-led preservation projects per year
	Urban resilience	-- Life expectancy, years
		-- Deaths attributed to disasters per 100k population
		-- Access to health care (Universal Health Coverage Index, doctors/nurses per 100k residents)
	Reduced pollution and resource use	-- Number of green jobs per 100k population
		-- Inflation rate, %
		-- Social infrastructure spending per resident
		-- % of solid waste and wastewater recycled
	Inclusive, safe, and accessible green and public spaces	-- Number of days with good air quality (AQI ≤ 50) annually
		-- % population living less than 300 meters away from major polluters
		-- % of residents living within 800 meters from green space
		-- Amount of green space area in acres/hectares per 100k residents
		-- Violent crime rate per 100k residents

SDG 1	Reduced poverty	-- % of urban population living in poverty according to national definitions -- % of children living in poverty
SDG 2	Reliable access to affordable, nutritious food	-- % of food consumed that is produced within 100 miles -- % of residents living within 800 meters of a grocery store -- % residents with obesity (Body Mass Index ≥ 30) in the total population
SDG 4	Inclusive, high-quality education and sustainability knowledge	-- % of residents with at least a high school diploma -- Number of public libraries per 100k residents -- % of public schools offering sustainable development curriculum
SDG 5	Social equity	-- % of urban women in poverty -- Number of women's suicides per 100k population -- Women's mortality rate [number of deaths] per 100k population -- Number of women's organizations & support centers per 100k residents
SDG 6	Safe, affordable drinking water	-- % of population lacking access to safe drinking water -- Total Dissolved Solids (milligrams per liter) in public water supply -- % of buildings reporting annual water benchmarking data
SDG 7	Renewable energy	-- % of buildings reporting annual energy benchmarking data -- % renewable energy in electric power
SDG 10	Reduce inequality	-- City-level Gini coefficient (from 0 to 1) -- % of population guaranteed anti-discrimination protections related to jobs, housing, and services -- % of population guaranteed free or affordable legal assistance
SDG 13	Climate mitigation and equity	-- Total and per capita GHG emissions -- % of municipal climate-related spending targeted to disadvantaged populations (by income, race, age, disability, or location)

Energy and water benchmarking indicators were also integrated into the SDG 11+, as some cities mandate reporting on building performance. For instance, Los Angeles, San Francisco, and New York require annual benchmarking of energy and water use, while Seattle's Building Emissions Performance Standard (BEPS) and Boston's Building Energy Reporting and Disclosure Ordinance (BERDO) strengthen transparency and efficiency in building operations. These examples highlight the role of locally mandated datasets in enhancing SDG 11+ indicators and supporting data-driven urban sustainability policies.

The updated SDG 11+ indicators incorporate relevant measures from other city-related SDGs. For example, under SDG 5 (Gender Equality), the indicator "Number of women's organizations and support centers per 100,000 residents" expands the assessment of social inclusion and support services (see Table 4.4). Under SDG 6 (Clean Water and Sanitation), the updated framework includes indicators such as "Percentage of the population lacking access to safe drinking water" and "Total Dissolved Solids levels in public water supplies."

To evaluate the environmental performance of urban systems while considering both climate and public health impacts, it is important to track comprehensive baseline metrics. For example, New York has set ambitious goals to reduce GHG emissions by 40% by 2030 and 80% by 2050. Therefore, I included the indicator "Total and per capita GHG emissions" in SDG 11+. This metric allows consistent comparisons across cities and strengthens integrated climate, health, and urban planning by providing a solid foundation for assessing progress.

Instead of using indicators lacking available datasets, such as 11.5.2 ("Direct economic loss from disasters relative to global GDP") and 11.5.3 ("Damage to infrastructure and disruptions to basic services"), the study proposed new indicators to better assess urban resilience: "Access to health care" (e.g., Universal Health Coverage Index, doctors/nurses per

100k residents), “Green jobs per 100k population” to track local economic adaptation, and “Social infrastructure spending per resident” to measure public investment in education, health, and social protection.

One of the important indicators for assessing environmental justice, “% population living less than 300 meters away from major polluters,” was added to the Target “Reduced pollution and resource use.” According to the Environmental Justice Mapping and Screening Tool, populations residing within 300 meters of major roadways face an elevated risk of exposure to traffic-related air pollution, which has been consistently linked to adverse health outcomes. For instance, a critical review by the Health Effects Institute (2010) found that 30% to 45% of people in large North American cities live within 300–500 meters of major roads, an area most affected by traffic emissions.

In practice, cities often prioritize indicators aligned with their specific contexts rather than strictly adhering to the universal measures defined by the 2030 Agenda. Therefore, global SDG frameworks should incorporate locally relevant indicators and data. Many cities already collect valuable datasets with strong potential to support an updated and more equity-oriented SDG 11+.

After developing the SDG 11+ indicators, the study reviewed the availability of datasets for each new target of SDG 11+. Using the same approach applied to the current SDG 11, I summarized and compared the results of indirect datasets reflecting SDG 11 and SDG 11+ for 19 U.S. cities, as shown in Table 4.5

SDG 11+ indicators enable cities to utilize existing datasets for more comprehensive analyses of urban sustainability. As shown in Table 4.5, datasets indirectly related to SDG 11+ are more widely available than those for the current SDG 11. High-performing cities also

provide direct datasets, such as “% of households spending over 30% of income on housing” and “% of buildings reporting annual water or energy benchmarking data.” All SDG 11+ targets have at least some indirectly related datasets, supporting broader and more diverse analyses that advance sustainable urban development. Consequently, SDG 11+ indicators facilitate in-depth and multidimensional assessments, where each dataset adds a new layer of insight. High-ranked cities lead this effort: the nine top-ranked cities account for over 84% of the datasets, while the nine lower-ranked cities contribute only 12%.

Table 4.5

Datasets Reflecting Existing SDG 11 and Potential SDG 11+ in 19 U.S. Cities

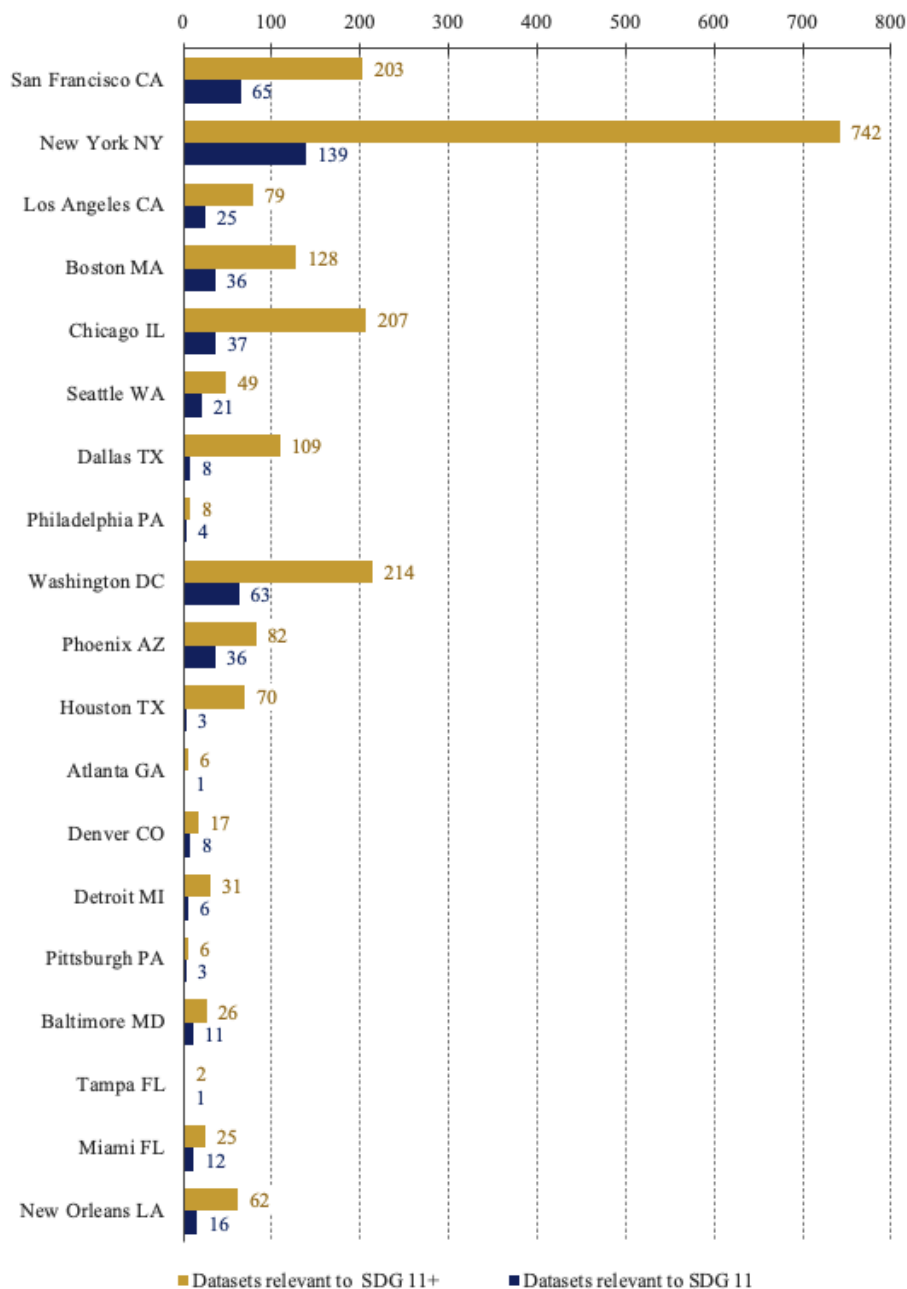
##	Cities, (States)	Count of Datasets		By SDG 11+ Targets						
		For SDG 11	For SDG 11+	11.1	11.2	11.3	11.4	11.5	11.6	11.7
1	San Francisco CA	65	203	23	51	49	31	13	6	30
2	New York NY	139	742	93	208	95	120	80	16	130
3	Los Angeles CA	25	79	14	21	19	8	9	4	4
4	Boston MA	36	128	29	3	32	25	19	0	20
5	Chicago IL	37	207	7	122	27	23	17	0	11
6	Seattle WA	21	49	2	10	7	8	2	1	19
7	Dallas TX	8	109	30	3	10	9	0	57	0
8	Philadelphia PA	4	8	0	0	5	0	0	3	0
9	Washington DC	63	214	15	1	113	5	16	8	56
10	Phoenix AZ	36	82	16	0	7	19	23	4	13
11	Houston TX	3	70	2	0	1	63	2	2	0
12	Atlanta GA	1	6	0	0	6	0	0	0	0
13	Denver CO	8	17	0	0	8	1	3	3	2
14	Detroit MI	6	31	2	1	23	0	3	1	1
15	Pittsburgh PA	3	6	1	0	3	0	0	0	2
16	Baltimore MD	11	26	2	0	12	1	2	5	4
17	Tampa FL	1	2	0	0	0	1	0	1	0
18	Miami FL	12	25	0	0	12	0	2	7	4
19	New Orleans LA	16	62	3	5	47	2	2	1	2
In Total		495	2,066	239	425	476	316	193	119	298

There are notable differences in the number of datasets between SDG 11 and SDG 11+,

with a total gap of 1,571 datasets (see Figure 4.3). Regarding the ratio of datasets for SDG 11 and SDG 11+, cities such as Houston (23.3), Dallas (13.6), and Chicago (5.6) have the potential to significantly shape sustainable urban development.

Figure 4.3

OGD SDG 11 vs SDG 11+ the U.S. Cities



4.3 Recommendations for Improvement of OGD Portal

Analyzing local open data portals of 19 U.S. cities helped identify key areas for improvement to better support SDG 11. Cities need to take a holistic approach to redesigning their OGD portals. Several critical areas that require attention are highlighted, such as updating the usability of OGD, enhancing overall portal content, prioritizing data integrity, managing timely updates, providing more “just disaggregated” OGD, and adopting “all-of-society,” which are discussed in detail below.

Usability functions need significant enhancements to improve data discoverability. City portals should strengthen technical capabilities for accessibility and usability, including allowing users to filter datasets, providing complete descriptions for each data column, defining acronyms in dataset titles, and eliminating duplicate datasets that differ only slightly. For example, the Boston and Phoenix portals do not allow filtering by view type, while in San Francisco and New York, searches using the same keywords sometimes fail to retrieve existing datasets. Additionally, Seattle presents “Paid Parking Occupancy” as five separate datasets covering 2018 through 2022, which could be consolidated for clarity.

Cities need to enhance their overall portal content design by explicitly linking OGD with specific city policy goals and SDG 11/SDG 11+. Presenting relevant indicators alongside comprehensive datasets and illustrating how these datasets demonstrate progress toward sustainability can better support cities in achieving their sustainability objectives. For example, San Francisco tracks the indicator of the city policy “% of households spending over 30% of income on housing,” related to SDG 11+, using its “Housing Production – 2005 to present” dataset, which details the number of units affordable to households across different income levels. For completed programs, such as the City of Phoenix’s “American Rescue Plan

Act Funding from 2021 to 2024,” the city should demonstrate completeness across program indicators and provide sufficient data descriptions. This structured approach to aligning portal content with sustainability goals can be replicated and effectively visualized in the dashboards across other policy areas within cities.

Cities need to prioritize data integrity by identifying key relationships between data points and standardizing them across departments. While some city portals provide large quantities of data, the significance or intent of these datasets is often unclear. Simply publishing data is not enough. For example, San Francisco’s Environment Department could better integrate its datasets with those from the Public Works or Health Service System Departments to uncover intersections that reveal critical urban challenges, such as the “San Francisco Flood Health Vulnerability.” Achieving this qualitative integration requires standardized data structures and definitions for the same entities, such as businesses or neighborhoods, across all departments. Cities can benefit from tools that enable the holistic integration of datasets, producing clear, visual representations that effectively inform policy and serve public needs.

Numerous scholars have highlighted the lack of timely updates for published datasets. For instance, the Park District’s Facilities Work Order Management system was intended to be updated weekly according to the dataset description, yet it has not received any updates since 2012. Some portals include datasets labeled as outdated or historical, without providing any corresponding recent data. For example, the SNAP Data by Pittsburgh Neighborhoods from a 2010 citywide study includes a note: “Please note that this data is not up to date. It was created with 2010 census data and early 2010s data for non-census-related data. Historic data is considered to be accurate at the time it was captured, but is not intended to reflect current conditions.” Such outdated datasets reduce the relevance and usability of OGD portals for

decision-making. Data timeliness remains a major challenge. As highlighted in the UN’s report, “approximately one third of indicators lack data for the past three years, hampering the ability of policymakers to make timely informed decisions and course corrections” (UN, 2024, p. 4).

More than “just disaggregated” OGD is essential for tracking the progress of SDGs. Some city portals lack key demographic and equity data—such as gender, age, ethnicity, disability status, religion, and income—and existing data are often inconsistently formatted across departments, making it difficult to combine, compare, or analyze. Cities should organize these datasets to ensure they are fully usable for analysis and informed decision-making.

An “all-of-society” approach, which actively engages governments, the private sector, civil society, academia, and local communities in both data collection and decision-making, is essential for integrating more inclusive and representative OGD. For example, the Seattle Open Data Portal includes a Customer Satisfaction Survey capturing feedback from individuals who interacted with officers after calling 911. Similarly, San Francisco offers multiple survey datasets, such as the Customer Survey on public facilities and services, the City Survey on residents’ perceptions of libraries, safety, and street cleanliness, and the Travel Decision Survey on commuting behaviors. Dallas also provides a Community Survey to improve service delivery and establish priorities based on residents’ input. To truly advance sustainability and equity, cities must actively empower community members to participate in shaping policies and solutions. Consistent and systematic support for participatory data collection strengthens OGD’s ability to foster community engagement and drive measurable progress toward achieving SDG 11+.

Conclusion

This paper examines how city-level OGD portals support SDG 11. The analysis focuses on 19 U.S. cities ranked in the 2024 SCI, using content analysis to assess their OGD portals to SDG 11 as well as an expanded and revised set, referred to as SDG 11+, to more comprehensively address the needs of sustainable urban development.

The study found that none of the 19 local OGD portals directly displayed current SDG 11 indicators, serving as an empirical example of this gap. The datasets that are indirectly related to SDG 11+ are more widely available than those directly related to the current SDG 11. SDG 11+ indicators enable cities to leverage existing datasets for more comprehensive analyses of urban sustainability. By analyzing the content of OGD portals in nine high-ranked and nine low-ranked sustainable cities, I identified that the availability of open data is correlated with a city's sustainability performance.

Examining local open data portals from 19 U.S. cities revealed important areas for improvement to strengthen support for SDG 11. Cities should adopt a more holistic strategy when redesigning their OGD portals. Specifically, key priorities include upgrading usability features, enriching portal content, ensuring data integrity, maintaining timely updates, offering more “just disaggregated” datasets, and embracing an “all-of-society” approach.

Summary and Conclusions

This dissertation examined the role of OGD in sustainable urban development, with particular attention to SDG 11. The central research problem addressed in this study is that, despite the growing importance of SDG 11 and the rapid expansion of OGD initiatives, limited research has systematically examined how open data can support planning, sustainability assessment, and progress toward sustainable urban development. The purpose of this dissertation was to investigate how SDG 11 has been implemented globally, how it relates to the broader SDG framework, and how city-level OGD systems can support planning and sustainability.

Together, the four chapters provide a comprehensive analysis linking OGD and SDGs, specifically SDG 11. Chapter 1 showed that implementation of SDG 11 has been uneven across countries, with limited attention to equity-related targets. Chapter 2 showed that SDG 11 is strongly connected to SDG 13 (Climate Action) and SDG 17 (Partnerships for the Goals) but is less closely linked to SDG 7 (Affordable and Clean Energy), SDG 2 (Zero Hunger), and SDG 16 (Peace, Justice, and Strong Institutions) than might be expected, suggesting areas where future iterations of the SDG framework could be strengthened. Chapter 3 found that OGD initiatives in U.S. cities remain in an early stage of development and are only partially integrated into municipal policies and planning documents. Chapter 4 revealed that existing OGD portals do not align well with current SDG 11 indicators and proposed an expanded indicator framework, SDG 11+, that provides a more practical and locally relevant basis for assessing urban sustainability.

Collectively, these findings advance the literature in several important ways. First, the dissertation offers one of the earliest integrated analyses linking SDG 11 and OGD. Second, it extends understanding of OGD beyond its traditional role as a transparency and accountability tool by demonstrating its potential as a practical instrument for planning, policy evaluation, and

sustainability assessment. Third, it bridges the gap between global sustainability frameworks and local planning practice by showing how city-level data systems can operationalize and improve sustainability indicators. Finally, the dissertation contributes practical conceptual recommendations and tools, for example, an OGD good-practice template and the SDG 11+ indicator framework.

The findings also have important implications for planning practice and public policy. For OGD to become a more effective tool for sustainable urban development, cities need to improve the quality, relevance, and accessibility of their data. This includes prioritizing policy-relevant datasets, strengthening data standards, providing more timely and appropriately disaggregated information, and offering training and outreach to diverse user groups. More broadly, planners and policymakers should integrate OGD into general plans, sustainability and climate action plans, and performance-monitoring systems so that data can be used systematically to guide decision-making and evaluate progress toward policy goals.

Overall, data are not merely technical resources but essential to sustainable urban governance. Stronger data systems, more relevant indicators, and better integration of OGD into planning processes can substantially enhance cities' ability to monitor, evaluate, and advance progress toward SDG 11 and sustainable urban development.

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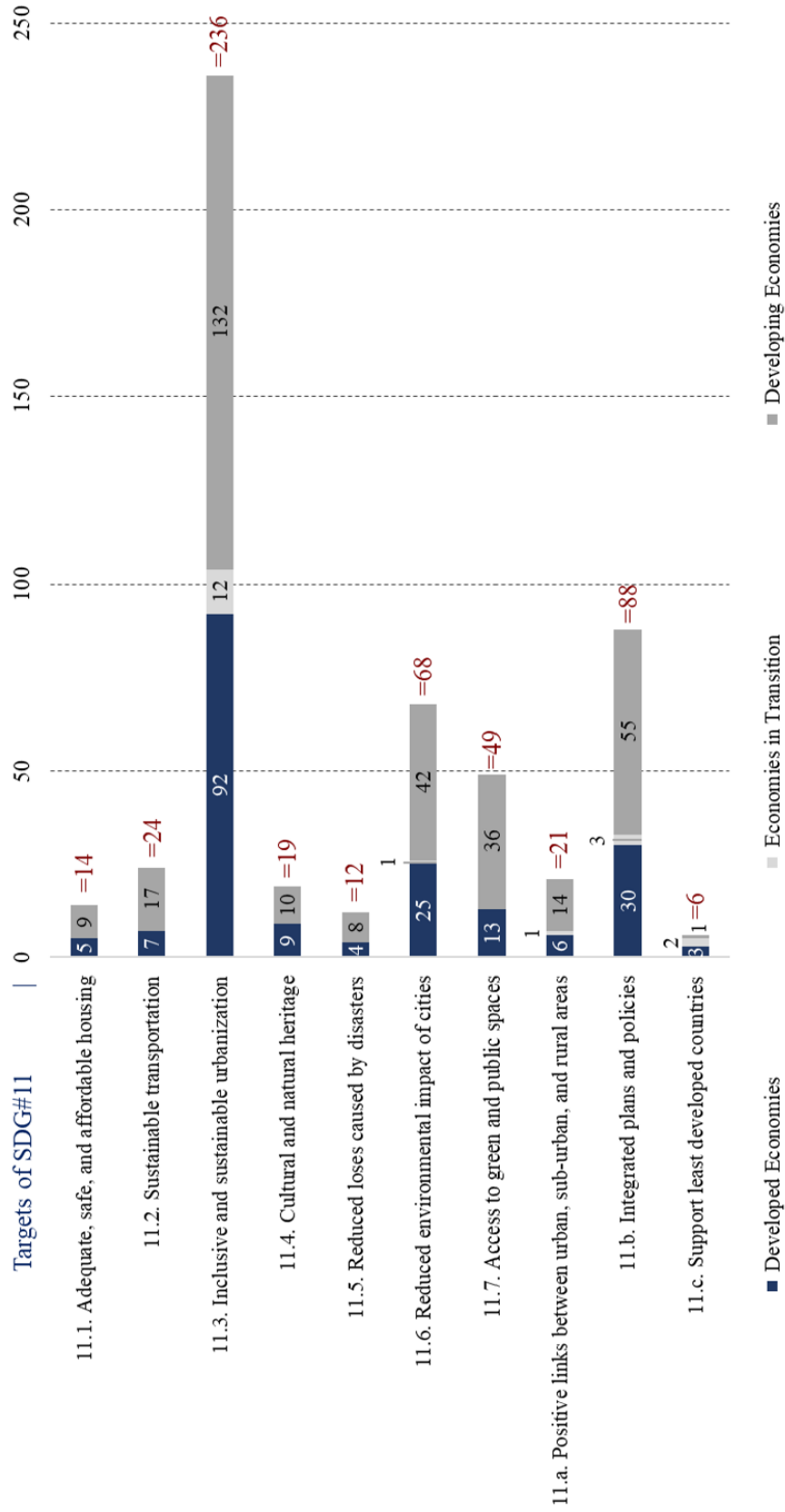
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APPENDIX A.1

The Distribution of Good Practices by the Targets of SDG 11 and Types of Economies



APPENDIX B.1

The Distribution of the Submitted Practices by Focus Areas

##	Focus Area	First Open Call		Second Open Call		Both Open Calls	
		Number of practices	% of the total	Number of practices	% of the total	Number of practices	% of the total
1	Planning	62	25.5%	12	7.5%	74	18.4%
2	Management	33	13.6%	15	9.4%	48	11.9%
3	Inclusiveness	28	11.5%	35	21.9%	63	15.6%
4	Raising awareness	22	9.1%	5	3.1%	27	6.7%
5	Capacity building	16	6.6%	32	20.0%	48	11.9%
6	Reducing wastes	11	4.5%	2	1.3%	13	3.2%
7	Healthier environment	10	4.1%	17	10.6%	27	6.7%
8	Green/public spaces	10	4.1%	9	5.6%	19	4.7%
9	Housing	9	3.7%	1	0.6%	10	2.5%
10	Wildlife	7	2.9%	-	0.0%	7	1.7%
11	Disaster control	5	2.1%	1	0.6%	6	1.5%
12	Tourism	5	2.1%	4	2.5%	9	2.2%
13	Water supply	4	1.6%	6	3.8%	10	2.5%
14	Volunteering	3	1.2%	2	1.3%	5	1.2%
15	Transportation	3	1.2%	-	0.0%	3	0.7%
16	Human rights	2	0.8%	2	1.3%	4	1.0%
17	Cultural heritage	2	0.8%	1	0.6%	3	0.7%
18	Infrastructure	2	0.8%	-	0.0%	2	0.5%
19	Air quality	2	0.8%	-	0.0%	2	0.5%
20	Energy	1	0.4%	-	0.0%	1	0.2%
21	Sports	1	0.4%	-	0.0%	1	0.2%
22	Technology	1	0.4%	-	0.0%	1	0.2%
23	Food supply	1	0.4%	10	6.3%	11	2.7%
24	Healthcare	1	0.4%	-	0.0%	1	0.2%
25	Education	1	0.4%	-	0.0%	1	0.2%
26	COVID	-	0.0%	4	2.5%	4	1.0%
27	Public Safety	-	0.0%	1	0.6%	1	0.2%
28	International Development	1	0.4%	1	0.6%	2	0.5%
In Total		243	100.0%	160	100.0%	403	100.0%

Note: Because some practices address several areas, the total number of times each area has been addressed is greater than the total number of good practices.

Appendix A.2

Interlinkages between SDG 11 and Other SDGs from the Literature Review

##	Source	Data for Analysis	SDGs interlinked with SDG 11																	
			1	2	3	4	5	6	7	8	9	10	12	13	14	15	16	17	Σ	
1.	Le Blanc (2015)	SDGs through the targets.	1		1						1	1				1		6		
2.	Misselwitz et al. (2015)	Systematic analysis of SDGs, targets, and indicators	1	1							1	1				1		5		
3.	Nilsson et al. (2016)	The interactions of SDGs						1					1					2		
4.	Vladimirova & Le Blanc (2016)	37 reports by the flagship UN organizations			1													1		
5.	Pradhan et al. (2017)	UN data on SDG indicators for 227 countries					(1)				1							1		
6.	The International Council for Science (2017)	Science-informed analysis of interactions across SDG domains												1				2		
7.	Tosun & Leininger (2017)	Voluntary National Reviews by six countries		1	1		1	(1)			1							4		
8.	MacDonald et al. (2017)	Surveys of 111 local governments															1	1		
9.	Qatar National Development Strategy on the SDGs (2017)	Strategic planning					1	1			1	1	1	1	1	1		7		
10.	Fuso Nerini et al. (2018)	SDG targets and the published evidence					1											1		
11.	Weitz et al. (2018)	34 SDG targets									1					1	1	3		
12.	UN DESA (2019)	UN reports and data	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16		
13.	Mantlana & Maoela (2020)	Published UN reports and academic manuscripts								1								1		
14.	Vijayapur & Shashidhar (2021)	2019-2020 Aayog Report by the National Institution for Transforming India (NITI)	1	1		1	1	1	1	1	1				1	1		7		
15.	Laumann et al. (2022) – all countries	400 indicators of the World Bank & the average											1				1	2		
In Total			1	5	2	6	3	4	4	3	3	3	4	5	6	3	2	7	4	64

Appendix B.2

Method for Analyzing Relative Proportions of Interlinkages

To analyze the interlinkages, I first calculated the total number of interlinkages between SDG 11 and each of the other SDGs by adding the numbers of the corresponding interlinkages for each practice:

$$I_{[SDG_{11} \leftrightarrow SDG_x]} = \sum_{n=1}^{n=17} I_{n[SDG_{11} \leftrightarrow SDG_x]}$$

where:

$I_{[SDG_{11} \leftrightarrow SDG_x]}$ – the total number of interlinkages between SDG 11 and SDG x , x – a specific number of another SDG linked with SDG 11, $x = [1, 10]$ and $[12, 17]$;

$I_{n[SDG_{11} \leftrightarrow SDG_x]}$ – a dummy variable indicating the presence of the interlinkage between SDG 11 and SDG x in a good practice n :

– $I_{n[SDG_{11} \leftrightarrow SDG_x]} = 1$, if there was an interlinkage between SDG 11 and SDG x in a good practice n ; or

– $I_{n[SDG_{11} \leftrightarrow SDG_x]} = 0$, if there was no interlinkage between SDG 11 and SDG x in a good practice n .

The total number of interlinkages between SDG 11 and all other SDGs was calculated by the addition of the numbers of all interlinkages between SDG 11 and each other SDG for all good practices in the sample:

$$I_{\text{total}} = \sum_{x=1}^{x=17} I_{[SDG_{11} \leftrightarrow SDG_x]}$$

Next, I calculated the proportions of the interlinkages between SDG 11 and each of the other SDGs ($I_{[SDG_{11} \leftrightarrow SDG_x]}$) in the total number of intersections between SDG 11 and all other

SDGs (I_{total}). Then, I compared those proportions among SDGs, noticing the ones with the highest and lowest proportions of interlinkages. Finally, I compared how the proportions of the interlinkages differed between the developed and developing countries.

To examine the significance of the difference in frequency distribution among SDGs for the entire data sample, I utilized a one-sample *chi*-square test for the hypothesis of equal proportions (e.g., assuming that interlinkages should be distributed equally among SDGs). To analyze the difference in the distribution of the interlinkages by types of economy, I utilized a *chi*-square test of homogeneity to test whether the observed differences were significant. To conduct both *chi*-square tests, I utilized the *Statistical Package for Social Science* (IBM SPSS Statistics), version 29.0.0.0(241).

Appendix A.3

Summary of the Metrics of the OGD Portals' Performance from the Previous Studies

##	Source	Purpose of Study	Dimension (Group)	Criteria (Subgroup)
1.	Lourenço (2013)	The author analyzed the functionality and data organization of the OGD portals from Australia, Canada, France, New Zealand, Singapore, the United Kingdom, and the United States based on the seven desired characteristics of data disclosure proposed in the literature on open government and transparency assessment.	1.1. Quality	[R1] Portals should consider mechanisms for external and independent quality assurance processes and associate the results of such revision processes with each published dataset.
			1.2. Completeness	[R2] Portals should present a master list of: – all relevant governmental dataset sources (not just entities publishing data); – all entities for which data is being disclosed; – all accountability-related information; – all time periods covered. [R3] Portals should provide metadata (the detailed description of each dataset) for each dataset.
			1.3. Access & Visibility	[R4] Portals should provide a mechanism for clearly identifying and distinguishing accountability-related datasets. [R5] Portals should provide free, oriented search and browsing mechanisms to help users find the required and related/complementary datasets.
			1.4. Usability & Comprehensibility	[R6] Portals should provide clear and simple descriptions (dictionaries) about the concepts associated with the data being disclosed.
			1.5. Timeliness	[R7] Portals should provide information that allows for assessing delay in information provision, such as release date, periodicity of publication, and the actual release and update date of each dataset.
			1.6. Value & Usefulness	[R8] Portals should provide mechanisms to allow users to suggest missing valuable data. [R9] Portals should provide mechanisms that allow users to express some measure of value or usefulness of the data disclosed.

	1.7. Granularity	[R10] Portals should provide each dataset with an indication of its granularity level (unit of analysis).
2. Vetro et al. (2016)	2.1. Traceability	2.1.1. Track of creation - the presence of metadata associated with the creation of a dataset. 2.1.2. Track of updates - the presence of metadata associated with the updates done to a dataset.
	2.2. Currentness	2.2.1. Percentage of current rows - the percentage of rows in a dataset that have current values; it means that they do not have any value that refers to a previous or following period. 2.2.2. Delay in publication - the ratio between (i) the number of days passed between the moment in which the information is available and the publication of the dataset, and (ii) the period referred to by the dataset (week, month, year).
	2.3. Expiration	2.3.1. Delay after expiration - the ratio between (i) the delay in the publication of a dataset after the expiration of its previous version and (ii) the period referred to by the dataset (week, month, year).
	2.4. Completeness	2.4.1. Percentage of complete cells - the percentage of the cells that are not empty and have a meaningful value assigned (a value coherent with the domain of the column).
	2.5. Compliance	2.5.1. Percentage of complete rows - the percentage in a dataset of the rows that do not have any incomplete cells. 2.5.2. Percentage of standardized columns - the percentage in a dataset of the columns representing some kind of information that has standards associated with it (for example, geographic information). 2.5.3. e-Government Metadata Standard (eGMS) compliance - the degree to which a dataset follows the e-GMS standard (a standardized framework designed to ensure the consistent description of OGD datasets and other government information, including the data categories, store, and presentation). 2.5.4. Five-star Open Data - the level of the Five-star Open Data model by Tim Berners-Lee, in which the dataset is and the advantage offered by this reason.

To get the maximum score of five stars, a dataset must (i) be available on the Internet under an open license, (ii) be in the form of structured data, (iii) be in a non-proprietary file format, (iv) use a uniform resource identifier (URI), and (v) include links to other data sources.		
2.6.	Understandability	2.6.1. Percentage of columns in a dataset that have associated descriptive metadata. The metadata easily allows understanding the information of the data and the way it is represented.
		2.6.2. Percentage of columns in comprehensible format - the percentage of columns in a dataset represented in a machine-readable format that can be easily understood by the users.
2.7.	Accuracy	2.7.1. Percentage of accurate cells - the percentage of cells in a dataset that have correct values according to the domain and the type of information in the dataset.
		2.7.2. Accuracy in aggregation - the ratio between the error in aggregation and the scale of data representation.
3.	Thorsby et al. (2017)	3.1. Content
		3.2. Help
3.	The study analyzed 37 LOGDIs of American cities based on the statistical analysis of interrelations between the characteristics of LOGDI portals and the city's type of government, population size, average level of education, associations with regional consortia (collaboration with communities to support	3.1.1. Datasets per 100,000 population.
		3.1.2. Organization of datasets by categories.
3.	The study analyzed 37 LOGDIs of American cities based on the statistical analysis of interrelations between the characteristics of LOGDI portals and the city's type of government, population size, average level of education, associations with regional consortia (collaboration with communities to support	3.1.3. Are users able to manipulate data in datasets online?
		3.1.4. Number of categories into which datasets are organized.
3.	The study analyzed 37 LOGDIs of American cities based on the statistical analysis of interrelations between the characteristics of LOGDI portals and the city's type of government, population size, average level of education, associations with regional consortia (collaboration with communities to support	3.1.5. Are users able to create visualizations online with the data?
		3.1.6. Are the data files in machine-readable formats?
3.	The study analyzed 37 LOGDIs of American cities based on the statistical analysis of interrelations between the characteristics of LOGDI portals and the city's type of government, population size, average level of education, associations with regional consortia (collaboration with communities to support	3.1.7. Are users able to suggest new datasets?
		3.1.8. Is metadata available to define and explain data?
3.	The study analyzed 37 LOGDIs of American cities based on the statistical analysis of interrelations between the characteristics of LOGDI portals and the city's type of government, population size, average level of education, associations with regional consortia (collaboration with communities to support	3.2.1. Can users search through datasets?
		3.2.2. Can users search through help topics?
3.	The study analyzed 37 LOGDIs of American cities based on the statistical analysis of interrelations between the characteristics of LOGDI portals and the city's type of government, population size, average level of education, associations with regional consortia (collaboration with communities to support	3.2.3. Are tutorials available?
		3.2.4. Is a list of help topics available?
3.	The study analyzed 37 LOGDIs of American cities based on the statistical analysis of interrelations between the characteristics of LOGDI portals and the city's type of government, population size, average level of education, associations with regional consortia (collaboration with communities to support	3.2.5. Is clear contact information available for users if they need help?

4.	Zhu & Freeman (2019)	The authors developed the User Interaction Framework based on the existing principles and evaluation methods to examine LOGDIs of 34 U.S. municipal government agencies from the perspective of potential users.	3.3. Policy	3.3.1. Is there data or an open data policy? 3.3.2. Is there a term of use statement?
			3.4. Result	3.4.1. Is there an app showcase available? 3.4.2. Is there a call for action or an invitation for citizens to use the data? 3.4.3. Is other information about the results of the datasets available? 3.4.4. Are analytics available? 3.4.5. Are APIs and other information for developers available?
4.	Zhu & Freeman (2019)	The authors developed the User Interaction Framework based on the existing principles and evaluation methods to examine LOGDIs of 34 U.S. municipal government agencies from the perspective of potential users.	4.1. Access	4.1.1. Data organization. 4.1.2. Searchability. 4.1.3. Restriction free. 4.1.4. License. 4.1.5. Multiple languages. 4.1.6. Machine processability. 4.1.7. Open formats.
			4.2. Trust	4.2.1. Permanent uniform resource identifier (URI). 4.2.2. Completeness. 4.2.3. Currentness. 4.2.4. Availability of data policy. 4.2.5. Sources. 4.2.6. Granularity of data. 4.2.7. Relevancy
4.	Zhu & Freeman (2019)	The authors developed the User Interaction Framework based on the existing principles and evaluation methods to examine LOGDIs of 34 U.S. municipal government agencies from the perspective of potential users.	4.3. Understand	4.3.1. User support. 4.3.2. App showcase. 4.3.3. Documentation. 4.3.4. Metadata.
			4.4. Engage-integrate	4.4.1. Availability of analytics. 4.4.2. Availability of Application Programming Interface (API).

	4.4.3. Availability of citation format.
	4.4.4. Personalization.
	4.4.5. Download.
	4.4.6. Online manipulation.
	4.4.7. Online visualization.
	4.4.8. Comparative data sets.
4.5. Participate	4.5.1. Proactive engagement.
	4.5.2. Shareability.
	4.5.3. Participation.
	4.5.4. User feedback.

Appendix B.3

The US Cities Sample from the SCI 2024

##	City, State	SCI 2024 Rank				Overall SCI 2024
		Planet	People	Profit	Progress	
1	San Francisco, CA	21	76	2	64	35
2	New York, NY	22	74	9	72	48
3	Los Angeles, CA	18	79	17	74	53
4	Boston, MA	26	69	25	86	56
5	Chicago, IL	48	73	6	71	58
6	Seattle, WA	33	78	10	92	60
7	Dallas, TX	70	87	3	85	63
8	Philadelphia, PA	51	84	20	76	64
9	Washington, DC	46	83	27	75	65
10	Phoenix, AZ	50	81	26	87	66
11	Houston, TX	82	71	7	91	67
12	Atlanta, GA	53	85	30	84	68
13	Denver, CO	49	82	44	69	70
14	Detroit, MI	56	75	48	78	71
15	Pittsburgh, PA	60	70	45	82	72
16	Baltimore, MD	59	86	41	73	73
17	Tampa, FL	54	77	51	89	74
18	Miami, FL	66	90	36	79	76
19	New Orleans, LA	79	88	34	90	78

Appendix C.3

The Data Sources for the Study

#	City	General Plan	Strategic Plan	OGD Policy
1.	San Francisco CA	San Francisco General Plan, https://generalplan.sfpplanning.org/g/opendata/	San Francisco's Climate Action Plan 2021, https://www.sfenvironment.org/files/events/2021_climate_action_plan.pdf	Chapter 22D: Open Data Policy, https://codelibrary.amlegal.com/codes/sanfrancisco/latest/sf_admin/0-0-0-13982
2.	New York NY	One NYC 2050, https://climate.cityofnewyork.us/reports/onenyc-2050/	PlaNYC: Getting Sustainability Done, https://climate.cityofnewyork.us/wp-content/uploads/2023/06/PlaNYC-2023-Full-Report.pdf	Local Laws of the City of New York, https://legistar.council.nyc.gov/LegislationDetail.aspx?ID=649911&GUID=E650813B-B1E9-4E56-81BA-58261487DA4A
3.	Los Angeles CA	Los Angeles General Plan, https://planning.lacity.gov/plans-policies/general-plan-overview	L.A.'s Green New Deal, https://plan.mayor.lacity.gov/sites/g/files/wph2176/files/2022-12/pLAn_2019_final.pdf	The City of Los Angeles Executive Directive No. 3, https://lacity.gov/sites/g/files/wph2451/file/s/2021-04/garcetti_ed03.pdf?utm_source=chatgpt.com
4.	Boston MA	Imagine Boston 2030, https://www.boston.gov/sites/default/files/embed/file/2018-06/imagine2030boston202030_pages2.pdf	City of Boston Climate Action Plan, https://www.boston.gov/sites/default/files/embed/file/2019-10/city_of_boston_2019_climate_action_plan_update_4.pdf	City of Boston Open and Protected Data Policy, https://data.boston.gov/dataset/open-and-protected-data-policy/resource/55dff3c-4b53-462f-b4c9-af51a81c7273
5.	Chicago IL	We will Chicago, https://www.chicago.gov/content/dam/city/depts/dcd/we_will/we_will_documents/cpc/WWC_Final_CPC.pdf	Chicago Climate Action Plan, https://www.chicago.gov/content/dam/city/sites/climate-action-plan/documents/Chicago-CAP-071822.pdf	Open Data Executive Order No. 2012-2, https://www.chicago.gov/city/en/narr/foia/open_data_executiveorder.html#:~:text=I%20Mayor%20shall%20designate%20a%20making%20and%20management%20through
6.	Seattle WA	City of Seattle Comprehensive Plan, https://www.seattle.gov/documents/departments/ose/2013_cap_20130	Seattle Climate Action Plan, https://www.seattle.gov/documents/departments/ose/2013_cap_20130	Open Data Policy, https://www.seattle.gov/Documents/Departments/SeattleGovPortals/CityServices/Op

		ts/Departments/OPCD/OngoingInitiatives/SeattleComprehensivePlan/SeattleComprehensivePlan.pdf	612.pdf	enDataPolicyV1.pdf
7. Dallas TX	https://www.dallasopendata.com/stories/s/odp-data-policy/eswx-6mh7/#:~:text=City%20of%20Dallas%20Open%20Data%20Policy&text=The%20City%20of%20Dallas%20recognizes,protecting%20privacy%20and%20sensitive%20data.	Forward Dallas! Comprehensive Plan, https://dallascityhall.com/departments/sustainabledevelopment/Pages/comprehensive_plan.aspx	Dallas Comprehensive Environmental and Climate Action Plan, https://www.dallasclimateaction.com/files/ugd/349b65_e4f9a262ceb_f41258fd4343d9af0504f.pdf	City of Dallas Open Data Policy, https://www.dallasopendata.com/stories/s/odp-data-policy/eswx-6mh7/#:~:text=City%20of%20Dallas%20Open%20Data%20Policy&text=The%20City%20of%20Dallas%20recognizes,protecting%20privacy%20and%20sensitive%20data.
8. Philadelphia PA	https://opendata.philly.org/	Philadelphia 2035 Comprehensive Plan, https://www.phila.gov/programs/the-comprehensive-plan/	Philadelphia Climate Action Playbook, https://www.epa.gov/system/files/documents/2023-12/philadelphia-climate-action-playbook.pdf	City of Philadelphia Executive Order No. 1-12, http://cityofphiladelphia.github.io/slash-data/executive-order/
9. Washington DC	https://opendata.dc.gov	The Comprehensive Plan for the National Capital, https://planning.dc.gov/page/comprehensive-plan#:~:text=The%20Comp%20Plan%20includes%20policies,anded%20develops%20in%20the%20future.	Sustainable DC, https://sustainable.dc.gov/sites/default/files/dc/sites/sustainable/page_content/attachments/sdc%202020%20Edits%20V5_web.pdf	DC Data Policy, https://opendata.dc.gov/pages/data-policy
10. Phoenix AZ	https://www.phoenixopendata.com	Plan PHX, https://www.phoenix.gov/administration/departments/pdd/growth-infrastructure/general-plan.html	Climate Action Plan, https://www.phoenix.gov/administration/departments/oep/climate-change/2021-climate-action-plan.html?utm_source=chatgpt.com	Open Data Policy, https://www.phoenixopendata.com/pages/open-data-policy
11. Houston TX	https://data.houstontx.gov	Plan Houston, https://www.houstontx.gov/planning/GeneralPlan/generalplan.html	Houston Climate Action Plan, http://greenhoustontx.gov/climateactionplan/CAP-April2020.pdf	City of Houston Administrative Procedure No. 8-7, Open Data, https://www.houstontx.gov/adminpolicies/8-7.pdf
12. Atlanta GA	https://gis.atlantaga.gov/?page=OPEN-	Plan A City of Atlanta 2021 Comprehensive Development Plan, https://atlantacclimateactionplan.wo	City of Atlanta Climate Action Plan, https://atlantacclimateactionplan.wo	NA

-	https://www.miami.gov/files/share-classes/public/v/1/miami-forever-climate-ready-2020-strategy.pdf	Neighborhood Plan, https://www.miami.gov/My-Government/Departments/Planning/Comprehensive-Planning-Main-Page	https://www.miami.gov/files/share-classes/public/v/1/miami-forever-climate-ready-2020-strategy.pdf
19. New Orleans LA	https://data.miamigis.openmiami.com/data/arcgis.com	New Orleans: A Plan for the 21 st Century, https://nola.gov/next/city-planning/topics/master-plan-plan-for-the-21st-century/	Climate Action for a Resilient New Orleans, https://nola.gov/nola/media/Climate-Action-Climate-Action-for-a-Resilient-New-Orleans.pdf
	https://data.miamigis.openmiami.com/data/arcgis.com		Executive Order MJL 16-01, https://content.govdelivery.com/accounts/LANOLA/bulletins/1611287

Note. NA - Not applicable

Appendix D.3

OGD References in Policies and Plans

City	Condition			In Total OGD in Policies and Plans
	(i) OGD Policies	(ii) General Plans and OGD	(iii) Sustainability/Climate Plans and OGD	
San Francisco CA	-	-	1	1
New York NY	-	-	-	-
Los Angeles CA	1	-	1	2
Boston MA	-	-	1	1
Chicago IL	-	1	-	1
Seattle WA	-	-	-	-
Dallas TX	-	-	-	-
Philadelphia PA	-	-	-	-
Washington DC	-	-	-	-
Phoenix AZ	-	1	-	1
Houston TX	-	-	-	-
Atlanta GA	NA	-	-	-
Denver CO	NA	-	-	-
Detroit MI	-	-	-	-
Pittsburgh PA	-	NA	-	-
Baltimore MD	-	1	-	1
Tampa FL	NA	-	-	-
Miami FL	NA	-	-	-
New Orleans LA	1	-	1	2
In Total	2	3	4	9

Appendix A.4

Potential SDG 11+ Targets and Indicators within the UN SDG Framework with Rationale

Targets	Potential Indicators	Rationale for Potential Indicators
Affordable and adequate housing for all	SDG 11 - Make cities and human settlements inclusive, safe, resilient and sustainable	
	-- % of households spending over 30% of income on housing	Captures affordability across income groups
	-- Number of homeless persons per 100k residents	Addresses extreme housing deprivation
	-- % of new affordable housing units in the total number of new housing units	Tracks both housing supply and inclusion efforts
	-- % of residents living in housing with less than 97 ft ² (9 m ²) per person	Highlights crowding and space adequacy
Inclusive, affordable, safe, and sustainable transport	-- % change in vehicle miles traveled (VMT) annually	Relates to GHG emissions, vehicle dependency, sprawl, and quality of life
	-- % of population living within 400 meters of public transport with regular service	Captures not only proximity but also service quality and diversity of transport options
	-- % of trips made by walking, biking, and public transit	Tracks the use of sustainable and low-emission modes
	-- Transport-related fatalities and injuries per 100k residents	Provides a globally comparable safety benchmark that reflects system design
	-- Number of residents per acre/hectare of urban area	Measures land use efficiency: sprawl, density, and compactness
Sustainable land use	-- % of land within each neighborhood used for (a) residential, (b) commercial, (c) industrial, and (d) institutional purposes	Measures of land use mix in city-defined neighborhoods indicate locally- and pedestrian-oriented communities
	-- % land cover change in metro area for farmland and open spaces	Shows loss of farmland and open space
	-- % voter turnout among registered voters in local elections	Reflects the extent to which citizens are engaged in formal political processes
	-- Number of registered NGOs, political parties, and protest events per 100k residents	Captures the vibrancy of civic life and political participation beyond elections
	-- Number of SDGs having all indicators covered by the data from the local open data portals	Reflects both the local data accessibility and support for data-driven decision-making within the SDG agenda
Protected cultural and natural heritage	-- Existence/strength of open government policies and standards (open meetings, conflict-of-interest, public consultation, transparent election financing, and open data)	Open and transparent government standards
	-- # of heritage sites with legal protection status at any scale	Tracks legal safeguards against demolition, neglect, or misuse
	-- Number of ongoing cultural heritage initiatives, programs, or community-led preservation projects per year	Reflects real-world investment in preservation efforts
Urban resilience	-- Life expectancy, years	Tracks broad health and equity outcomes

	-- Deaths attributed to disasters per 100k population -- Access to health care (Universal Health Coverage Index, doctors/nurses per 100k residents) -- Number of green jobs per 100k population -- Inflation rate, % -- Social infrastructure spending per resident	- Provides a direct measure of risk and impact - Shows health care adequacy - Captures local economic adaptation and progress toward a just green transition - Indicates economic pressure on households - Assesses public investment in education, health, and social services
Reduced pollution and resource use	-- % of solid waste and wastewater recycled -- Number of days with good air quality ($AQI \leq 50$) annually -- % population living less than 300 meters away from major polluters	- Reflects circular economy progress through comprehensive waste recovery - Captures the frequency of healthy air quality conditions important for public health and clear for the public - Indicates population exposure to pollution, supporting equitable planning & zoning.
Inclusive, safe, and accessible green and public spaces	-- % of residents living within 800 meters from green space -- Amount of green space area in acres/hectares per 100k residents -- Violent crime rate per 100k residents	- Measures physical accessibility to urban green areas for well-being and equity. - Measures the overall quantity of green spaces - Provides a widely used, comparable metric of public space safety.
Reduced poverty	SDG 1 – End poverty in all its forms everywhere	
	-- % of urban population living in poverty according to national definitions -- % of children living in poverty	- Provides a basic yardstick for economic progress - Reveals intergenerational inequality and identifies vulnerable groups most impacted by poverty
Reliable access to affordable, nutritious food	SDG 2 – End hunger, achieve food security and improved nutrition and promote sustainable agriculture	
	-- % of food consumed that is produced within 100 miles -- % of residents living within 800 meters of a grocery store -- % residents with obesity (Body Mass Index ≥ 30) in the total population	- Measures the sustainability and resilience of the urban food supply chain - Captures physical access to food - Serves as an early warning indicator of poor nutrition and sedentary urban lifestyles
Inclusive, high-quality education and sustainability knowledge	SDG 4 - Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all	
	-- % of residents with at least a high school diploma -- Number of public libraries per 100k residents -- % of public schools offering sustainable development curriculum	- Measures access to basic educational services - Reflects access to free, lifelong learning and public knowledge spaces - Captures the integration of the sustainable development concept and agenda into formal education
	SDG 5 - Achieve gender equality and empower all women and girls	

Social equity	-- % of urban women in poverty	Gets most directly at the plight of many women
	-- Number of women's suicides per 100k population	Tracks the severity of gender-based health and violence impacts
	-- Women's mortality rate [number of deaths] per 100k population	Reflects the availability of institutional and community-based support for women's empowerment, safety, and participation
	-- Number of women's organizations & support centers per 100k residents	
SDG 6 - Ensure availability and sustainable management of water and sanitation for all		
Safe, affordable drinking water	-- % of population lacking access to safe drinking water	Measures the extent of basic water access and identifies underserved areas
	-- Total Dissolved Solids (milligrams per liter) in public water supply	Provides a widely used water quality indicator related to safety and health
	-- % of buildings reporting annual water benchmarking data	Tracks progress on urban water management and transparency
SDG 7 - Ensure access to affordable, reliable, sustainable and modern energy for all		
Renewable energy	-- % of buildings reporting annual energy benchmarking data	Promotes transparency and efficiency in urban energy use
	-- % renewable energy in electric power	Basic measure of the renewable energy transition
SDG 10 - Reduce inequality within and among countries		
Reduce inequality	-- City-level Gini coefficient (from 0 to 1)	Offers a widely recognized, quantifiable snapshot of overall income inequality
	-- % of population guaranteed anti-discrimination protections related to jobs, housing, and services	Basic legal protections for many classes of people
	-- % of population guaranteed free or affordable legal assistance	Helps ensure equal treatment within the justice system
SDG 13 - Take urgent action to combat climate change and its impacts		
Climate mitigation and equity	-- Total and per capita GHG emissions	Provides baseline climate indicator
	-- % of municipal climate-related spending targeted to disadvantaged populations (by income, race, age, disability, or location)	Captures the equity dimension of climate action by showing how city resources are distributed to those most at risk