

DETERMINING LOW CARBON CITY (LCC) INDICATORS FOR GOVERNANCE AT LOCAL GOVERNMENT IN MALAYSIA

Nor Baizura Jamaluddin¹, Yusfida Ayu Abdullah^{1*}, D. Ary Adriansyah Samsura², Nurul Shakila Khalid¹ and Na'asah Nasrudin¹

¹ School of Town Planning and Landscape Architecture, College of Built Environment, Universiti Teknologi Mara (UiTM), Selangor, Malaysia

² Nijmegen School of Management, Department of Geography, Planning, and Environment, Radboud University, the Netherlands

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ABSTRACT

The Low Carbon City (LCC) concept has been introduced previously in Malaysian urban development and practice. Through the Low Carbon Cities Framework (LCCF), the Malaysian government has accordingly delineated local authorities' targets for achieving zero carbon status. However, to achieve smooth governance of LCC delivery, it is essential to ensure that institutional approaches are well-practised and administered. Nevertheless, what are the key elements that can be a guide for LCC governance in local government? Thus, this paper aims to establish the indicators applicable to LCC in governance and practice at local government. This study, therefore, employed a qualitative method with a purposive sampling approach, using the technique of in-depth interviews consisting of three (3) local authorities practising low carbon efforts, and also employed thematic analysis for secondary data. This study showed that LCC governance could be operative considering several important indicators for practice. The findings found that the LCC indicators are substantial for the local authority in delivering LCC initiatives, as well as the challenges faced by the local government in restructuring the institutional framework to achieve better governance practices. The study outcome, therefore, can be a reference to local government when implementing LCC initiatives through a better governance approach.

1. INTRODUCTION

The United States Geological Survey (2022) refers to global warming as increased global temperatures resulting from human activities emitting Greenhouse Gases (GHGs) into the Earth's atmosphere. Pappas (2022), on the other hand, mentioned that global warming is the rising average temperature across the earth. This demonstrates that urban activities trap greenhouse gases in the atmosphere and cause global warming and climate change (Malaysia Meteorological Department, 2023). Along with environmental effects, climate change later became one of the environmental consequences of increasing global air or surface temperatures caused by GHG emissions from human activities through mining and deforestation, industrial and transportation activities, agricultural activities, and overpopulation (Weatherall et al., 2022). The change occurs due to

human or natural activities, and the roots come from urbanisation processes, leading to extreme changes in the frequency and intensity of weather or climates (Valente & Laurini, 2022). The effect of greenhouse gases inevitably contributes to global warming, leading to climate change. As a result, incorporating the sustainable city concept has emerged as a paramount concern within urban planning, aiming to mitigate the adverse impacts of climate change. According to the United Nations (2023), sustainable development is commonly defined as a form of development that addresses the requirements of both current and future generations by integrating the principles of economic growth, social inclusivity, and environmental protection into urban planning and governance (Figure 1).

*Corresponding author: yusfida@uitm.edu.my



Figure 1: The Pillars of Sustainable Development Concept
 Source: Adapted from Govindadass (2021)

To illustrate the point of the sustainable development concept, one of the approaches is the implementation of a Low Carbon City (LCC) concept by local authorities that are specifically designated to address carbon emissions in four (4) main areas, including the urban environment, urban infrastructure, urban transportation, and urban building (Malaysian Green Technology and Climate Change Centre, 2022). To implement those fields, an institutional framework is important to ensure the success of delivering the low-carbon method through good urban governance. As Raco (2020) mentioned, a model for governing a city called ‘good urban governance’ is closely related to sustainable development. Figure 2 presents the eight elements of the sustainable city concept, which demonstrate the element of governance



Figure 2: Elements of Sustainable Cities
 Source: Ministry of Energy, Water and Green Technology (KeTTHA) (2017)

According to the Ministry of Energy, Green Technology, and Water, sustainable development is currently being practised in governing urban development due to the rising issues of global warming and climate change caused by urbanisation, an increase in population, and economic growth that led to more energy consumption and GHG emissions (Ministry of Energy, Water, and Green Technology (KeTTHA), 2017). A study showed the significance of low carbon governance at the local government level as a sustainable approach, where increasing carbon emission intensity can be one of the key factors in the decision-making process, especially among leaders of the related department in promoting policy-related LCC (Tie et al., 2020). The approach used in Malaysia’s sustainable agenda governance structure is in line with the Eleventh Malaysia Plan (11th

MP), which focuses on a paradigm shift towards more participatory government by citizens and Non-government organisations as partners in designing the delivery of sustainable agenda (Economic Planning Unit, 2021a). Meanwhile, in the Twelfth Malaysia Plan (12th MP), low carbon efforts and resilient development approaches were outlined as part of the many tactics to promote sustainable socio-economic growth (Economic Planning Unit, 2021b). Figure 3 shows an example of inter-relations between governance and sustainable development in the case of smart cities, as studied by Sharifi and Khavarian-Garmsir (2023). The figure shows that the transformation of a city to become what it should be in the future is interconnected and has a relationship with climate change and sustainability. Therefore, urban planning must include a sustainable development approach as the paramount technique to minimise the effect of climate change. Besides, as shown in Figure 3, the institution component also represents the institution’s importance in achieving sustainable development.

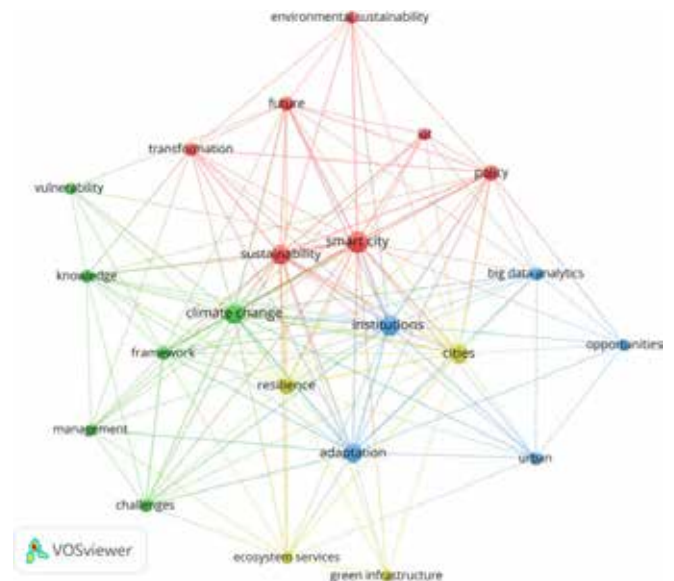


Figure 3. An example of a study showing the relationship between governance and sustainable development
 Source: Sharifi & Khavarian-Garmsir(2023)

Concerning those underlying reasonings, this study, therefore, evaluates the concept of urban governance through three key components; (i) urban governance for sustainable development; (ii) the indicator for low carbon governance; and (iii) the practice of low carbon delivery. This paper aims to establish the indicators applicable to LCC in governance and practice in local government.

2. LITERATURE REVIEW

2.2 Urban Governance for Sustainable Development

Urban governance can be defined as a set of indicators, processes, and evaluators to achieve urban sustainability (Abdel-Razek, 2021). It covers a broad spectrum of the relationship between the parties who plan and manage the city through a continuing process. However, several conflicts may occur to mitigate this possibility

(UN-Habitat, 2023). Table 1 shows the main components of a study on governance. One (1) influential component element in this context is the presence of an institutional structure. Cantele (2019) defines the institutional framework as the system of laws, regulations, procedures, or stakeholders with their roles and rules that shape the nation, state, or local socio-economic activity. Therefore, The institutional framework is claimed to be imperative in sustaining environmental goods and services (Achieng et al., 2022).

In this sense, governance pertains to the management or implementation of a system, whereas the institutional framework encompasses the individuals and factors involved in the system. It is understood that an institutional framework is an organisation with complete systems that govern the entirety of a process (Abdullah et al., 2022a). The institutional framework incorporates laws, amendments, acts, ordinances, mandates, regulations, and enforcement mechanisms (JeyaSundar, Ali, & Zhang, 2020). In other words, an institutional framework is perceived as a collaborative approach to achieving institutional outcomes, in which the forms of 'governance' act as one of the ways to integrate the institutional framework problems (Jiang, 2021). It represents a formal organisational structure, rules, and informal norms for service provision (Mortensen, 2019).

In Malaysia, the sustainable agenda is governed by the Malaysian three-tier government. At the national level, climate action is under the working committee on environment and natural resources, which involves related ministries and federal agencies. Meanwhile, a dedicated council at the state level is also formed to govern climate change. Finally, as the main party, the local authorities set up their own division or specific unit to administer and manage sustainable development. Because of that, local authorities have significant roles in translating acts into practices (An & Bostic, 2021). In short, governance is crucial to ensuring the efficacy of LCC implementation and sustainable development. Whereby many scholars conveyed their study outcomes, which demonstrated the contribution of governance to LCC (Table 1)

Based on Table 1, it can be seen that governance through local government has a particular function in delivering LCC initiatives, particularly in technical, policy, and administrative aspects. Previous studies showed that local authorities play a greater role in ensuring the city achieves sustainable development targets. In addition, it was also revealed that the governance of LCC is being addressed in multiple contexts, especially practice at the local authority. However, only a few studies focused on the indicators applied for LCC at the local level.

Table 1. Previous studies reflecting the essential role of governance in LCC and sustainable development

Authors	Year	Scope of Study	Remark
Liu, Zhou, Yao & Zhang	2022	Emphasised the governance of low carbon economic peer effects in city level context and under sustainable environmental rules, including the scope, and the control towards green governance.	This study justifies how the administration at the local level is influenced by the way or approach towards sustainable development. Thus, the approach toward sustainable development can be adopted and applied to the local government context. It was found that the study by Liu et al., (2022) is related to this study in terms of administrative context toward low carbon governance although the focus emphasis on the economic context.
Russell & Christie	2022	Emphasised the matters related to carbon baseline as guidance to various stakeholders, and multi-level climate governance at the city level. It first emphasised the significance of local baseline as a basis by key agencies for climate mitigation planning and implementation.	This study demonstrated the detail on carbon inventory that can be a reference to be used by the industry's players, and the other local authorities, as well as for other research related to carbon inventory study. The scope of this study in terms of carbon footprint and inventory can also be compared to the one studied by Russel & Christie.
Dyson & Harvey-Schleos	2022	Explained the efforts and local authority actions in reducing carbon emissions. It described the local authorities' roles in leading or coordinating climate action and the policies for sustainable development.	Able to understand how local authorities played their roles and the mechanisms adopted to turn the national strategies into a local-level context. Similarly, this study also describes the roles of local authorities in managing the implementation of a low carbon approach.
Abdul Azeez	2021	Emphasised the low carbon initiatives in Malaysia. The study highlighted the practice of low carbon development and formulation of policies that target emission reduction.	The study by Abdul Azeez highlights the initiatives, policies, and practices of low carbon that are found much similar to the context of this study. It also reveals how the government takes action to deliver all the initiatives.
Zhang et al.,	2021	Emphasised the carbon emission governance system and low carbon governance at the district level.	Studies by Zhang et al., (2021) and Liu et al., (2022) both demonstrate how the practices of low carbon governance in the local government context is able to act as a benchmark for other LCC governance study. Similarly, the context is related to this study although the areas of study are different.
Rotondo et al.	2020	Explained the practices and organisations shift toward a low carbon society. Thus, this study focuses on governance practices, tools, and actors involved across the multi-variable context.	The study highlights society's involvement and the government's approach to sustainability may bring a good impact on the community. Although the context is not focused on the administrative context, it did reveal how low carbon society can be tackled in certain approaches.
Liu et al.	2018	Emphasised the framework of low carbon governance. It emphasized the roles of government, the measures, policy tools, actions, and the integration of technical, spatial, and social of LCC governance.	A study by Liu et al. illustrates the framework as a system for governing the LCC approach. The context of governance covers all aspects to be addressed in an organisation and through this study, all aspects will be represented through the identification of relevant variables.

Source: Liu, Zhou, Yao & Zhang (2022); Liu, Zhou, Yao & Zhang (2022); Dyson & Harvey-Schleos (2022); Abdul Azeez (2021); Zhang et al. (2021); Rotondo et al. (2020); Liu et al. (2018)

2.3 The Indicators for Sustainable Governance in LCC

Urban governance is also the sum of the many ways in which individuals and institutions, both public and private, plan and manage the everyday affairs of the city in a continuing process where conflicting or diverse interests may be accommodated, and cooperative action can be taken (UN-Habitat, 2023). Urban governance is also considered a set of indicators, processes, and evaluators governed together to achieve urban sustainability (Abdel-Razek, 2021). This term includes citizens, communities, private-sector actors, and voluntary organisations (Raco, 2020). Raco (2020) also claimed that governance is one of the critical pillars of the sustainability agendas promoted by agencies. Avis (2016) believed urban governance policy planning might affect the city authority’s policy design, structure, and roles.

Drummond (2021) and Van der Heijden (2019) highlighted the nine (9) factors that influence the defectiveness of climate governance, encompassing supportive political and legal context, autonomy, access to funding for climate action, vertical coordination, horizontal coordination, membership of capacity-building and learning networks, collaboration with and participation of stakeholders, presence of local climate champion, conducive urban form and infrastructure, and societal pressure (Figure 4). Following their ideas, urban climate governance covers not only the management aspect (legal, coordination, and network) but also efforts for the physical features of the city (involving the urban form and infrastructure).

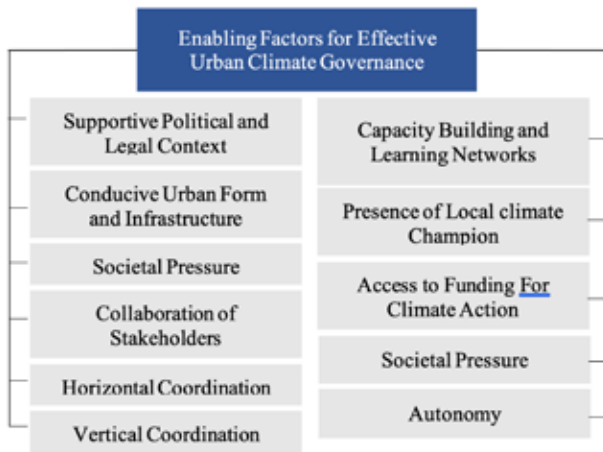


Figure 4. Enabling factors for effective climate governance
 Source: Drummond (2021); Van der Heijden (2019)

In a previous study conducted by Moreno-Pires and Fidélis (2012), a comprehensive framework consisting of seven (7) major parts of sustainable indicators was determined for the analysis of governance (Table 2). These indicators consider the assignment of overall responsibility, government coordination, stakeholder involvement, integration with local plans or strategies, connection with (inter) national networks, and communication with society.

Table 2 portrays the integral combination of criteria to ensure functional administration and management in governance. The indicators demonstrated that the organisation’s foundation (nature

of the administrative system) and the organisation’s dynamic in responding to changes will define the organisation’s situation. Also, the practice of coordination and networking among separate levels of agencies will denote the governance’s performance in government coordination. Apart from that, other significant indicators are the stakeholders’ participation, international connections, and communication. To examine an institution’s achievement in delivering sustainable development (also relevant to LCC delivery), these seven (7) indicators can be a reference.

Table 2. The Review on Sustainable Indicators in Governance

GOVERNANCE ELEMENT / CRITERIA	INDICATORS
(1) Nature of the indicator system	
Scope	Area of the study (e.g.: area of sustainable development)
Timeframe	Vision target
Coherence	Objectives, managerial roles, internal aims, internal target groups
Political	Commitment by the Mayor, decision making
(2) Assigning overall responsibility	
Sensitivity to change	Financial, stability of the project team, number of human resources, procedures
(3) Government coordination	
Sectoral (internal) coordination	Unit, structure in a strategic organizational position, procedure, routine, mechanism,
Regional coordination	Mechanism with other municipalities and regional or national bodies
Training	Different training programs (based on issues)
Multi-stakeholder	Involvement of different stakeholders outside the local government, experts, and different public officers of the local council
(4) Stakeholders’ involvement	
Participation mechanisms	Mechanisms/techniques to promote the participation of different stakeholders
Feeling of ownership	A strong feeling of ownership by the stakeholders
(5) Link with local plans or strategies	
Performance	Strong integration of the indicators in the targets of local plans/strategies
Funding	Solid local budgets and stable funding schemes
(6) Link with (inter)national networks	
Learning	Close involvement in another national/international indicator-related project
(7) Communication with society	
Communication	Different communication channels

Source:Moreno-Pires, & Fidélis (2012)

Meanwhile, to achieve sustainability, several scholars suggested several parameters considered fitting in governing the nation towards sustainability, as shown in Table 3. According to Tan et al. (2017), the indicator system is a framework for standardising low-carbon cities. Additionally, it delineates the fundamental elements of low-carbon management specific to various urban areas. Therefore, Tan et al. (2017) suggested that the indicators for sustainable cities are usually based on economic growth, energy patterns, social and living conditions, carbon and environmental index, level of urban mobility, solid waste management, and water quality. Meanwhile, Lao et al. (2019) bring up that the indicators include economy, energy

use, social aspects, carbon and environment, urban mobility, solid waste, water, and land use. In a recent study by Ma et al. (2022), the authors extended the existing literature by identifying several indicators contributing to sustainability assessment. These indicators encompass population density, green area coverage, carbon emission levels, intensity and footprints, waste management, and energy consumption.

Table 3. Sustainable Indicators Suggested by Scholars

Authors	Year	Indicators
Ma et al.	2022	Population density, urban public green area, carbon emission, intensity and footprints, waste, energy consumption
Lao et al.	2019	Economy, energy use, social aspect, carbon and environment, urban mobility, solid waste, water, and land use.
Tan et al.	2017	Economic, Energy pattern, Social and Living, Carbon and Environment, Urban mobility, Solid Waste, and Water.
Tan, Yang & Yan	2015	Economic, energy pattern, technology, social and living, carbon & environment, urban accessibility, and waste.

Source: Ma et al. (2022); Lao et al. (2019); Tan et al. (2017); Tan, Yang & Yan (2015)

According to Tan et al. (2017), an indicator system is crucial in guiding the low-carbon strategy, urban planning, policy framework, and subsequent implementation. In their study, Tan et al. (2017) highlighted that the key indicators in low carbon studies will always put carbon footprint as the main indicator, and most of the studies focused on the energy sector. Recently, Abdullah et al. (2022a), in their similar study, emphasised the governance criteria that must be considered contributing to the change to low carbon governance (Figure 5). They believed that in the LCC approach, governance should pay attention to the process of LCC delivery, covering not only the management process but also the resources and planning. According to Yusup et al. (2016), every local authority has its functions and responsibilities for achieving state targets. Because of that, to enhance the value of the administrative system for low-carbon cities, it is suggested that the local authority consider enhancing its administrative structure as one of the criteria for implementing a more effective administrative strategy (Yusup et al., 2016).

According to Figure 5 below, Abdullah et al. (2022a) have identified fourteen(14) variables that can be adopted by the local authorities in governing the nation or city, including the guideline as the basis for the authorities, benchmarking the best practices, a system as the database, a zone to implement the suitable mechanism, the sources of funding, the collaboration between stakeholders, a champion who can derive the changes, key performance indicators to evaluate the performance in achieving the target, procurement that influences the minimal impact, especially toward the environment, monitoring approaches, a strategy included in the work plan, job description to highlight the scope of work, and finally the capacity building to empower the human resources.



Figure 5. Variables of Governance Studies.

Source: Abdullah et al (2022a)

2.4 The Low Carbon City Practice in Malaysia

In delivering low-carbon city practices, having several referral documents to guide the actions is a must. Policy planning and implementation are the elements to be considered in delivering a low-carbon city. These aspects play a significant role in attaining desired outcomes in this domain (Schrage & Kjrs, 2022). As stated in the 12th Malaysia Plan, Malaysia seeks to improve environmental rankings and green technology (Economic Planning Unit, 2021b). The Low Carbon City Framework (LCCF) acts as one of the low-carbon tools to reduce the environmental impact due to climate change, and to carry this out, coordination among agencies must be practised (Senin et al., 2021). The LCCF is a government program for the years 2010-2011. Its primary objective is to initiate further measures and actions at different levels to decrease the nation's carbon footprint effectively. Many local authorities in Malaysia have put great effort into enhancing the practices of low-carbon city delivery by establishing their action plan. They are preparing the action plan as the delivery tool that contributed to the effort shown by the local government in achieving the green and sustainable objective (Nasrudin et al., 2020). The Federal Department of Town and County Planning governs urban development at the local level, and the implementation activities are directed to relevant government agencies. To attain efficiency in pursuing low-carbon governance, it is vital to establish robust collaboration and coordination among many stakeholders and agencies. This collaborative effort is essential for facilitating the transformation of cities and empowering various actors to adopt optimal operational approaches and policy formulation (Rahman, 2020). Abdullah et al. (2022a) point out that the roles and responsibilities played by the local authorities in low carbon administration still need to be comprehensively assessed due to a need for more priority on governance elements. In governing the low carbon approach, most of the local authorities in Malaysia adopt the LCCF as their primary referral, and simultaneously, they establish specific targets for the implementation of their low carbon framework, tailored to suit the unique characteristics of their respective local contexts (Nasrudin et al., 2020).

Through the years, numerous local authorities in Malaysia have dedicated significant resources towards improving the implementation of low-carbon city initiatives by formulating their respective action plans. The action plan serves as a comprehensive instrument that incorporates several mechanisms for effectively implementing the strategic plans at the upper level. The local government has undertaken initiatives to attain environmentally friendly and sustainable goals by formulating an action plan as the means of implementation (Nasrudin et al., 2020). In its role as the executor, the local government has undertaken numerous activities and initiatives to promote low-carbon urban development. These include the provision of complimentary bus services and the improvement of walkways infrastructure and urban green space. Policy planning and implementation are the elements to be considered in delivering a low-carbon city. Identifying local benefits is one of the most significant ways for the local government to find the best solution for policy innovation related to climate change (Guo et al., 2022).

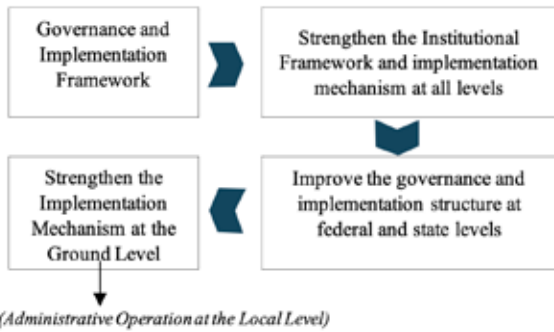


Figure 6. The Process of LCC Delivery
 Source: Ministry of Energy, Green Technology and Water (KettHA) (2021)

Figure 6 above shows the process of LCC delivery. The figure shows the duties that need to be addressed by a local government to fulfil the target outlined through the Low Carbon City Framework (LCCF). Local government is deemed the real implementor in realising the national aspiration on sustainable targets. Therefore, as has been practised, several local governments in Malaysia are currently attempting to enhance their governance framework and improve their implementing approach.

3. METHODOLOGY

For this study, two (2) approaches were applied, including (i) a secondary data review and (ii) an in-depth interview with the officers from the local authorities. The data was first obtained from previous governance and LCC initiatives studies. In the second stage, the data was gained from Expert Interviews (through Purposive Sampling), which captured the experiences shared by the expertise in LCC delivery. The expert interviews involved officers from the Shah Alam City Council (MBSA), Subang Jaya City Council (MBSJ), and Petaling Jaya City Council (MBPJ). In addition, document analysis was also employed using the Shah Alam City Council and Petaling

Jaya City Council’s LCC documents to support the data. The data were then analysed using the Thematic Analysis by applying the Scoping Techniques.

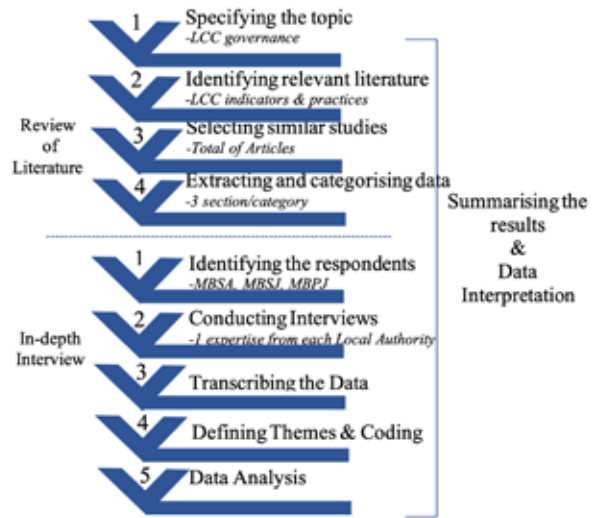


Figure 7. Method of Study
 Source: Adapted from Westphal et al. (2021); Abdullah et al. (2022b); Jamaluddin et al. (2023)

Figure 7 above shows the scoping review process adapted from Westphal et al. (2021), Abdullah et al. (2022b), and Jamaluddin et al. (2023) to gather the data in reviewing the literature. Four (4) steps have been conducted to review the literature, starting by determining the topic of study, which is “low carbon governance”. Using this keyword, the study obtained an estimated nineteen thousand (19,000) results from indexed and non-indexed journal articles. After that, it was to reduce the scope of study focusing on the “low carbon governance indicators” for the past five (5) years, bringing the estimated result of two hundred ninety-four (294) articles. Due to the huge number of articles, it is important to narrow down the topic, and therefore, eighty-eight (88) articles from the last five years have been identified using the keyword of “low carbon city indicators and practices”. From this, the articles were schemed manually, which assessed the content, context, and suitability to achieve more relevant references for the study and then finalised the articles to thirty-five (35) articles, which became the main references for the literature review. Three (3) criteria were specified to finalise the articles: the suitable governance context (local government), the relevant indicators for low-carbon governance, and the delivery practices of low-carbon initiatives at the city level. On top of the thematic analysis from the literature, the study included expert interviews and selected expertise from three (3) local authorities in the State of Selangor, Malaysia, which are currently venturing into the delivery of LCC initiatives. The expert interviews aimed to gather data on the local authorities’ use of governance indicators. Five (5) indicators were tested to understand the practice of current delivery. The indicators, which include (i) institutional structure, (ii) roles or job descriptions,

(iii) tools and referral documents, (iv) partnership, and (v) database, are based on the study by Abdullah et al. (2022a). The interview data were transcribed, coded, and categorised for thematic analysis.

4. RESULTS AND DISCUSSION

LCC practices are seen as becoming more popular in local governments in Malaysia. Several authorities have already drawn their strategies to implement the concept of LCC. Based on the results, this study may suggest several essential guides for LCC governance. The scoping technique in selecting the right references resulted in the discovery of twenty-seven (27) indicators that can be used or are suitable for LCC governance. The indicators can be classified as the actors throughout the LCC delivery process, weightage of roles, administrative structure and hierarchy to represent autonomy and scopes of work, the human resources, especially experts in the field, capacity building, and coordination among the internal and external parties, bureaucratic, the existence of the organisation, performance of the implemented strategies, the mechanism used, the action, the process, the system, monitoring approach, the issues encountered by the stakeholders, the city target, guideline or policy, and sustainable index. The summary is highlighted as shown in Table 4 below.

Table 4. The Indicators Suitable for LCC Governance Based on Literature Study

Indicator/variable	Source
Actors involved in LCC delivery	Russell & Christie (2022); Cheshmehzangi et al. (2018); Lah, O. (2017); Moloney & Horne (2015)
Roles/ responsibility/ function	Abdullah et al. (2022a); Li, Bai & Tang (2022); Dyson & Harvey (2022); Nochta & Skelcher (2020)
Administration structure	Drummond, P. (2021); Nochta & Skelcher (2020)
Resources/capacity/ expertise	Du et al., (2021); Drummond (2021)
Capacity building (skills, training)	Abdullah et al. (2022a)
Internal coordination/ participation	Shih & Yao (2020); Drummond (2021)
Networks/collaboration	Abdullah et al. (2022a); Drummond, (2021); Nochta & Skelcher (2020)
Bureaucratic quality	Van de Walle (2005)
Institutional	Ofori et al. (2023).
Performance	Yin et al. (2023)
Approach/operation/ mechanism/current practices	Oshita et al. (2015); Abdullah et al. (2022a); Li, Bai & Tang (2022); Liu, et al. (2022); Drummond, P. (2021); Abdul Azeez (2021); Rotondo et al. (2020)
Initiative/program / projects	Abdullah et al. (2022a); Ma et al., (2021); Abdul Azeez (2021); Nochta & Skelcher (2020)
Action/strategy/tools	Abdullah et al. (2022a); Rotondo et al. (2020)
Process of LCC delivery	Nochta & Skelcher (2020)
System/database/ technology used	Tan, Yang & Yan (2015); Abdullah et al. (2022a)
Monitoring/mitigation	Abdullah et al. (2022a); Liu et al. (2022)
Achievements (reduction) Performance	Su et al., (2013); Lien et al., (2019); Liu et al. (2021); Asmat.A et al., (2021)
Issues	Russell & Christie (2022)

Indicator/variable	Source
The way forward/ suggestion	Russell & Christie (2022)
Framework	Ma et al., (2021)
Measurements	Fu, He, & Luo (2021)
Target/aim/low carbon status	Nochta & Skelcher (2020)
Low carbon policy goal and implementation/ formulation	Shih & Yao (2020); Abdullah et al. (2022a); Li, Bai & Tang (2022); Dyson & Harvey (2022); Ma et al., (2021); Abdul Azeez (2021); Liu et al. (2016); Lah (2017)
Content and Instruments/ policy delivery into practices	Liu et al. (2016); Heffron et al. (2013)
Cities Index/environment quality	Ofori et al. (2023); Tan et al. (2017)
Securing policy	Fu et al. (2021)
Progress/achievements	Dyson & Harvey (2022)

From the literature review, it was learned that the indicators from the governance context combined with the LCC context may derive suitable LCC governance parameters and can be adopted in determining the level of effectiveness of LCC governance. The study also found that it is imperative to have a complete institutional framework to govern LCC initiatives according to the various indicators discovered that a local government can apply. Meanwhile, Table 5 below shows the indicators identified from the main referral document of the three (3) local authorities (MBSA, MBSJ, and MBPJ). The indicators employed by the local authorities were identified through the action or mechanism implemented and outlined from their sustainable or LCC plan.

Table 5. The Indicators of LCC Governance Identified through Authorities' Main Documents

Local Authority	Indicators (Parameters)
Shah Alam City Council (MBSA)	Organisation, institutional framework, guideline or main documents (policy/ action plan), achievement in fulfilling or sync with the global and national target, commitment, element/ sectors involves, area, programs, role, work plan, timeline, collaborators, mitigation approaches, procedure, databases system, type of initiatives and incentives, participation among the developer/industries, compliance to the requirements and Green Building Index, carbon assessment performance
Subang Jaya City Council (MBSJ)	Guideline or main documents, target, strategy and action, timeline, type of initiatives and incentives, collaborations and participations, performance or achievement, the Green Building Index, Total of carbon reduction, carbon footprint, procedure, commitment.
Petaling Jaya City Council (MBPJ)	Guideline or main documents, target, type of initiatives and incentives, strategy and action, timeline, collaborations and participations, performance or achievement, the Green Building Index, Total of carbon reduction, carbon footprint, procedure, database system, coordination, and commitment.

As shown in Table 5 above, each local authority systematically addresses LCC initiatives by incorporating many indicators into its strategic planning. The identified indicators are practised to

administer and manage sustainable development and LCC projects. All three (3) local authorities generally have similar indicators for LCC practices. However, the mechanism may differ among local authorities following their LCC action or strategic plan.

To further investigate the suitable indicators for application at the local level, the study assessed the indicators from the literature review (as shown earlier in Table 4). It combined the indicators discovered from the case studies (MBSA, MBSJ, and MBPJ) from Table 5. Through this approach, six (6) indicators were then selected to be tested (as shown in Table 6) for the case studies. The six (6) indicators adopted from the literature review and the experiences of LCC work by the three (3) local authorities were then established, i.e.; (i) target; (ii) structure; (iii) roles or job description; (iv) tools / main document; (iv) collaborations/partnership; and (vi) database system. These indicators were then employed to investigate the case studies (MBSA, MBSJ, and MBPJ).

Table 6. The Practices of LCC Governance at the City Level

Practices	Local Authority
SHAH ALAM CITY COUNCIL (MBSA)	
City Target	MBSA intends to be the best Low Carbon City and Malaysia's best model in Low Carbon City Initiatives by 2030. To achieve this aspiration, MBSA's aims to fulfill the National Carbon Reduction target of 45% by 2030. Under the administration of MBSA, Shah Alam has been recognized as one of the most sustainable cities in Malaysia since 2010.
Governance Structured	Under the planning department, MBSA allocates one unit known as Sustainable Unit as the main actor within the authority to promote and deliver the low carbon approach.
Roles	<ul style="list-style-type: none"> · Conduct any research related to sustainable development (including low-carbon cities) · Conduct capacity building for the improvement of the organization · Promote sustainable development
Tools/ Document	<ul style="list-style-type: none"> · Shah Alam Low Carbon City Action Plan · Shah Alam Local Plan
Collaboration and coordination	Good collaboration within internal-external agencies/ stakeholders. Aim to reposition the position or establish a formal structure to have greater coordination.
System	Action Plan is the main system to derive the implementation and monitor, and no standard database since the authority applied their approach to keep, record, and manage all the data.
SUBANG JAYA CITY COUNCIL (MBSJ)	
City Target	MBSJ is one of the local authorities that has achieved great progress in delivering the low-carbon city approach within their administrative area. Subang Jaya attains its City status in 2020 and with this recognition, the sustainable development of Subang Jaya aims to be enhanced through a world-class service delivery system. The authority aims to make Subang Jaya become a sustainable city with a choice and opportunities based on Sustainable City principles: Social, Economy, and Environment.
Governance Structured	Under this authority, there are Sustainable Development Unit under the Planning Department that is responsible for the development of a low-carbon city at Subang Jaya.
Roles	Applied the green development policies into specific action plans as well as responsible for the management of low-carbon initiatives among the stakeholders
Tools/ Document	<ul style="list-style-type: none"> · Subang Jaya Low Carbon City 2030 Action Plan (upcoming) · Subang Jaya Local Plan · Subang Jaya Strategic Plan · Subang Jaya Sustainable Cities Action Plan · Subang Jaya Green City Action Plan
Collaboration and coordination	Great collaboration within internal-external agencies/ stakeholders. Still hoping to improve the current coordination approach to become more efficient.

Practices	Local Authority
System	Strategic Plan is the main system to derive the implementation and is supported by many mechanisms through multiple action plans. Similarly, no standard database since the authority applied and used a set of Excel sheet format consisting of a checklist and indicators to be fulfilled, and submissions are made online. The data was kept separately according to the parties involved.
PETALING JAYA CITY COUNCIL (MBPJ)	
City Target	MBPJ strives to infuse sustainable development into its development plans. This authority has come out with an action plan to plan and implement initiatives toward LCC and carbon reduction. Besides, MBPJ has come out with LCC action plan to transform the city into low carbon and green city and become the lead and role model in delivering the LCC approach.
Governance Structured	Under the development planning department, MBPJ allocates one section to deliver the sustainable agendas under the Sustainable Development Section.
Roles	Delivering low-carbon city initiatives is one of the leading roles of sustainable units. As a secretariat to deliver the approach.
Tools/ Document	<ul style="list-style-type: none"> · MBPJ Low Carbon City Action Plan-Climate Action Plan · MBPJ Strategic Plan 2021-2025 · MBPJ Strategic Plan 2020-2026
Collaboration and coordination	Great collaboration with the internal department within authority and any other agencies, communities in the neighbourhood, private sectors, and another industrial player, as well the institutions.
System	MBPJ Low Carbon City Action Plan is a Climate Action Plan that is being used as implementing and monitoring tool. Build an online system known as Building Energy Data Online System as their database system.

Indicator 1: LCC Target

The study reveals that the indicators will integrate governance and low-carbon aspects as the variables in planning for smooth and better governance. By attaining the Sustainable Development Goals (SDGs) through the LCC approach, Shah Alam City Council (MBSA), Subang Jaya City Council (MBSJ), and Petaling Jaya City Council (MBSJ) work enthusiastically to make their cities more sustainable whereby all three (3) local authorities have a similar target to achieve. From the summary of the investigation in Table 6 above, it is clearly stated that MBSA targets to be a model of LCC in Malaysia and hopes to attain a carbon reduction of 45% by 2035. MBSJ, on the other hand, sets to become a sustainable city and uses the LCC approach as one of the methods in their development plans. Meanwhile, MBPJ is determined to implement LCC initiatives and aspire to become a leading local authority in LCC, like MBSA.

Indicator 2: Governance Structure

In terms of governance structure, the Planning Department of these three (3) local authorities is responsible for delivering sustainable planned development to meet the goal. The authorities had assigned a small-sized structured team under the Planning Department to create a sustainable agenda. It was also discovered that although there is a specific team to tackle the sustainable development matter, a dedicated division still needs to be created for administering and managing LCC projects. The unit known generally as the Sustainable Unit under the Planning Department in MBSA, MBSJ, and MBPJ is the one that plans, implements, and monitors the LCC initiatives. Even though the unit is assigned under the Planning Department,

it only focuses on sustainable development-related issues rather than performing its core responsibilities as a town planner, which include the development plans and planning permission. However, the roles and job scopes delivered by these units are broader than the context of LCC, only achieving the city targets. As claimed by the officers from the units, only some constraints are currently faced by them, such as the autonomy and time taken to govern the low-carbon initiatives. The internal agencies in each local authority are working together to achieve the city's plan and goal, and it was expected that more benefit would be gained if expertise across departments collaborated in one formal dedicated unit to take responsibility for addressing the LCC matter, hence achieving the city and national target.

Indicator 3: Roles or Job Description

When examining the roles of the team, it was found that the main role of the Sustainable Unit at each local authority is to act as a secretariat to deliver the approach. The authorities clarify that the significance of the units' tasks is focusing on (i) undertaking all relevant, sustainable development research, including research on LCC; (ii) conducting capacity training for the organisation's improvement; and (iii) supporting sustainable development. The local authorities' technical divisions are in charge of overseeing the strategy's execution in the meantime. As previously mentioned, the small unit (Sustainable Unit) within the Planning Department manages the LCC projects and programs. According to this report, the context of sustainable development goes beyond the primary responsibilities of the planning department. However, both local governments have given the units less priority, which has led to an organisational intervention and a change in how LCC initiatives are governed. These sustainable units look for a "formal" role (with authority's adeptness) with specific roles or job scope to handle the problems that arise during the governance process.

Indicator 4: Tools / Main Document

In another evaluation, the main document acts as guidance and is referred to by the local authorities when delivering LCC initiatives. It also acts as a tool or mechanism to deliver all the strategies or policies towards LCC and sustainable planning. The local authorities claimed that the strategy outlined in their main development document is one of the tools used to deliver and monitor the LCC initiatives. MBSA uses its action plan, the Low Carbon City Shah Alam Action Plan 2035, which outlines the strategies established in the National LCC Masterplan 2020. In the context of MBSJ, the authority still needs to develop its specific LCC action plan aligned with the National LCC Masterplan 2020. However, the implementations of the LCC initiatives are delivered based on their main document, namely the Subang Jaya Local Plan 2035, Subang Jaya Strategic Plan 200-2025,

and the Green City Action Plan. Meanwhile, MBPJ were earlier than MBSA and MBSJ in producing their action plan known as the MBPJ Low Carbon City Action Plan-Climate Action Plan, supported by the MBPJ Strategic Plan 2021–2025.

Indicator 5: Collaboration/Partnership

When assessing the perspectives of collaborations and coordination, the local authorities have a standard practice of collaborating with other government agencies, developers, and industry players willing to join the initiative for their building construction or business, together with non-governmental organisations and the communities. To support the local authority's efforts to become a 'low carbon community', the private sector is encouraged to incorporate the LCC concept into their development plans. For instance, the private sector has significantly contributed to the MBSA's efforts to include LCC aspects in its projects. To ensure the program's success, the authority aggressively promotes the benefits of the LCC method and strives for broader stakeholder engagement. As stated earlier. Several projects have been achieved by winning the LCC award based on the contribution from the developer, such as Eco World and Sime Darby, as well as the success of Green Building certification for *Perbadanan Kemajuan Negeri Selangor* and many more industrial players. Meanwhile, the MBSJ is honourably well-known for the success of their township, like Sunway City, in achieving carbon reduction. Many strategies covering all development sectors have made the city more sustainable, minimising the environmental impact and achieving energy efficacy. For example, to infuse low-carbon elements into their township, MBSJ collaborates with developers to use low-carbon materials. Due to this, the authority gained recognition for its low-carbon initiatives, and this success was led by good collaboration between the authority and the industrial player. The success of the Sunway City project, in which the government acts as an advocate for developers in creating a city that incorporates low-carbon technologies, may serve as a benchmark for other agencies in implementing a low-carbon approach. MBPJ collaborates similarly to the other two (2) authorities and strives to widen the partnership with various organisations and agencies. In delivering the initiatives, MBPJ also partnered with international agencies to gain more experience, learn from the expertise, and get guidance in planning for better carbon management plans in the future. MBSA, MBSJ, and MBPJ make a substantial effort to encourage private sector engagement in LCC development projects for physical planning and development, even though doing so is optional for growth within their administrative limits. The industries related to the low carbon context were one of the key players in achieving the city's low carbon status.

The study also reveals that the coordination among the multiple agencies is great in each local authority. Also, the participation of

either internal-external agencies within the authorities was claimed to be successful due to the commitment and targets each agency aims to achieve that aligns with the Sustainable Development Goals. However, the study also found that there still needs to be more coordination in the operational practices, which include the database system and technology used, as well as the communication barriers (i.e., multi-layer LCC governance) that influence the effectiveness of the delivery.

Indicator 6: Database System

From the database aspect, the practice used by the authorities to record all the data in the context of operations or management reveals that no formal system or database is used for LCC records. A collection of Excel sheets with a checklist and indicators for completion are sent to local authorities, and submissions are performed online (for example, using an email system). Regarding management, each party involved in private or public agencies and other departments within the local authority is recorded separately. The lack of a centralised database system to store and record the files makes it extremely difficult for the local government to obtain the information. This problem also surfaces when collaboration between the agencies is required, impacting the administration and operational aspects of LCC delivery.

In addition, the study has identified four (4) constraints related to LCC governance hence bringing challenges in adopting the LCC indicators. The challenges may be seen through; (i) empowering the parties or units in charge of low-carbon delivery; (ii) indicating the broad dimension of current policies into specific and detailed action plans that are relevant to the local context (especially to the local authorities that not yet having specific LCC action plan); (iii) in data management which is developing a centralised database system to keep and record the data; and (iv) encourage strong cooperation between various stakeholders and different actors to achieve efficiency in the operational approach.

The lack of a formal structure for delivering LCC, a database system, and an unorganised administrative structure in an organisation was among the issues found through the literature study to support the challenges that need to be addressed in the future development plan. As mentioned earlier, due to a lack of emphasis on governance components, the indicators such as roles, job descriptions, or duties of local authorities in low carbon administration still need to be thoroughly completed (Abdullah et al., 2022a). Each local authority has a specific role to play in achieving its objectives. The local authority may therefore improve one of the criteria based on the outlined indicators to put better administration practices to establish a greater system of governing the LCC (Yusuf et al., 2016). These challenges were also agreed upon by the officers from the local authorities up until now. For example, the challenges will be outlined based on several indicators (Table 7).

Table 7. The Challenges in Adopting the LCC Indicators

Indicators	Challenges
Policy/ document/ guideline/ tools	When implementing the policies and strategies from the upper level, other external aspects should be taken into account to make sure the delivery matches the development requirement. The challenge encountered by the local authority is in translating the existing policies/ framework into specific action, however, the city still lacks an expert to handle the LCC delivery.
Administrative structure	Most of the local authorities still did not have a specific unit for low-carbon city development. The team was established under the Planning Department or Waste Department and may cause an overlapping task among the officers. It is also a challenge to have more officers/ expertise if there is a change in the existing administrative structure.
Roles	The context of sustainability is indeed wider and the strategies are applied to many sectors/departments within the local authority to achieve the city target. Yet, the roles played by the Sustainable Units are bound within the department and affect the communication and coordination among the technical department in the local authority.
Bureaucratic / autonomy	The autonomy is restricted due to multiple layers of governance at the local level resulting in organization intervention. Therefore, it brings challenges to the unit to reposition the unit to gain more power and enhance the efficacy of the governance of LCC.
Coordination	The challenge is having coordination among the operational stakeholders to work together if any issues regarding the system, procedure, or governance are not fully addressed.
Procedure	No formal procedure is being undertaken either by the authorities or developers and therefore brings a challenge to get through the process involving, having involvement, and managing the data.
Database	No standard system or database is used. The lack of a centralized database system to store and record the files brings a challenge for the local government to obtain the information.
Performance	Authorities are not able to see their current achievement if involvement from the various parties is less coordinated which is seen through the authority roles within the monitoring stage. Thus, there are constraints on who will monitor the implementation of the low-carbon initiative

5. CONCLUSION

This paper conveys a study on the indicators of urban governance in the context of LCC delivery. The suitable indicators were identified by reviewing the specific related articles from the scoping and expert interview analyses. The intention is to understand the delivery of LCC initiatives through governance. The first section in the literature review summarises the topic of studies from previous scholars that related to sustainable governance from the past five (5) years. After that, the second section focuses on the indicators for Sustainable Governance Study. The context of governance studies is huge and needs to emphasise various variables. Accordingly, this study only limits the review to the governance parameters / variables / indicators

and the LCC indicators, especially at the city level. Besides, the current LCC practices in Malaysia were reviewed in the last section of the literature. The study found that good urban governance, institutional framework, and sustainable development approach are interrelated to address climate change issues. Therefore, the planning must include a sustainable development approach, but the roots toward successful sustainable governance must be addressed using LCC governance indicators to improve the LCC delivery and implementation. As for the method, this study conducted a detailed literature review and applied a non-probability sampling technique known as purposive sampling. The expert interview technique was engaged with an expert from three (3) local authorities, which were the Shah Alam City Council (MBSA), Subang Jaya City Council (MBSJ), and Petaling Jaya City Council (MBPJ).

The process resulted in determining the six (6) indicators for LCC governance, and these indicators were then applied for investigation for the case studies (MBSA, MBSJ, and MBPJ). The indicators were tested by the local authorities and proved that the six (6) indicators were very much applicable to measure LCC governance at local government. Findings revealed that the indicators play an ultimate role in shaping the sustainable agenda for the local authority and towards a better governance system. In addition, the study showed that the variables are suitable to be applied in assessing the effectiveness of the governance or as the parameters for implementation and monitoring the LCC initiative, which included the inter-institutional administrative criteria and LCC criteria. From the administrative feature, the findings indicated that the current administrative practice needs to be restructured to empower the roles of the dedicated unit for LCC efforts and enable a more effective delivery system, including coordination among the related agencies and database management. From the policy application, it was identified that all local authorities convey the global and national strategies for achieving sustainable status by establishing their action plan as the ultimate document and tools for implementing and monitoring the LCC initiative delivered at the local level. Therefore, all plans for action within a local authority must be in line with the requirements outlined in the policies. The roots for guaranteeing the approach's efficacy must be strengthened by increasing its governance component to implement it properly. In addition, the local government is presenting the private sector with this strategy to enhance urban planning and management. It is necessary to develop an institutional framework for LCC delivery that includes each component or part as a whole to ensure better practice in the future. From the findings, the researchers believe that this outcome can be a reference for LCC measurement by other local governments in Malaysia. To end the discussion, this study suggests that future research may include experimenting with other parameters in evaluating the delivery of LCC or further examining the performance of LCC implementation based on the target the authority made.

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