Malaysian Journal of Social Sciences and Humanities (MJSSH) (e-ISSN : 2504-8562)
2022, Volume 7, Issue 12, e002011
DOI: https://doi.org/10.47405/mjssh.v7i12.2011

The Need for Sustainability Improvements in Residential Building Stock: A Case of Klang Valley, Malaysia

Siti Aishah Ramli[1], Julitta Yunus[2*], Mohd Tajul Izrin Mohd Tajul Hasnan[3], Rumaizah Mohd Nordin[4], Padzil@Fadzil Hassan[5]

[1]Centre of Studies for Postgraduate, College of Built Environment, Universiti Teknologi MARA 40450 Shah Alam, Selangor Darul Ehsan, Malaysia.
Email: sitiaishahramli94@gmail.com
[2]Centre of Studies for Construction, College of Built Environment, Universiti Teknologi MARA 40450 Shah Alam, Selangor Darul Ehsan, Malaysia.
Email: julitta@uitm.edu.my
[3]Centre of Studies for Architecture, College of Built Environment, Universiti Teknologi MARA 42300 Puncak Alam, Selangor Darul Ehsan, Malaysia.
Email: tajulizrin@uitm.edu.my
[4]Centre of Studies for Construction, College of Built Environment, Universiti Teknologi MARA 40450 Shah Alam, Selangor Darul Ehsan, Malaysia.
Email: drrumaizah@uitm.edu.my
[5]Centre of Studies for Quantity Surveying, College of Built Environment, Universiti Teknologi MARA 40450 Shah Alam, Selangor Darul Ehsan, Malaysia.
Email: padzil037@uitm.edu.my

CORRESPONDING AUTHOR (*):
Julitta Yunus
(julitta@uitm.edu.my)

KEYWORDS:
Sustainability
Low Carbon City
Carbon Reduction
Residential buildings

CITATION:
Siti Aishah Ramli et al. (2022). The Need for Sustainability Improvements in Residential Building Stock: A Case of Klang Valley, Malaysia. *Malaysian Journal of Social Sciences and Humanities (MJSSH), 7*(12), e002011.
https://doi.org/10.47405/mjssh.v7i12.2011

ABSTRACT

Energy consumption in residential buildings is increasing and continues to escalate. As a developing country, Malaysia faced rapid urbanization due to population growth and heavy migration from rural areas to cities which raised the need for economic development, resulting in rising demand more than ever. Guidelines for conserving energy in buildings have become more critical now, encouraging the growth of sustainability concerns in Malaysia. However, the urgency has been given to commercial, governmental and industrial buildings, making the push towards the residential sector less noticeable despite a large number of the housing typology. This paper aims to investigate the course of Malaysia's sustainability agenda towards achieving sustainable development, and further analyse the response to the uptake at the local level. To achieve that, a systematic review of existing national policy and masterplan produced by the government, state and local councils towards decarbonization efforts in the building sector was conducted. Following that, a thematic synthesis was carried out to further evaluate low carbon initiatives on the local level, in particular among ten (10) local authorities committed to the Low Carbon City Framework (LCCF). In short, the current policy of sustainability in the residential building remains limited with only four (4) local authorities highlighting improvement strategies despite residential becoming the largest building typology in the

© 2022 by the authors. Published by Secholian Publication. This article is licensed under a Creative Commons Attribution 4.0 International License (CC BY).

country. Hence, there is a need for sustainability improvements among residential building stock, in which an extensive policy embracing possible strategies for achieving energy efficiency should be devised.

Contribution/Originality: This study contributes to the existing literature on Malaysia's direction and movement towards achieving sustainable development goals by 2030, specifically for the Low-Carbon City target. Very few studies have investigated the importance of taking sustainability measures toward residential buildings that have to start with policy action at the local level.

1. Introduction

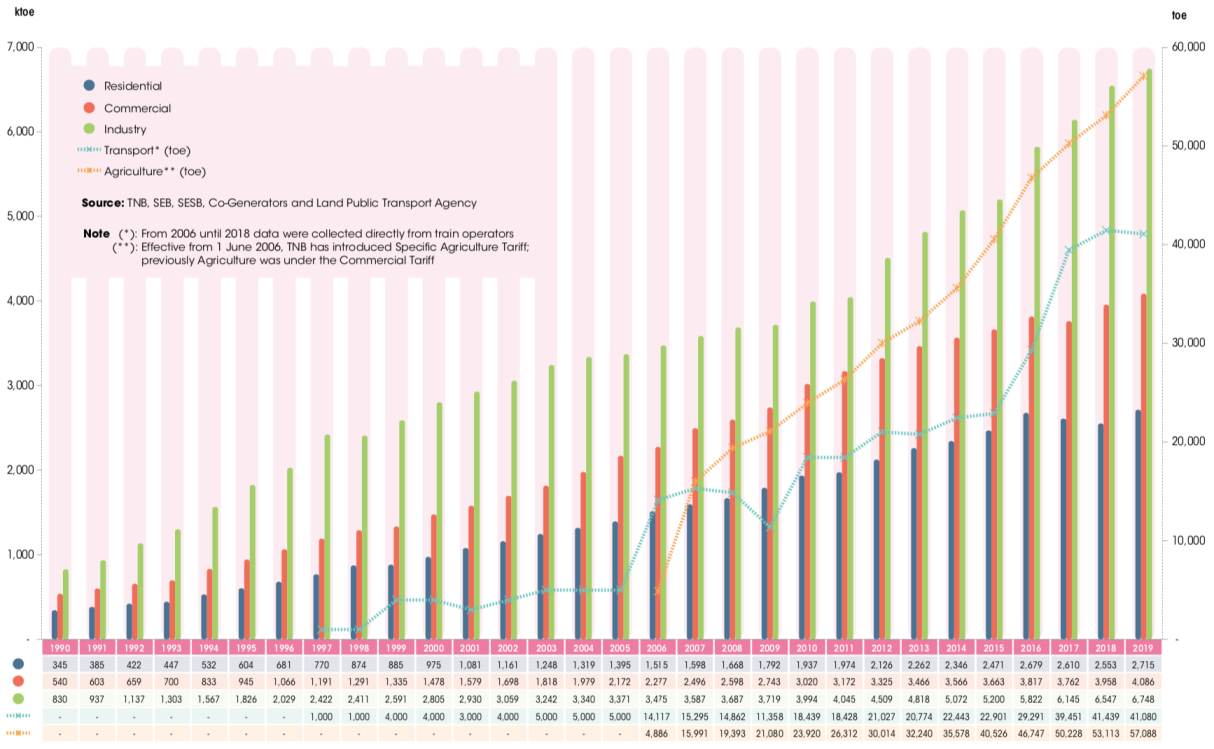
Rapid population rise and urbanization play a major role as a pivotal economic growth in Malaysia which is of help to the quality of life to the community. Malaysia faced an escalating level of urbanization from 26.8% in 1970 to about 76.6% in 2020 and it is expected to reach 88% by 2050 (Department of Statistics Malaysia, 2020). Malaysia pledged to commit to and support the Sustainable Development agenda in the spark of the United Nations Sustainable Summit. However, there are persisting challenges in combating climate change due to energy-related carbon dioxide (CO2) emissions which have become the main concern as a developing country. Malaysia faced critical challenges in decarbonizing efforts given that fossil fuel is the key driver to the economy while taking into account the increased population. The energy sector has evolved from heavily relying on oil for energy to adding coal and natural gas to diversify the energy resources, and now noting the rise of renewable energy in our system.

In a way, the building construction industry has become one of the most significant contributors to climate change and environmental issues as CO2 emissions from the building sector are up till now the highest recorded. According to IEA and UNEP (2019), the building construction sector accounted for 35% of total energy consumption and 38% of global energy-related CO2 emissions as population growth and floor area surge boosted the impacts. In Malaysia's context, the national energy balance in Figure 1 shows an escalating trend over the last two decades. A total electrical consumption from 104,519 GWh in 2010 to 158,603 GWh in 2019 indicating a growing energy demand is envisioned shortly. Following the industry and commercial sectors that consumed Malaysia's total electricity consumption at 49.5% and 28.8% respectively, the residential sector is responsible for 33,322 GWh, about 21% of total electricity consumption in Malaysia (Energy Commission, 2020).

Moreover, as a building gets older, more energy is consumed to operate the building which eventually leads to excessive building energy consumption (Che Husin et al., 2019). Since the country's residential stock has been built and accumulated for the last few decades, especially in the main big cities, we are obliged to effectuate decarbonization efforts among the existing residential stock as the efforts towards achieving low carbon city should be inclusive – focusing on each of pillar systems of what makes a city. Globalization, demographic changes and the rising income level since the country's development had transformed the housing provision system in Malaysia (Shuid, 2016). Thus, adapting to excessive energy consumption in residential buildings always brings forward the topic of sustainability improvements through refurbishment actions, which represents the main objective of this paper.

© 2022 by the authors. Published by Secholian Publication. This article is licensed under a Creative Commons Attribution 4.0 International License (CC BY).

Figure 1: The trend of Malaysia's national energy balance (Energy Commission, 2019).



	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
	345	385	422	447	532	604	681	770	874	885	975	1,081	1,161	1,248	1,319	1,395	1,515	1,598	1,668	1,792	1,937	1,974	2,126	2,262	2,346	2,471	2,679	2,610	2,553	2,715
	540	603	659	700	833	945	1,066	1,191	1,291	1,335	1,478	1,579	1,698	1,818	1,979	2,172	2,277	2,496	2,598	2,743	3,020	3,172	3,325	3,466	3,566	3,663	3,817	3,762	3,958	4,086
	830	937	1,137	1,303	1,567	1,826	2,029	2,422	2,411	2,591	2,805	2,930	3,059	3,242	3,340	3,371	3,475	3,587	3,687	3,719	3,994	4,045	4,509	4,818	5,072	5,200	5,822	6,145	6,547	6,748
	-	-	-	-	-	-	-	1,000	1,000	4,000	4,000	3,000	4,000	5,000	5,000	5,000	14,117	15,295	14,862	11,358	18,439	18,428	21,027	20,774	22,443	22,901	29,291	39,451	41,439	41,080
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4,886	15,991	19,393	21,080	23,920	26,312	30,014	32,240	35,578	40,526	46,747	50,228	53,113	57,088

Nevertheless, sustainability propaganda and decarbonization efforts were typically associated with commercial, governmental, and industrial buildings, making the urge towards the residential sector remain imperceptible. According to a recent Property Stock report by Valuation and Property Services Department (2022), the total residential building stock in Malaysia has surpassed 6 million, with an incoming and planned supply of more than 900,000 by the end of 2022 United Nations Environment Programme (2020) further reveals residential buildings as a major contributor to energy consumption and is responsible for 17% of global CO_2 emissions directly and indirectly. In typical Malaysian homes, an increase in energy usage is forecasted to mainly result from heating and cooling spaces in particular air-conditioning and refrigerators, followed by lighting features (Malaysia Green Building Council, 2020). In light of this, we ask: How has Malaysia's agenda of sustainable and decarbonization efforts highlighted the residential sector? In what way the decarbonization efforts were implemented among the local initiative? Is the local agenda successful in achieving the target and are the efforts enough? The paper will first review the country's commitments to realize the decarbonization target across the national strategic plan, federal-state capacity the local initiative action plan. The next section of the paper evaluates the significance of residential buildings in promoting sustainability efforts thus highlighting the efforts of reducing carbon emissions in the construction industry. We will then detail several local action plans and analyse their efforts towards achieving residential building sustainability. Finally, the paper will conclude the need for sustainability improvements in the residential building stock.

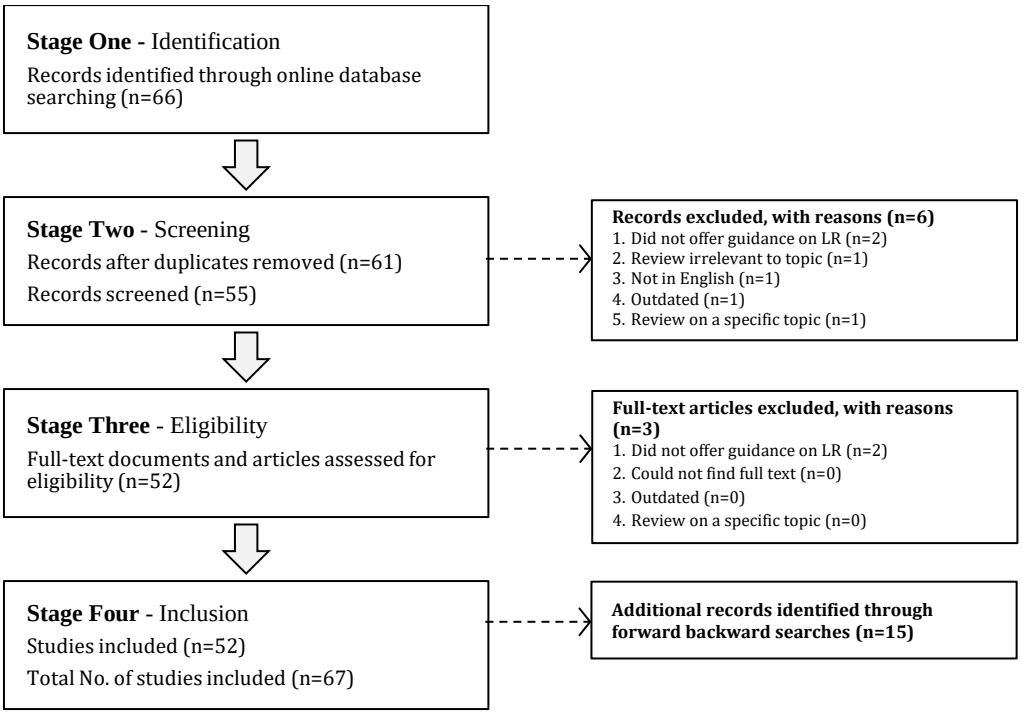
2. Methodology

To obtain an in-depth insight into the related subject of sustainability and decarbonization efforts, a systematic literature review on Malaysia's national agendas was carried out. This is to investigate whether the low carbon initiative in Malaysian

© 2022 by the authors. Published by Secholian Publication. This article is licensed under a Creative Commons Attribution 4.0 International License (CC BY).

cities conforms to the need for sustainability improvement among residential buildings. To begin with, the process involved secondary data collection from multiple sources of the existing national masterplan, blueprints, and action plans as well as reports related to Malaysia using the keywords "sustainable", "green" and "low carbon." In the earlier stage, this paper appraises the country's commitment to addressing climate change through the national, state and local levels of the administrative structure of Malaysia. Next, it highlights the significance of residential buildings in the construction industry which emphasized increased initiatives among the typology. Finally, it provides a comparative review of the approach and schemes related to the low carbon action plan of nine local authorities committed to the action in Klang Valley. The review intends to probe into the call for sustainability improvements among residential building stock. The detailed process of systematic review is illustrated in Figure 2 below.

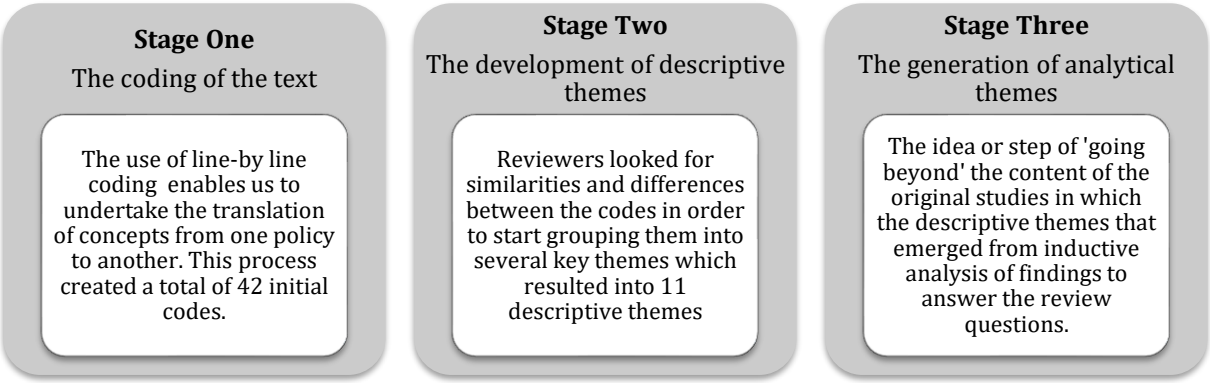
Figure 2: Detailed process of the systematic review.



The first stage of identification involves a database search through online websites and documents related to national policy using the feature keywords of “low carbon”, “green technology”, “green growth”, “energy efficiency”, “construction” and “buildings”. During this process, the researcher found several sources extensively including in grey literature of reports, slide sharing as well as book chapters. For quality assessment of the next stage, several records were excluded following the aims, context, rationale and findings, the screened documents then proceeded for a full assessment. A total of 52 documents were reviewed including journal articles and conference proceedings, and throughout the entire process, thorough searches were conducted with the total number of documents reviewed in this paper being 67. After the recorded documents were finalized, a thematic synthesis of qualitative research in the systematic review was conducted in three stages in Figure 3 referring to Thomas and Harden (2008), beginning with the coding of text ‘line-by-line’; the development of ‘descriptive themes’; and the generation of ‘analytical themes’.

© 2022 by the authors. Published by Secholian Publication. This article is licensed under a Creative Commons Attribution 4.0 International License (CC BY).

Figure 3: The steps of thematic synthesis adopted in this paper



We used thematic synthesis to integrate the existing national, subnational and local policies and determine key themes to probe into the intervention studies. In the existing policies review process, we ended up creating a total of 42 initial codes. For example, some of the text we coded as 'low carbon' from one policy (KLCH, 2018) resulted in the highlights:

'**Action 6: Low Carbon Green Building** – *which encourages the implementation of sustainable design strategies, usage of energy efficient (EE) and renewable energy (RE) building and technologies and monitoring and management of green buildings.'*

'**Action 5: Community Engagement and Green Lifestyle** – *which establishes a low carbon society whereby residents are practising low carbon behaviour and empowering the community to undertake low carbon initiatives and adopt low carbon lifestyle.*

The next stage of synthesis involves the similarities and differences between the codes to further capture the groups for 42 initial codes. The process resulted in several structure layers to develop a total of 11 descriptive themes that are: Environment Policy, Renewable Energy, Green Technology, Climate Change, Green Building, Low Carbon Building, Building Consumption, Building Sector Energy Efficiency, Strategies/ Initiatives and Low Carbon Action Plan. Finally, the third stage requires the 'advanced' interpretation of the outcome of previous findings to answer the research question. In this paper, the question was asked *"How has Malaysia's agenda of sustainable and decarbonization efforts highlighted the residential sector?"*. From the key themes organized earlier, six of the 11 descriptive themes concerned the influences on the building sector. From these, we inferred the influences of strategies to low-carbon initiatives among different building typologies, which answers the research question before and ultimately achieves the research objective. Since this is part of ongoing studies of a PhD program, ten (10) local authorities in Klang Valley pledged to achieve low carbon city mandate were reviewed in this paper and to further narrow the scope of the case study, thus one local authority was selected for the next stage of the research.

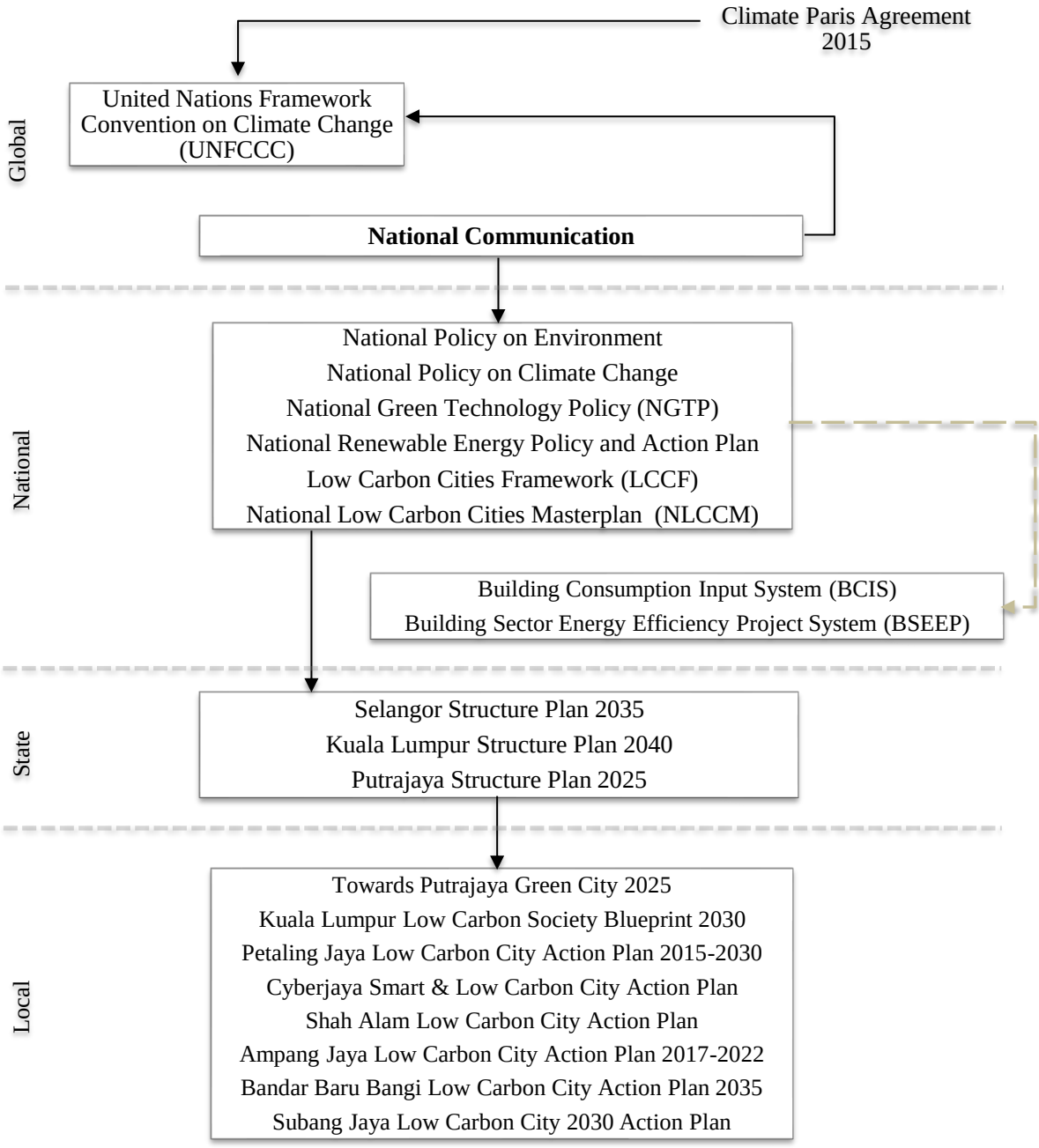
3. Result and Findings

Cities are responsible for major global CO_2 emissions, resulting from industrial and transportation systems that utilize fossil fuel heavily for energy consumption, and infrastructure constructed with carbon-intensive materials. Cities occupy 2% of total land but contributed to 70% of global GHG emissions, 60% of global energy consumption and 70% of global waste (Ministry of Environment and Water (KASA), 2016). Dasgupta,

© 2022 by the authors. Published by Secholian Publication. This article is licensed under a Creative Commons Attribution 4.0 International License (CC BY).

Lall and Wheeler (2022) highlights the World Bank's latest Climate Change Action Plan (2021-2025) which emphasizes city systems as one of five key systems that generate the most GHG emissions and sustain huge adaptation challenges, which brought forward the importance of cities as carbon sinking tool. As a developing country, facing the escalating urban population, cities in Malaysia are facing challenges in decarbonization efforts and becoming more accountable for GHG emissions urging stipulated actions to be taken by the stakeholders. National commitment towards sustainable development in lessening carbon emissions and reducing energy consumption can be classified into three levels of administration structure of Malaysia that are: national, federal/state, and local level.

Figure 4: Malaysia's national commitment towards sustainable development.



The Malaysian government is cognizant of the effects of global warming on the country and is devoted to addressing climate change. During the 15th United Nations Framework Convention on Climate Change (COP 15) in Copenhagen, Malaysia pledged to reduce its

© 2022 by the authors. Published by Secholian Publication. This article is licensed under a Creative Commons Attribution 4.0 International License (CC BY).

CO_2 emission intensity by 40% per GDP by 2020. When Agenda 2030 was first developed during the Paris Agreement in 2015 to pursue global sustainable development more aggressively, the country aligned sustainable development goals (SDGs) with the Eleventh Malaysia Plan. Malaysia promised to participate in global efforts and remain committed to addressing climate change while determined to reduce its emissions intensity by 45% reaching 2030. Figure 4 illustrates a general overview of Malaysia's national commitment towards achieving sustainable development which features several masterplan and blueprints as well as action plans to guide the stakeholders in achieving the decarbonization target. Ensuring that, several policies and strategic plans have been developed, from the national level following the pledge at the global Paris Agreement to the state level and lastly, the local level capacity to redirect the country towards less carbon-intensive prospects. Malaysia's commitment to adopting SDGs can be traced way back to the 1970s when the New Economic Policy (NEP) was introduced. It is a robust policy that encompassed sustainable economic growth envisioning basic access to the people mainly to eradicate poverty. During this period of economic growth, the cities' landscape was painted with mass production of residential stock to cater for heavy migration from rural and restructure societal imbalance.

3.1. Malaysia's National Sustainability Agenda in Building Construction Sector

There are several policies and masterplan developed by the government in response to addressing climate change in Malaysia. The establishment of a legal and institutional framework by the Malaysian government ensures that the environment is sound and protected and promotes the effort of sustainable development for the country. The federal, state and local government's efforts should be concurrent to ensure that the policies undertaking enacted by the federal government towards climate change mitigation are implemented by the state government and later, the local government – so that the feat can be inclusive.

National Policy on Environment (NPE) has been established in 2002 to improve the quality of life among Malaysians through environmental well-being and sustainable development. It persisted in economic, social and cultural progress through i) a clean, safe, healthy and productive environment for present and future generations, ii) the conservation of the country's unique and diverse cultural and natural heritage with effective participation by all sectors of society, and iii) a sustainable lifestyle and pattern of consumption and production (NPE, 2002). This policy emphasizes the importance of conserving the environment of natural ecosystems and resource utilization while marking economic development, as well as the role of both public and private sectors in ensuring the goal can be achieved.

National Renewable Energy Policy and Action Plan (NREPAP**)** is a report prepared based on in-depth consultations and a series of discussions with various stakeholders under the KeTTHA in 2008. The report accentuates issues and predicaments arising from the renewable energy development towards reducing electricity generation which called upon a more effective policy, renewable energy policy for the country. Renewable energy (RE) sources identified in Malaysia include palm oil biomass wastes, mini-hydro, solar power, solid waste and landfill gas, wind energy and geothermal, and wastes and gases from agro-based and farming industries. However, in the context of the building construction sector, only solar photovoltaic (PV) cells can be associated as strategic RE in buildings. With the average values of solar irradiance in Malaysia, solar PV technology appears to offer the most satisfactory long-term prospect for RE in the country. It also

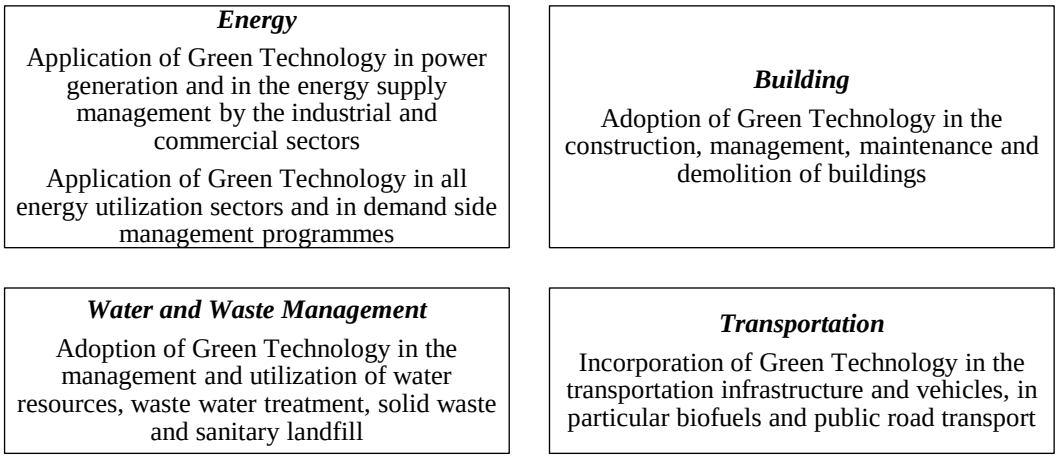
© 2022 by the authors. Published by Secholian Publication. This article is licensed under a Creative Commons Attribution 4.0 International License (CC BY).

highlights the actual opportunity for solar PV to reside in homes (residential areas), warehouses and other low-rise commercial buildings as roof-top solar PV modules can provide limited to three-story energy-efficient buildings in Malaysia. The constraint to adopting solar power potential remains on the availability of funding and the domestic and international production facilities to cope with demand rather than the availability of solar irradiation (NREPAP, 2008).

In 2009, the Ministry of Energy, Green Technology and Water (KeTTHA) is cognizant of the international environmental movement by the United Nations Millennium Development Goals (MDGs) to integrate the principles of sustainable development into the country's policies and programmes. National Green Technology Policy (NGTP) was launched to address climate change by promoting green technology as a driver to accelerate the economy towards sustainable development. The policy encompasses four main pillars of Energy, Economy, Environment and Social that aim to minimize the growth of energy consumption, facilitate the growth of the green technology (GT) industry, increase national capability and capacity for innovation and enhance public education and awareness of the green technology (NGTP, 2010). The energy pillar seeks to attain energy independence and promote efficient utilization, the Economy pillar enhances national economic development through the use of green technology, the Environment pillar conserves and minimizes impact on the environment and the Social pillar improves the quality of life for all.

In the NGTP, there are four main sectors supported the short-term, mid-term and long-term goals of the 10th Malaysia Plan as highlighted in Figure 5. The short-term goals focused on the increased public awareness among the stakeholders from 2011 to 2015. The mid-term goals targeted a larger market share on GT and its expansion to most economic sector in 5 years. For the long-term goals in 12th Malaysia Plan from 2020 and beyond, the inculcation of GT in Malaysian culture is intended while marking a significant reduction in national energy consumption. Furthermore, NGTP also highlights five (5) strategic thrusts comprised of economy, environment and social elements (Figure 6).

Figure 5: Highlighted four main sectors in NGTP

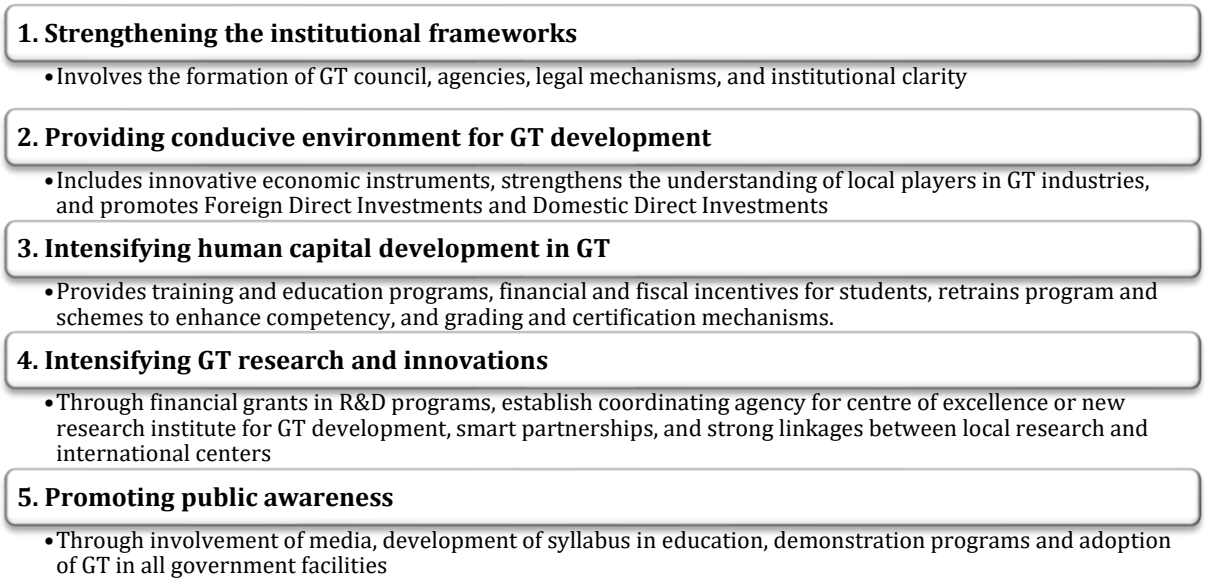


In this policy, the key goals for 2010 highlight: i) Green Township Guideline in which the Carbon Footprint Baseline for Putrajaya and Cyberjaya was developed, ii) Green Rating System, which develops a rating system to calculate carbon emission and carbon footprint, as well as aiming to iii) Saving 10% of energy and water usage in government buildings in Putrajaya to lead by example. The three main goals were set up as pioneers

© 2022 by the authors. Published by Secholian Publication. This article is licensed under a Creative Commons Attribution 4.0 International License (CC BY).

to steer the country's path towards achieving carbon reduction in cities, and buildings and through retrofitting actions. This policy also highlights National Key Indicators to measure the success of Green Technology Policy and its initiatives in terms of environment, economy and society, and provide a feedback mechanism to improve or strengthen the initiative as necessary to the Government.

Figure 6: Five (5) main objectives of NGTP



National Policy on Climate Change (NPCC) is a policy developed by the Ministry of Natural Resources and Environment Malaysia in 2009, a response to Malaysia's commitment to the Paris Agreement. The policy states to ensure climate-resilient development to fulfil national aspirations for sustainability. To undertake mainstream national responses to climate change, this policy facilitates the integration of climate change considerations into the planning and implementation of development activities and decision-making processes to foster the country into achieving sustainable economic, conscious human development that complements environmental conservation (NPCC, 2009). In this policy, the highlights of strategic thrusts related to energy efficiency (EE) in the building sector are organized in Table 1 below.

Table 1: Highlighted key actions of building energy efficiency in NPCC

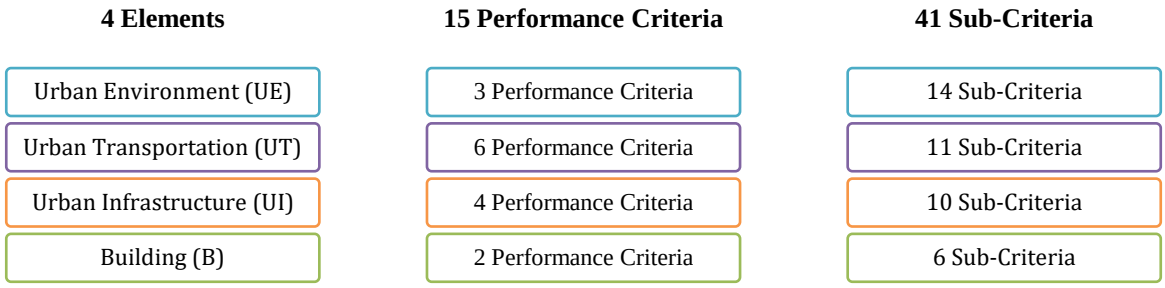
Key Actions (KA)	Strategies
KA21 – Promote and increase EE in industrial sectors	Review and establishment of legal mechanism for EE application in industries Provision and promotion of technical and financial assistance or incentives to the industry using EE technology and processes Conduct of technology needs assessment Conduct of energy audit in industrial and building sectors; and Adoption of EE practices by new industries
KA22 – Promote the construction of green buildings in the commercial/ institutional, industrial and	Application of low or zero energy concept in the design and construction of new buildings Retrofitting of efficient ventilation and cooling systems as well as lighting systems Energy conservation practice in buildings Retrofitting existing buildings to include EE features and generate

© 2022 by the authors. Published by Secholian Publication. This article is licensed under a Creative Commons Attribution 4.0 International License (CC BY).

residential sector (RE); and Development of a green building index (GBI)

In line with the NGTP, the Low Carbon City Framework and Assessment System (LCCF) was initiated in 2011 by the Malaysian Green Technology and Climate Change Centre (MGTC) to provide a framework to achieve sustainable developments in reducing carbon emissions. It is a national framework and assessment system to guide and assess the development of cities towards sustainable development while inspiring the stakeholders (local authorities, township developers, designers and individuals) to participate in climate change mitigation. According to LCCF (2011), the concept of low carbon city is defined as a city that incorporates societies that consume sustainable green technology, and green practices and release relatively low carbon or GHG as compared to the present day to mitigate the adverse impact of climate change. The GHG reduction approach of the LCCF utilizes the carbon corresponding to each activity producing GHGs focusing on 4 identified elements: Urban Environment, Urban Transportation, Urban Infrastructure and Building, and the further 15 performance criteria and 41 sub-criteria (KeTTHA, 2017). The summary of key elements, performance criteria and sub-criteria in Figure 7 helps the stakeholders to comprise the cities' carbon footprint and guide them in capturing the applicable reduction actions in attaining the national climate aspirations.

Figure 7: Key summary of LCCF (KeTTHA, 2017)



The framework provides guidelines in the planning of sustainable development that can contribute to the reduction of GHG emissions, plus it also provides recommendations for carbon emission reduction for each of the performance criteria (KeTTHA, 2017). Other than that, LCCF also highlights performance criteria for low carbon buildings in Table 2. Since several local authorities committed to the target set by the government with the vision to lead by example and to create a prosperous urban environment. As of June 2019, a total of 52 local authorities have remained committed to the LCCF program.

Building Consumption Input System (BCIS) is an online input database system developed to track operational carbon using Common Carbon Metric (CCM). The system is developed and administered by GreenTech Malaysia to monitor the energy and water consumption of buildings. The system works using the data collected for CCM Analysis to find out the value of carbon that was released from the buildings. If the building has high carbon release, initiatives must be taken to save 10% of energy and water. However, BCIS is restricted only to the government building owner, user and manager in Federal Government Administrative Center in Putrajaya.

© 2022 by the authors. Published by Secholian Publication. This article is licensed under a Creative Commons Attribution 4.0 International License (CC BY).

Table 2: Performance criteria for low carbon buildings.

Performance Criteria	Recommendations
Operational Energy Emissions	Compare building performance to the benchmark set by Common Carbon Metric for building typologies: offices, residential buildings, hotels, hospitals, schools / institutional buildings, and commercial & industrial buildings. Encourage all large-scale businesses to submit GHG reduction plans.
Operational Water Emissions	Indoor water use in buildings undergoing major renovations as part of the project must be an average of 40% less than in baseline buildings.
Emission Abatement through Retrofitting	Retrofit and reuse existing habitable building stock Do not demolish any historic buildings, or alter any cultural landscapes as part of the project
Building Orientation	Prioritize passive solution on buildings Increase the harnessing of sunlight by looking to block orientation (compact development) and building orientation (natural ventilation, prevailing winds and wind zone). Offset the mechanical HVAC systems for cooling purposes.
Shared Facilities and Utilities within Building	Share and integrate community service centres with other building use Save green sites and ensure sustainable land use

United Nations Development Programme (UNDP) and Public Works Department (PWD) Malaysia are the global and local implementers of the Building Sector Energy Efficiency Project System (BSEEP) respectively. It was a project financed by The Global Environment Facility (GEF) through funds contributed to help combat climate change. BSEEP aims to reduce the annual growth rate of GHG emissions from the building sector in Malaysia by improving energy utilization efficiency. The goal of this project is to improve energy utilization efficiency in Malaysian buildings, particularly those in the commercial and government sectors, focusing on energy-conserving design in new buildings and improving the efficiency in energy consumption of existing buildings. This system has its goal to reduce the annual growth rate of GHG emissions from the Malaysian building sector. At the same time, this project intends to facilitate the uptake of building energy efficiency technologies, systems and practices.

Another project sponsored by the collaboration of UNDP and GEF is the Green Technology Application for the Development of Low Carbon Cities (GTALCC) which is a 5-year project that assists in the implementation of low-carbon initiatives in Malaysian cities. This project aims to reduce 346,442 tonnes of CO^2eq by the end of the project in 2030. There are five participating cities in this programme that are: 1) Iskandar Regional Development Authority; 2) Petaling Jaya City Council; 3) Putrajaya Corporation; 4) Sepang Municipal Council; 5) Hang Tuah Jaya Municipal Council. National Low Carbon Cities Masterplan (NLCCM) is a document of low-carbon initiatives in Malaysian cities under the GTALCC project. NLCCM aims to pull off integrated low-carbon urban planning and development through policy support, raise awareness and capacity building and demonstration projects. The master plan presented key challenges to low-carbon pathways in most Malaysian cities and key directions and actions to be taken for low-carbon development focusing on buildings in Table 3. Under the NLCCM (2016) masterplan, the 3M approach is commenced to guide climate change mitigation through Measurement; by establishing a baseline and conducting periodic monitoring of GHG

© 2022 by the authors. Published by Secholian Publication. This article is licensed under a Creative Commons Attribution 4.0 International License (CC BY).

emissions, Management; in terms of policy, targets and planning, and Mitigation; through design and implementations of programmes and projects.

Table 3: Highlighted approaches and possible interventions for the next five years.

KEY DIRECTION 09 **Develop Citywide / Sectoral Development Strategies on Low Carbon**
ACTION 9.1 Spatial Planning and Development
Green Building Recognition
Increase the number of buildings that have been certified as Green Building at municipal level
Use of active and passive design solutions to retrofit the old buildings
Prioritize the use of active and passive design solutions on new buildings
Adopt climate-resilient design solutions on new buildings
Implement and enforce rainwater harvesting at the source
Encourage and provide incentives to install the rainwater harvesting systems
ACTION 9.2 Energy
Energy Audits & Energy Management in Buildings and Industries
Introduce matching grants where free energy audits will be provided to large and medium-sized commercial buildings, industries, and large Government facilities provided that the business owner is willing to invest an amount of energy-saving measures equal to the cost of the energy audit
Energy Consumption
Implement Energy Management System for buildings and certified for Energy Management Gold Standard
Adopt energy efficient building technology to improve energy efficiency and reduce energy consumption
Encourage all large-scale commercial and government buildings to submit Energy Audit report
Monitor the energy consumption and performance through measurement, reporting and verification (MRV)
Retrofit the old buildings into energy efficient buildings

Local Agenda 21 (LA 21) has been adopted at the subnational level by many state governments, including the Selangor State government in 2006. The commitment to achieve Sustainable Development was initiated in 1998 with two participating local councils – Petaling Jaya (PJCC) and Shah Alam (SACC) which piloted Selangor's Agenda 21 implementation. The State of Town and Country Planning Department (PLANMalaysia) Selangor and Urbanice Malaysia are working together to serve technical support to create the first Selangor Voluntary Subnational Review (VSR) report. Selangor's sustainability effort is further strengthened through various initiatives of the implementation at the local level such as SDGs VLR by Shah Alam (Urbanice Malaysia and SACC, 2021) and Subang Jaya (Urbanice Malaysia and SJCC, 2021).

5. Implementation of Low Carbon Initiatives at the Local Level

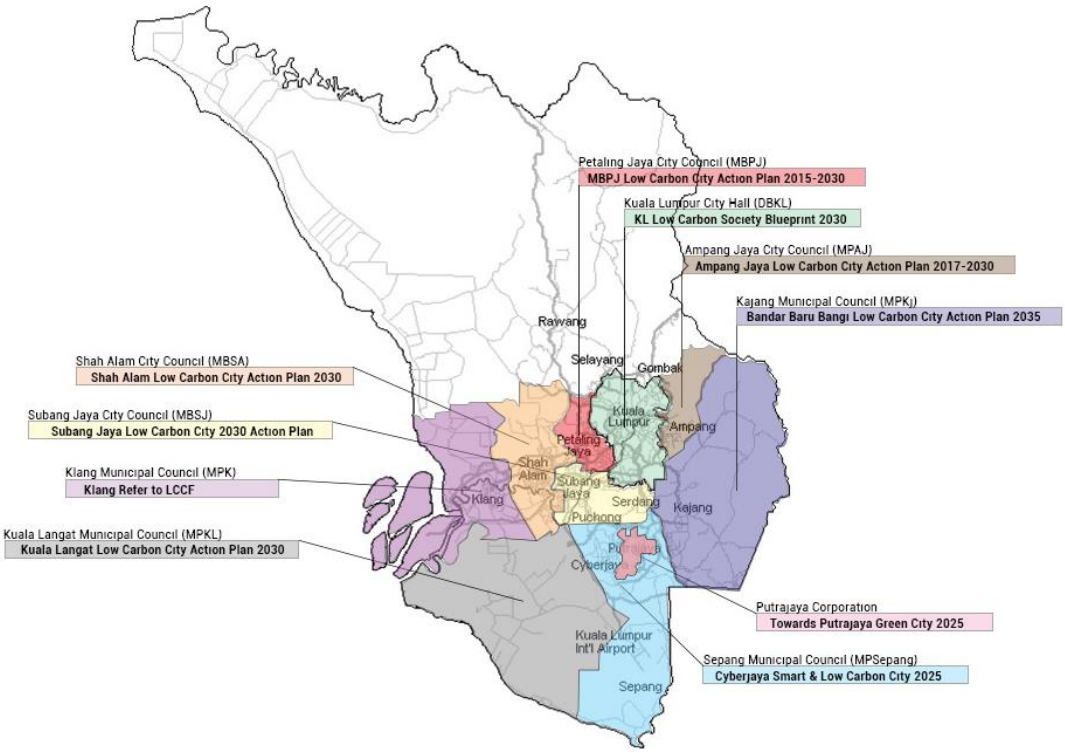
Located at the heart of the country, Klang Valley is an urban cluster in Malaysia with Federal Territory Kuala Lumpur and Putrajaya at the centre, surrounded by adjoining states and cities of Selangor. The focal urban development of Malaysia centred on this area with almost 9 million population (DOSM, 2022). Figure 8 demonstrates selected target cities within the Klang Valley area that had developed their action plan to implement mitigation initiatives to transform their cities into low carbon including one local authority that refers to LCCF in leading towards low carbon pathway. Targeted cities in the NLCCM have referred the local governments that have been selected to

© 2022 by the authors. Published by Secholian Publication. This article is licensed under a Creative Commons Attribution 4.0 International License (CC BY).

revolutionize their cities into low carbon and selected based on their population that has exceeded 300,000 based on 2010 census data by the DOSM.

The targeted cities are grouped based on their advanced involvement in low-carbon development for the past five (5) years. In Klang Valley, half of the cities; Kuala Lumpur, Putrajaya, Petaling Jaya, and Sepang were in the advanced group and another half; Ampang Jaya, Kajang, Klang, Selayang and Subang Jaya in the intermediate group. Leading the low carbon initiatives, the advanced local governments had to develop GHG inventories that include baseline emissions and established a target to reduce 33% of absolute GHG emissions by 2030. Once successfully achieved the target in 2030, it will be declared a year of carbon neutrality. For the intermediate group, the target should be achieved the latest by 2035.

Figure 8: Low carbon initiatives among cities in Klang Valley.



A total of ten (10) local authorities in Klang Valley are keen to reduce GHG emissions to support the national master plan and policy of decarbonization. Nine (9) local authorities have developed their action plan with the target to achieve carbon neutrality within the respected period. Despite not meeting the criteria to be among the Target cities, Kuala Langat still presented its commitment through the development of its action plan. As for Klang city, despite the action plan, the dedication to the initiative is still directed under the reference to LCCF. The investigation of each local authority on their steadfast initiatives to mitigating climate change specifically in buildings, energy efficiency and built environment is further analysed in Table 5. All the action plans and initiatives carried out by the local authorities in the past years, as well as their commitment to the LCCF, were placed under scrutiny.

Kuala Lumpur City Hall (KLCH) is the local government of the Malaysian capital city, comprised of major commercial centres, headquarters of multinational corporations and

© 2022 by the authors. Published by Secholian Publication. This article is licensed under a Creative Commons Attribution 4.0 International License (CC BY).

mega shopping building complexes. According to KLCH (2018), about 80% of the commercial and residential space supply in KL consist of existing buildings. With the rapid growth of GDP in the city, the total GHG emission from the building sector will rise about three times by 2030. Therefore, countermeasures are urgently needed for both the new and existing buildings. Buildings contributed to 49% of total Kuala Lumpur's GHG emissions where 10,329 ktCO2 was generated from commercial buildings and 2,152 ktCO2 from residential buildings, respectively. Therefore, KLCH presents a huge potential in reducing over 48,000 $ktCO_2eq$ by 2030 and up to 70% of the reduction can be secured through programs and courses under KLCH's direct and indirect purviews.

Putrajaya Corporation is the local authority for the city of Putrajaya, committed to its efforts towards realizing the vision of Pioneer Township in Green Technology. In 2007, total GHG emissions were estimated at 664 $ktCO_2eq$ with which the highest emissions being from the government office, followed by the transportation sector. The GHG emissions from the commercial sector are expected to increase 7.5 times in the case where no countermeasures were taken immediately (Putrajaya Corporation, 2015). This answers the focus of the government in targeting to reduce the energy consumption of government offices at the government administration centre city of Putrajaya. With that, the developers in Putrajaya have been actively seeking to attain green building certification for their buildings through the design of new construction. Currently, there are six green buildings; five of them are non-residential new construction, while another one is a non-residential existing building. Putrajaya Corporation aims to reduce energy consumption in buildings since the sector contributes 72% of total CO2 emissions in the city.

Petaling Jaya City Council is a local council that worked with Carbon Trust in 2015 to develop a carbon management plan. Petaling Jaya along with Shah Alam piloted Selangor's Agenda 32 implementation developing a 3-years project blueprint for sustainable development. The plan commits to reducing CO_2 by 25% between 2014 and 2020. The city council came up with Low Carbon City Action Plan 2015 – 2030 targeting a 30% carbon reduction by 2030 from the 2014 baseline of 3,496 kt CO_2 among residential, industrial & commercial, new development, and renewable energy. Building energy use has been identified as the largest energy consumption sector in Petaling Jaya which accounts for 63% of the measured footprint (Lih Shyan, 2020). According to PJCC (2021), the city's land use is comprised of housing (30%), infrastructure & utilities (29%), commercial (12%), green area/recreational (12%), public amenity (12%), and industrial (5%), the carbon emissions reduction is focused on four objectives, namely on residential, industrial & commercial, new development, and renewable energy.

Shah Alam City Council (SACC) is a local council that replaced Kuala Lumpur as the capital city of Selangor State in 1978, four years after Kuala Lumpur became a Federal Territory. This city is committed to sustainability initiatives since 1998 through Agenda 21 Selangor and remain engaged in the low-carbon city mandate until now. SACC is committed to implementing the LCCF program and developed the Action Plan for the city, aiming to accomplish a 45% national carbon reduction by 2030. According to SACC, (2014), the land use for the city consists of residential and commercial (42%), industrial area (25%), forest (21%), agriculture (10%), water (1%) and clear land (1%) (Latif & Kamsan, 2018). SACC has focused on the existing carbon measurement initiative targeting certain areas to commit to the savings. In 2020, SACC has successfully achieved a total carbon emission reduction of 41,170.56 tCO_2 equivalent to an impressive reduction of 28.22% from the baseline.

© 2022 by the authors. Published by Secholian Publication. This article is licensed under a Creative Commons Attribution 4.0 International License (CC BY).

Sepang Municipal Council sets out Cyberjaya Smart and Low Carbon City 2025 report as an active participation in supporting Selangor State Government's agenda. Cyberjaya which is located in the Sepang district was one of two cities pioneering the green initiatives as the pilot project in adopting Malaysia's efforts towards low carbon city framework in the country. Developing from a plantation land, the rapid growth is stimulated by its efforts in producing a thriving Cybercity with steadfast infrastructure, technology, and green initiatives while aiming to elevate it into a global technology hub (Sepang Municipal Council, 2017). As a newly developed city – just over 20 years, over 30% of the land use still consist of vacant land, followed by commercial (12.2%), transportation (17.7%), infrastructure (9.1%), open spaces and recreational area (9%) and housing (6.3%).

Kajang Municipal Council launches Bandar Baru Bangi as a pioneer in adopting low-carbon initiatives considering its strategic location, population, its function as a City District and Administration of Education, as well as the uniqueness and suitability of its community to adapt to changes compared to other areas. The carbon reduction strategies action plan was developed in line with the smart city concept of Smart Selangor Action Plan and LCCF which highlights three main principles to achieve the target that is: 1) low-carbon township, 2) low-carbon society, and 3) smart municipality concept. The four main elements in LCCF (Urban Environment, Urban Infrastructure, Urban Transport and Building) were embraced to analyse the low-carbon achievements of Bandar Baru Bangi. From the Pilot Project for LCCF certification of the city in 2017, it was reported that the highest CO2 emissions resulted from embodied carbon from building construction and infrastructure construction, responsible for almost 80% (Kajang Municipal Council, 2018).

Ampang Jaya Municipal Council sets off Carbon Management Plan that features a strategy and action plan for reducing carbon emissions over the next 5 years as well as Ampang Jaya Low Carbon City Action Plan 2017-2030. The plan provides a platform for the local government to extend their focus and catalyse action on carbon management across the city. In 2015, AJMC spent RM 6.6 million on energy and emitted 9,421 tonnes of CO_2eq, mainly for the cooling and street lighting (AJMC, 2017). Therefore, the target will reduce carbon emissions by 3,142 tonnes of CO_2eq annually and is expected to achieve a reduction of 30% from the 2015 baseline of 9,421 tonnes by 2022.

Subang Jaya City Council has initiated several efforts to address the urban issues in the city by developing local policies and strategies. Subang Jaya (SJ) demonstrates a strong commitment to SDGs especially through their action plans addressing the current issues as well as their responsibility towards global commitment. SJ acquired its city status in October 2020, developed a mature city with an urban built-up area of 84% predominantly residential and institutional uses and further supported by commercial and industrial pursuit (Urbanice Malaysia and SJCC, 2021). SJ embarked on several action plans which consisted of the Green City Action Plan, Safe City Action Plan, Smart City Action Plan, Livable City Action Plan, Healthy City Action Plan and Women Friendly City Action Plan, all together made up the blueprint of Subang Jaya Sustainable City Action Plan 2019-2024.

Klang Municipal Council has been chosen as one of the pioneers for low-carbon alongside four other local authorities in Selangor in 2017. By the end of 2017, Klang has successfully achieved a carbon reduction of 722.84 tCO_2 through its One System Approach to LCCF system (Rahim & Mezan, n.d.). As for now, Klang has undergone three

© 2022 by the authors. Published by Secholian Publication. This article is licensed under a Creative Commons Attribution 4.0 International License (CC BY).

phases of achievement towards a low-carbon city that are first, awareness of LCCF and advanced training, secondly the development of low carbon baseline and action plan, and last the achievement of carbon reduction and continuous improvements. The land use for Klang is comprised of forest (29.79%), agriculture (20.80%), transportation (12.40%), residential (10.81%), industrial (8.91%) and followed by empty land, water bodies, infrastructure and utilities, institutional, recreational and lastly, commercial area (1.12%).

Kuala Langat Municipal Council produces an action plan that aims towards the implementation initiatives in reducing carbon in the district despite the city not being listed as Target Cities in NLCCM. Nevertheless, its efforts towards sustainability remain steadfast and well embedded in the city's strategic plan for 2021-2025. The action plan is based on proposals and quantitative LCCF strategies such as policy achievement, method, the best management, research and development, as well as improving low-carbon sectors (Kuala Langat Municipal Council, 2020). As for now, the land use for this district is incorporated of only 12.11% of the area developed for residential, commercial, industrial, infrastructure and institutional as well as community facilities, with over 68.62% of the land use consisting of agriculture, farming and reserved forest (KLMC, 2019).

From Table 4, some of the measures highlighted by the local authorities were developed according to the nature and development of the cities, the conduct is more inclined towards carbon reduction for certain building typologies. For example, KLCH has developed a detailed program for its policymakers for low-carbon green building initiatives, with the highlights mainly focused on commercial and existing building typology. This is in line with the development of KL which is 80% built up of existing commercial and residential buildings. Meanwhile, for Putrajaya, the efforts are prompted towards governmental and commercial buildings as the city is mostly comprised of government complexes. As the administrative and judicial capital of Malaysia, Putrajaya is leading the concept of a 'green city' with different strategies of LCCF with the increase of new green building construction and existing building retrofit.

As for Petaling Jaya, with 30% of the city's land comprised of housing, the effort is more rigorous towards community engagement in reducing the carbon footprint. The engagement is similar to Subang Jaya but differs in the context – in which PJ focuses on the approach towards the owner's property to retrofit while offering grants to develop green projects but, SJ focuses on the community participation of the green programs administered by the local authority. Shah Alam as the capital of Selangor develops more inclusive efforts of decarbonization, focusing to achieve carbon reduction of the existing state administration buildings as well as an institutional building while encouraging community engagement in the efforts. Sepang as one of the pioneer cities in low-carbon initiatives has established a detailed action plan incorporating EMS among public and commercial building typologies as well as a comprehensive guideline on low-carbon residential buildings.

© 2022 by the authors. Published by Secholian Publication. This article is licensed under a Creative Commons Attribution 4.0 International License (CC BY).

Malaysian Journal of Social Sciences and Humanities (MJSSH) (e-ISSN : 2504-8562)

Table 4: Highlighted low-carbon initiatives of the local authorities.

Local Authority	Highlights	Initiatives
Kuala Lumpur City Hall (KLCH) KL Low Carbon Society Blueprint 2030	Promote use of technology e.g. adoption of Energy Star Rating appliances, rainwater harvesting system, solar photovoltaic panel to residential association. Target community engagement and involvement like introduce Community Energy Saving program, setting up database to record low carbon activities and Low Carbon Residential Association	Focusing on the implementation of sustainable design strategies, usage of EE and RE building technologies, monitoring and management of green buildings among new construction, commercial and existing buildings.
Putrajaya Corporation Towards Putrajaya Green City 2025	Use green technologies e.g. energy efficient lighting fixtures in office complex, newly constructed small businesses kiosks, and lighting of bridges. Encourage use of solar photovoltaic during new construction of office complex and residential units, as well as bus stop.	For commercial complexes, green building design requirements is necessary for non-residential types of development that new requirement to include a report and assessment for GBI to be included by consultants. Impose government offices and commercial buildings to utilized centralized Gas District Cooling (GDC)
Petaling Jaya City Council (PJCC) PJ Low Carbon City Action Plan 2015 - 2030	Develop Property Assessment Tax Rebate Scheme for individual house owners' retrofitting based on 6 major criteria; energy, water, transportation, biodiversity, waste and others. Offer community grant to encourage engagement and funds for community groups in implementing climate actions initiatives like urban farming, waste composting, rain water harvesting, and tools bank.	Encourage of Passive and Active Design which require implementation of energy efficiency measures in new and existing buildings Encourage energy efficiency measures among all stakeholders; residents through basic measures, commercial & industrial through lighting fixtures and more effective motors, target 10% of solar PV generation.
Shah Alam City Council Shah Alam Low Carbon City Action Plan 2030	To promote environmental sustainability to spearhead towards the goal which include Green Procurement of 5 key areas namely: Energy, Transportation, Building, Waste and Water. To reduce 45% of carbon emissions by 2030, yearly 4% reduction.	Encourage the use of cooling system, rain water harvesting, low emission building and use of LED/inverter lighting. Pilot Project: Track total carbon emission of 23 buildings in Section 14 Town Centre and 30 buildings of UiTM Campus, as well as 6 buildings of state administration area to record its carbon emission reduction.
Sepang Municipal Council Cyberjaya Smart & Low Carbon City 2025	Establish two main Type of Actions that are: New – establishing of new physical things/programs/projects/activities/investment for improving function and vitality, and Enhance – restoring/enhancing existing components/ programs/project/activities such as buildings, infrastructure, streetscape etc for improving or enhancing current condition. Target 40% energy reduction from buildings by 2025 therefore, encourage energy efficient buildings in Cyberjaya by using renewable energy to offset annual CO_2 emission.	Implement energy management system (EMS) and enforce the adoption of MS1525 to all public buildings and expand to commercial buildings. Promote use of solar energy in residential areas and provide Passive Design Toolkits and Low Carbon Home Renovation Guidebook to educate and update homeowners with information on sustainable material providers. Impose rule of passive design first then active among new residential buildings.

© 2022 by the authors. Published by Secholian Publication. This article is licensed under a Creative Commons Attribution 4.0 International License (CC BY).

Kajang Municipal Council Bandar Baru Bangi Low Carbon City Action Plan 2035	Encourage low-carbon buildings and cultivate low-carbon practices among the community. The city aims to meet at least 93% of all 104 low-carbon city criteria set in the LCCF checklist published in 2011 and achieve 45% carbon reduction by 2035.	Increase the efficiency of energy and water use in buildings, optimize active and passive design for new building construction, encourage replacement of conventional equipment with energy and water efficient equipment for existing buildings.
Ampang Jaya Municipal Council Ampang Jaya Carbon Management Plan	Target savings through a variety of projects of upgrading building lighting, street lighting, building cooling systems and building fabrics and installing solar panels on a number of buildings.	Encourage smart partnership with private companies and NGOs in developing and maintaining green city/neighbourhood to draw community directly.
Subang Jaya City Council Subang Jaya Sustainable City Action Plan 2019-2024	About 9.5 million tonne a year of carbon emission in year 2019 based of the year number of population. 21.4% of carbon reduction by urban community with the implementation of tree planting program. Target 40% carbon reduction (LCCF track)	Encourage green technology (solar/rainwater harvesting/LED/etc) for existing buildings and new construction and provide incentives for implementation. Encourage carbon reduction through green lung project, forest reserve and use of sustainable mobility. Observe the achievement to carbon reduction.
Klang Municipal Council (KMC) Klang Low Carbon City Framework 2017-2027	Encourage green procurement of MyHijau Mark and promote development action plan for different project buildings according to phases. Produce Green Earth Smart (GES) system that contains basic information, low-carbon planning layer, link to LCCF track and BCIS system, forum spaces, activity album and low-carbon achievement analysis data. Ensure a 5% carbon reduction by 2027 compared to 2017.	Aim to improve and increase the usage of renewable energy, such as solar energy systems for a target usage of 5% solar energy and target to reduce energy consumption of all existing buildings that applied LCCF elements by minimum 5% by 2027. Increase water usage efficiency, encourage the use of rainwater harvesting, and implement 5R program to reduce solid waste. Introduce green data centre for the city to optimize and reduce the energy usage of KMC's main office and data centre branches.
Kuala Langat Municipal Council Kuala Langat Low Carbon City Action Plan 2030	Commit in achieving its target to reduce carbon production in stages starting with 5% in 2020 through effective low carbon city plan and execution, to reduce the release of carbon by 20% in 2025 and finally by 45% in 2030. Implement green technology application (solar PV/ rainwater harvesting/LED/etc). Provide incentives for building owners whom implement green technology and encourage the usage for energy savings.	Replace all street lights and public lightings to LED lights while increase efforts in saving electricity. Install active and passive energy saving system in old and new buildings (upgrade part of roof materials to reduce electricity usage and enhance daylighting, install shading devices and use building materials that has GBI index rating.) Implement Rainwater Harvesting system at existing building and encourage the use of system at private residences.

All the other four cities of Kajang, Ampang Jaya, Klang and Kuala Langat devise a similar exertion of decarbonization efforts referring to the LCCF focusing on four main elements of Urban Environment, Urban Infrastructure, Urban Transport and Building. Klang produced a GES system linked to the LCCF track to attain low carbon analysis while targeting a 5% carbon reduction by 2027. With the target of 30% carbon reduction, Kajang, Ampang Jaya and Kuala Langat cities emphasized the optimization of green strategies for new building construction and the upgrade of existing buildings through retrofitting actions to reduce energy consumption. In a nutshell, all of the local councils

© 2022 by the authors. Published by Secholian Publication. This article is licensed under a Creative Commons Attribution 4.0 International License (CC BY).

in Klang Valley have set their target in reducing carbon emissions, committed to referring to LCCF while creating their action plans to achieve carbon reduction.

6. Discussion

Malaysia has recognized the urgency of climate change mitigation and has been actively participating in the pledge to reduce carbon emissions through the initiatives' corroboration between federal, state and local government levels. Among the interventions set by the government in addressing climate change, NPE was developed in 2002 focusing on the importance of conserving natural resources and calling for the role of both public and private sectors in the effort. The policy depicted the improvement in the quality of life for Malaysians. In 2008, NREPAP was developed with a more effective RE policy for the country, featuring a high potential of solar PV technology in residential and low-rise buildings in the context of Malaysia's climate. Nevertheless, the policy also evoked a lack of funding that may affect the uptake of solar PV in the building construction sector. Afterwards, NPCC was developed in 2009 to ensure climate-resilient development and to undertake mainstream national response to climate change is facilitated, accentuating the significance of EE and construction of green building sector in the commercial, institutional, industrial and residential sectors. In the same year, NGTP was also launched to promote green technology as a driver towards sustainable development through four main pillars; Energy, Economy, Environment and Social.

In line with the NGTP, MGTC initiated LCCF in 2011 which presented a thorough guideline for achieving carbon emission reduction among the local government to assess sustainable development in the cities which focused on Urban Environment, Urban Transport, Urban Infrastructure and Building. This policy became a pivotal adoption of low-carbon city mandate among cities in the Klang Valley area, mainly as a reference and recognition to reducing carbon emissions at the state and local government. Under the GTALCC project, a document of NLCCM was developed and five local authorities have participated in the implementation of low-carbon initiatives in Malaysian cities, namely: Iskandar Regional City, Petaling Jaya, Putrajaya, Sepang and Hang Tuah Jaya city. NLCCM presented key challenges to carbon reduction means in cities and further emphasized the action plans to address each issue.

At the national level, the development of sustainability measures can be described as a growingly emerged exploit in the pursuit of enacting the sustainable development movement in the country. The sub-national/state level of Kuala Lumpur, Selangor and Putrajaya interpreted the national outlook on climate change mitigation into more distinct conduct and formulated the responses for the adoption of local councils (KLCH, 2021). The course of sustainable development at the local government level is more pertinent to the low-carbon initiatives of the cities that presented implementation strategies as well as development programmes for the local councils. The adoption of LCCF among the local councils portrayed the favourable outcome of federal/state friction as well as their willingness to regulate the sustainable efforts into the local action plans. However, the ambitious environmental goals set at the local level will depend on its delivery practice as Malaysia always struggles with enforcement. A study by Juhari et al. (2019) reported that there are persisting challenges and issues in the policy implementation of LCCF in Malaysia which requires the understanding and implementation of local authorities and stakeholders of the construction industry. Hence, it highlights the importance to look into challenges hindering successful implementation

© 2022 by the authors. Published by Secholian Publication. This article is licensed under a Creative Commons Attribution 4.0 International License (CC BY).

of the policy enforcement among the local councils to ensure the existing policy is enacted accordingly, and eventually, carbon reduction is imposed.

Table 5: Low carbon initiatives of each building typology among the local councils.

City	NRNC	NREB	RNC	REB	GBNC	GBEB
Kuala Lumpur	/	/	/	/	/	
Putrajaya	/	/			/	/
Petaling Jaya		/	/	/		
Shah Alam		/				/
Sepang	/	/	/	/		
Subang Jaya		/				
Kuala Langat	/	/		/		/
Klang		/				/
Kajang	*Target carbon sequestration by landscape and encourage community engagement*					
Ampang Jaya	*Target to reduce building energy consumption by retrofit action among existing buildings*					

NRNC: Non-Residential New Construction; **NREB:** Non-Residential Existing Building; **RNC:** Residential New Construction; **REB:** Residential Existing Building; **GBNC:** Government Building New Construction; **GBEB:** Government Building Existing Building

In the context of the building construction sector, it can be concluded from Table 5 that among ten (10) local councils in Klang Valley, only eight of the cities finalized the focus of their low carbon initiative mandate on the building typologies, targeting to conduct a comprehensive action towards these buildings. While all seven cities include in their action plans the strategies to reduce the carbon emission of a non-residential existing building, featuring prominence to retrofit actions among existing buildings. Kuala Lumpur is the capital city of Malaysia, setting the benchmark in providing carbon reduction strategies for the main building typology of non-residential and residential buildings. Putrajaya places importance on governmental and non-residential buildings and sets the target to reduce carbon emissions focusing on the existing buildings while targeting more new green building construction. With most of the land development in PJ city made up of residential buildings, the efforts towards decarbonization of the residential and existing buildings are justifiable. Shah Alam focuses on the carbon reduction strategies for the selected region at one time, mostly on non-residential existing buildings and institutional buildings. As a pioneer city in the low-carbon initiative, the strategies used in Sepang were to encourage new green construction buildings and upgrade the existing building. Meanwhile, for Subang Jaya, the focus remains on the improvement of existing buildings for non-residential and industrial buildings. And for Kuala Langat city, the action plan highlights new non-residential green construction as well as places significance on the upgrades of all existing buildings. Last but not least, Klang emphasizes the development of action plans for governmental buildings, and non-residential, commercial, and institutional buildings. Among the two other cities that are Kajang and Ampang Jaya, the parameters of the building typology were not yet established, only emphasizing achieving carbon reduction through retrofit actions of existing buildings.

Throughout the development of Malaysia's sustainable movement in the building sector, the urge towards climate change mitigation through the policies enacted by the federal government to the state government level in the Klang Valley area – which has the

© 2022 by the authors. Published by Secholian Publication. This article is licensed under a Creative Commons Attribution 4.0 International License (CC BY).

highest urbanization rate in Malaysia is on a fair path to decarbonization pathways. Nevertheless, there are still a lot of improvements that can be put into practice, rectifications to be executed, and goals must be accomplished to ensure that we are at a satisfactory level of obligating to the SDGs. The building sector plays a significant part in the CO_2 emissions globally which resulted from the adverse impact of the non-sustainable built environment (Ali et al., 2020). The decarbonization efforts in Malaysia have evolved over the years, but on average, the uptake should be moving on a faster route nonetheless, providing Latif et al. (2021) emphasize a decade-long for a notable reduction of GHG emission to be apparent since the government's energy policy implementation. Providing the commitment towards sustainability movement started way back in 2009, and it has been long enough to start taking into account more vigorous actions on the country's efforts. Ali et al., (2020) expressed concern over the current approach of the building sector, highlighting that it will be too late to remedy the past unsustainable actions if we were to continue with our current pace. They believed that the strategies to reduce CO_2 emissions in the building sector include enforcing standards and policy, conducting impact assessments, adopting low-carbon technology and restricting energy utilization (which also highlights the use of renewable energy).

From the review of this paper, it can be concluded that sustainability efforts were mostly directed at the typology of non-residential buildings and concentrated on commercial and governmental buildings, forbearing an extensive scheme among all building typologies. The outcome underlines the lack of focus on residential typology which hinders the inclusive efforts of sustainable development despite a large number of housing typologies in Malaysia. Malaysia's property development is dominated by residential existing stock which now stood at slightly above 6.02 million units with almost 1 million units incoming and planned supply with Selangor recording the highest number of units among all development stages (Valuation and Property Services Department, 2022). Moreover, residential buildings play a significant role in our daily lives especially after the Covid-19 pandemic, stressing the increased building energy consumption due to staying at home, while calling for the transformation of residential building design and operation to achieve energy efficiency and indoor comfort (Farea et al., 2022). As the building owner of residential buildings, the public's verdict will do much to ameliorate the situation if they are cognizant of the sustainability efforts as Abdul Rahman (2020) asserted the need for strong and effective coordination between international, national, state and local society, integration into different sectoral priorities and policies, and the participation of all stakeholders in the implementation of carbon reduction measures in cities to realize the national aspiration.

7. Conclusion

The notion of sustainability and low-carbon mandate in Klang Valley can be described as a keen movement towards mitigating climate change, as the development of action plans for each local authority as well as their target to attain carbon reduction for the city can be recognized. While the Malaysian government has always been an active supporter of addressing climate change, it is time for the country to uphold a more robust action towards sustainability movement and distinguish more vigorous efforts despite the notable voluntary commitment to the global pursuit. By 2020, Malaysia's goal is to reduce 40% of its CO_2 emission intensity, however, when the SDGs agenda was aligned with the Eleventh Malaysia Plan in 2015, the country is set to reduce only 45% of its emissions intensity by 2030. The increased 5% goal set by the government does not reflect the assertiveness in making the shift towards sustainable development

© 2022 by the authors. Published by Secholian Publication. This article is licensed under a Creative Commons Attribution 4.0 International License (CC BY).

compelling enough. It can be said that the country's goal as a developing country in carbon reduction target is relatively poor, especially in the long-term as the government did not embark on more vigorous measures beyond the 45% reduction target – while knowing that attaining 35% intensity reduction target was virtually assured (Susskind et al., 2020).

The sustainable movement has manifested interventions at the national/federal government in a general initiative of different elements and sectors to be addressed, to the local government level of more explicit actions for each strategy to be executed. Each of the state and local government movements must respond to the national plan to ensure the seamless transition of the government's agenda can be delivered to the community level. For Malaysia to reach the 45% intensity reduction goal is possible, however, the absolute emissions will continue to rise as the country's economy is heavily reliant on fossil fuels. According to Susskind et al. (2020), one potential measure to address this problem is to focus on the sub-sector CO_2 reductions. While a top-down approach may play a significant role in steering the country's movement towards sustainability agenda, a smaller initiative starting from the sub-sector residential building may present the most feasible bottom-up approach to accumulating a useful and accountable carbon reduction footprint.

For example, the strategy to reduce the carbon emissions by tons of household electricity use in Malaysia – with a high number of existing residential stock, is by opting for renewable energy sources that can help in reducing the absolute carbon emissions. This has raised the need for sustainability improvement efforts to encourage carbon reduction efforts to start at the smallest scale – home. From the outcome of this study, the most fitting local council ideal in extending the efforts for the residential building would be PJ, as the typology dominates the majority of land use in the city. Further, the city has adopted several existing action plans immediately to the decarbonization efforts – the Property tax scheme, which can be regarded as a head-start to the enquiry later on. If Malaysia intends to step up its sustainable action plans to meet the global pledge, the country will need to establish a definite carbon reduction target to oversee aggressive efforts.

Acknowledgement

Part of this article was extracted from an ongoing doctoral thesis of Universiti Teknologi MARA (UiTM) Shah Alam, Malaysia.

Funding

The authors would like to thank Universiti Teknologi MARA (UiTM) for the support and partial funding of the study and publication through the Geran Insentif Penyeliaan (GIP) under the Research Management Centre (RMC) [600-RMC/GIP 5/3 (095/2021)].

Conflict of Interests

The authors reported no conflicts of interest for this work and declare that there is no potential conflict of interest with respect to the research, authorship, or publication of this article.

© 2022 by the authors. Published by Secholian Publication. This article is licensed under a Creative Commons Attribution 4.0 International License (CC BY).

References

Abdul Rahman, H. (2020). Malaysia Commitment towards Low Carbon Cities. *International Journal of Academic Research in Business and Social Sciences*, *10*(15). https://doi.org/10.6007/ijarbss/v10-i15/8247

Ali, K. A., Ahmad, M. I., & Yusup, Y. (2020). Issues, impacts, and mitigations of carbon dioxide emissions in the building sector. *Sustainability (Switzerland)*, *12*(18). https://doi.org/10.3390/SU12187427

Ampang Jaya Municipal Council (AJMC). (2017). *Majlis Perbandaran Ampang Jaya Carbon Management Plan* (Issue March 2017).

Che Husin, S. M., Mohd Zaki, N. I., & Abu Husain, M. K. (2019). Implementing Sustainability in Existing Building through Retrofitting Measures. *International Journal of Civil Engineering and Technology*, *10*(1), 1450–1471.

Dasgupta, S., Lall, S., & Wheeler, D. (2022). *Cutting global carbon emissions: Where do cities stand*. Sustainable Cities. https://blogs.worldbank.org/sustainablecities/cutting-global-carbon-emissions-where-do-cities-stand#:~:text=Cities account for over 70,constructed with carbon-intensive materials.

Department of Statistics Malaysia. (2020). *Report for Evolution of Migration for Urban and Rural*.

Department of Statistics Malaysia. (2022). *Current Population Estimates, Malaysia* (Issue Press Release-Prime Minister's Department of Statistics Malaysia Press Release).

Energy Commission. (2019). *National Energy Balance 2019*.

Energy Commission of Malaysia. (2020). *Energy Commission - Annual Report for 2020*. www.st.gov.my

Farea, T. G., Kandar, M. Z., Baba-, Z. J., Shamang, K. J., & Lukman, L. M. (2022). Building energy consumption assessment during and after lockdown : Case study of Malaysian housing. *Journal of Civil Engineering and Environmental Sciences*, *8*, 4–11.

IEA and UNEP. (2019). 2019 Global Status Report for Buildings and Construction: Towards a zero-emissions, efficient and resilient buildings and constructi on sector. In *UN Enviroment programme* (Vol. 224).

Juhari, S. K., Omar, D. B., Ling, O., & Leh, H. (2019). The Readiness Of The Stakeholders In The Implementation Of Low Carbon Cities Framework (Lccf) In An Urban Area : Methodology Of The Readiness Of The Stakeholders In The Implementation Of Low Carbon Cities Framework (Lccf) In An Urban Area : Methodolog. *IOP Conference Series: Earth and Environmental Science*, 385. https://doi.org/10.1088/1755-1315/385/1/012071

Kajang Municipal Council. (2018). *Laporan Interim pelan tindakan perbandaran rendah karbon bandar baru bangi*.

KLCH. (2018). *Kuala Lumpur Low Carbon Society Blueprint 2030* (Issue Summary for Policymakers 4th Edition).

KLCH. (2021). *Kuala Lumpur Smart City Master Plan 2021-2025*.

Kuala Langat Municipal Council (KLMC). (2020). *Kuala Langat Low Carbon City Action Plan 2030*.

Latif, S. N. A., Chiong, M. S., Rajoo, S., Takada, A., Chun, Y. Y., Tahara, K., & Ikegami, Y. (2021). The trend and status of energy resources and greenhouse gas emissions in the Malaysia power generation mix. *Energies*, *14*(8), 1–26. https://doi.org/10.3390/en14082200

Latif, Z. A., & Kamsan, M. E. S. (2018). Assessing the relationship of land use land cover on surface temperature in city of Shah Alam, Malaysia using landsat-8 oli. *Journal*

© 2022 by the authors. Published by Secholian Publication. This article is licensed under a Creative Commons Attribution 4.0 International License (CC BY).

of Fundamental and Applied Sciences, *9*(5S), 514. https://doi.org/10.4314/jfas.v9i5s.36

LCCF - Ministry of Energy Green Technology and Water. (2011). *Low Carbon Cities Framework and Assessment System (LCCF)*. https://www.ptonline.com/articles/how-to-get-better-mfi-results

Lih Shyan, L. (2020). *Low Carbon Cities : Driving the Zero- Carbon Transition MBPJ ' s Efforts*.

Malaysia Green Building Council. (2020). http://www.mgbc.org.my/

Ministry of Energy Green Technology and Water (KeTTHA). (2017). *Low Carbon Cities Framework Version 2*. https://doi.org/10.4018/978-1-7998-9590-9.ch010

National Policy on the Environment. (2002). A report by Ministry of Science Technology and Environment. In *Transnational Environmental Policy*. https://doi.org/10.4324/9780203464731

National Green Technology Policy. (2010). A report by Ministry of Green Energy and Water. In *Office*. http://portal.ppj.gov.my/c/document_library/get_file?p_l_id=17335&folderId=27605&name=DLFE-4709.pdf

National Low Carbon Cities Masterplan - Ministry of Environment and Water (KASA). (2016). *National Low Carbon Cities Masterplan - Under the Green Technology Application for the Development of Low Carbon Cities*.

National Policy on Climate Change. (2009). Ministry of Natural Resources and Environment Malaysia. (2009). *Dasar Perubahan Iklim Negara (National Policy on Climate Change)*.

National Renewable Energy Policy and Action Plan. (2008). Ministry of Energy Technology and Water (KeTTHA). National Renewable Energy Policy and Action plan: Highlights and Updates. In *Applied Mechanics and Materials* (Vol. 90). https://doi.org/10.4028/www.scientific.net/AMM.465-466.275

Petaling Jaya City Council (PJCC). (2021). *Petaling Jaya Ke Arah Bandar Raya Pintar, Mampan, Berdaya Tahan Dan Dinamik Menjelang 2025*.

Putrajaya Corporation. (2015). *Towards Putrajaya Green City 2025* (Issue First Edition, pp. 1–11). http://2050.nies.go.jp

Rahim, S. A., & Mezan, S. N. (n.d.). *A Review on Low Carbon City Development Initiatives by Majlis Perbandaran Klang (MPK)*.

Sepang Municipal Council. (2017). *Cyberjaya Smart Low Carbon City Action Plan 2025*. https://www.ptonline.com/articles/how-to-get-better-mfi-results

Shah Alam City Council. (2014). Shah Alam Low Carbon City Action Plan 2030. *Notes Shah Alam*, *April 2014*, 1–9.

Shuid, S. (2016). The housing provision system in Malaysia. *Habitat International*, *54*, 210–223. https://doi.org/10.1016/j.habitatint.2015.11.021

Susskind, L., Chun, J., Goldberg, S., Gordon, J. A., Smith, G., & Zaerpoor, Y. (2020). Breaking Out of Carbon Lock-In: Malaysia's Path to Decarbonization. *Frontiers in Built Environment*, *6*(March). https://doi.org/10.3389/fbuil.2020.00021

Thomas, J., & Harden, A. (2008). *Methods for the thematic synthesis of qualitative research in systematic reviews*. *10*, 1–10. https://doi.org/10.1186/1471-2288-8-45

United Nations Environment Programme. (2020). 2020 Global Status Report for Buildings and Construction: Towards a Zero-emission, Efficient and Resilient Buildings and Construction Sector. In *Renewables Global Status Report*. http://www.ren21.net/resources/publications/

Urbanice Malaysia and SACC. (2021). *Shah Alam Voluntary Local Review 2021*. https://sdgs.un.org/sites/default/files/2021-07/VLR SDGs Shah Alam.pdf

Urbanice Malaysia and SJCC. (2021). *Subang Jaya Voluntary Local Review 2021*.

© 2022 by the authors. Published by Secholian Publication. This article is licensed under a Creative Commons Attribution 4.0 International License (CC BY).

https://portal.mbsj.gov.my/sites/default/files/Subang Jaya Voluntary Local Review 2021.pdf

Valuation and Property Services Department and Ministry of Finance Malaysia. (2022). *LAPORAN STOK HARTA TANAH - Property Stock Report*.

© 2022 by the authors. Published by Secholian Publication. This article is licensed under a Creative Commons Attribution 4.0 International License (CC BY).