



Building Climate-Resilient and Sustainable Cities During Pandemic

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Abstract

Pandemic Coronavirus disease (COVID-19) began to hit worldwide in December 2019 and was regarded as one of the most significant obstacles for the Malaysian government. However, with the Movement Control Order (MCO) implementation to curb the pandemic, air pollution, carbon footprint, and carbon dioxide (CO₂) emissions have decreased. There are three primary sources for releasing carbon in Malaysia: energy, transportations, and solid waste production. However, solid waste production is a significant contribution to the environmental footprint during the pandemic. The statistic substantiates that Malaysia's waste production increased tremendously from 2010 to 2020, asserts that Malaysians generate more waste even during the pandemic. This article discusses the impact of the pandemic COVID-19, with the legislation, policies, and control measures taken by the government, local authority, and Non-Governmental Organizations (NGOs) to achieve the low carbon goals to reduce Greenhouse Gases (GHGs). As a result, producing a more climate-resilient environment and more sustainable practice in the metropolis aids the city in mitigating and reducing the effects of climate change.

Keywords: COVID-19 Pandemic, Movement Control Order (MCO), Air Pollution, Waste

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INTRODUCTION

On 11 March 2020, World Health Organisation (WHO) had declared the coronavirus COVID-19 as a global crisis. And the world has been in a downtime state since then, and nature was sighted to be reset on its own due to less human activity. This period elucidates that the carbon emission for 2020 was the lowest because of reduced transportations, changed consumption patterns, and industry activities worldwide, especially in urban cities (Liu & Li, 2021). Before the emergence of the COVID-19, three primary sources of carbon emission in Malaysia are energy consumption, movement from public and private vehicles, and solid waste in landfills (Naderipour et al., 2021).

During these unprecedented times, COVID-19 is one of the most significant challenges that the Malaysian government faces, and most nations around the world have yet to overcome this crisis. As a result, the Malaysian government has made a concerted effort to enforce Movement Control Orders (MCO). Therefore, the level of air pollution, carbon footprint, and carbon dioxide (CO₂) emissions have decreased tremendously (Naderipour et al., 2020). Among all, solid waste production is one of the significant contributions of environmental footprint during the pandemic. This statement is proven by the statistic that substantiates that in 2020 Malaysia waste production increased

43% from 2010 to 2020, asserting that Malaysian waste generation is increasing even during pandemics (Ismail et al., 2020).

Future research should focus on exploiting this pandemic pattern to develop more sustainable and effective transportation, energy, and waste policies and trends. However, policymakers are suggested to take the current Greenhouse Gas (GHG) performance as the new benchmark for the coming years. This action is crucial since, during the COVID-19 crisis, the environment is mostly back to the better good (Arora et al., 2020). Moreover, Arora (2020) also states that this could help curb the pollution produced in specific sectors and help the environment to bounce back. In addition, short-term reductions in GHG concentrations are not a long-term strategy to cleaning up our environment. Therefore, the positive and negative impacts during this crisis should be an opportunity for the authority to consider the environmental policies and legislation in the future. Meanwhile, creating awareness in the local community to apply sustainable environmental practices during the pandemic COVID-19.

This article discusses the impact of the pandemic COVID-19 on the environment during the crisis and how the city will develop a sustainable environmental practice during this unprecedented time. Besides, it is advantageous for the government, local authority, and Non-Governmental Organizations (NGOs) during this crisis to initiate and implement the policies, awareness, and programs to the urban community. Finally, building more climate-resilient and sustainable

practices is crucial to slow down the climate change issue. It is also in line with the United Nations' 2030 Sustainable Development Goals (SDGs).

Towards Sustainable Energy Consumption

As the world's population grows, so will the demand for inexpensive energy, and an economy based on fossil fuels is causing significant climate change. To achieve SDG 7 goals by 2030, investing in solar, wind, and thermal power will improve energy productivity and ensure that everyone has access to energy. Malaysia had begun to reduce carbon emissions in energy sectors even before the pandemic strikes. For example, the Selangor State Government itself has supported this approach to make sure Selangor becomes a green technology state by creating a "green technology action plan for the state of Selangor 2016-2018". For this purpose, the Selangor State Government intends to introduce the concept of Rumah Selangorku with green technology features such as electricity generation through solar roofs, rooftop gardens, and suitable windmills. Selangorku homeowners can enjoy a better quality of life through this action and reduce living costs by saving up to 68% per month on electricity bills (Jawatankuasa Tetap Pelancongan, Alam Sekitar, Teknologi Hijau dan Hal Ehwal Pengguna Selangor, 2016). Residents of the Selangorku Pangsapuri Puchong Utama Housing Project were among the first to support this initiative. Green energy products such as solar, rainwater collection systems, and LED lighting have also been introduced.

Minimizing energy consumption results from sustainable design methods such as designing buildings with solar access and natural ventilation, using climate-responsive design matter, and effective insulation materials to cope with the surrounding environment. Energy consumption savings are used to increase the role of urban public space and make it possible to create new vibrant communities and improve the population's well-being. Building design with minimum energy consumption for heating, cooling, ventilation, and lighting are seen to be technically feasible. Existing technology allows the city to operate at low energy consumption levels by using renewable energy sources, air and water flow, and a natural ecosystem in urban areas (Zareba et al., 2017).

Demand for energy needs is showing an increase worldwide. The building sector, in general, has represented a large percentage in rate values global energy consumption. Therefore, efforts to improve energy efficiency in buildings are significant. Building services include Heating systems and Ventilation and Air Conditioning (HVAC) systems, which are also in charge of large-scale building energy use (Chenari, Carrilho & Silva, 2016). In HVAC systems, ventilation is a significant problem in providing the appropriate and safe Indoor Air Quality (IAQ). In addition, it is also responsible for energy consumption in the buildings. Therefore, improving the ventilation system sustainably plays an important role, not only to improve energy efficiency in buildings but also to provide a better indoor climate for occupants as well as being able to reduce the chances of health problems in the future.

Global energy demand and consumption are expected to decline due to the COVID-19 pandemic, resulting in reduced CO₂ emissions. Global energy demand is expected to drop by 6% in 2020, compared to 2019. Commercial and industrial demand continues to decline, but residential demand keeps rising (Jiang et al., 2021). Energy demand has decreased dramatically due to governments around the world imposing strict full and partial lockdowns. Energy demand and consumption declines are detrimental to the energy business. For instance, the COVID-19 pandemic forced at least 19 energy companies in the United States industry into bankruptcy due to the low demand (Crider, 2020). In Malaysia, the MCO is unlikely to reduce overall electricity production, considering the country is small and produces just 12,000 to 13,000 GWh of electricity monthly (Yusup et al., 2020).

Reducing Traffic-Related Air Pollution (TRAP) and Towards Low Carbon City (LCC)

COVID-19 spread in early 2020 was unprecedented and highly disruptive. As a result of pandemic lockdowns, global economic and social activity decreased rapidly, as did emissions of air pollutants and greenhouse gases. Several viewpoint articles have suggested that this episode provides an unprecedented scientific opportunity to detect, attribute, and understand the impacts of anthropogenic emissions on the Earth's atmosphere at all spatial scales (Gkatzelis et al., 2021; Jia et al., 2020; Saxena & Pandey, 2020). Ground-level monitoring networks and spaceborne remote sensing instruments have documented shifts in regional air quality. In Malaysia, the first episodes of movement control order (MCO) have been developed and designated for phases 1, 2, and 3 as of 18 March 2020 (Abdullah et al., 2020). The MCO restricts government and private activity in Malaysia except for several significant services. For example, universities and schools are not allowed to undertake educational activities while daycare and retail centers are closed. It also prohibits mass gathering and limits tourism and recreation activities.

The main objective of the MCO is to limit COVID-19 nationwide transmission (Ismail et al., 2020). Meanwhile, many studies have been done on the Movement Control Order (MCO) effect on air quality in Malaysia. For example, in the study by Ash'aari et al. (2020), the average levels of Particulate Matter (PM_{2.5}), Carbon Monoxide (CO), and Nitrogen Dioxide (NO₂) were decreased by 23.1%, 21.74%, and 54.0%, respectively, compared with before MCO. In stations located in urban areas, the highest reduction in PM_{2.5}, CO, and NO₂ was observed, with 63% decreases in PM_{2.5}, and CO, while all stations showed significant decreases in NO₂. In addition, it was shown that, while high numbers of local hot spots were recorded simultaneously from NASA's Moderate Resolution Spectrometer (MODIS), 70.5 percent of stations recorded lower concentrations of PM_{2.5} during MCO in comparison with before MCO (Ash'aari et al., 2020).

The study was supported by Othman & Talib (2020); whereby, there is a significant decrease of nitrogen dioxide during MCO compared with before MCO. Lockdown reduced the number of vehicles on the roads, especially in major urban areas. Consequently, nitrogen dioxide (NO₂) gas, which mainly originates from the fuel combustion used for vehicles, has been dramatically reduced. All these findings are appealing since particulate matter (PM) and nitrogen dioxide (NO₂), which are emitted from vehicle exhaust, are the main contributors to urban air pollution (Mohd Shafie & Mahmud, 2020). Air pollution resulting from the combustion of fossil fuels in motor vehicles or TRAP (traffic-related air pollution) has been a substantial risk factor for cardiovascular illness, including hypertension (Kim et al., 2017). Children are especially vulnerable to air pollution, and accumulating data suggests that TRAP exposure might impair pregnancy outcomes and infant development (Mortamais et al., 2019).

The reduction of traffic-related air pollution during MCO is noticeable. However, the reduction is unlikely to endure, and it will have minimal impact on the total amount of greenhouse gases (GHGs) accumulated in the atmosphere over decades. Government policies and how much the people continue to rely on fossil fuels will thus define the real climate impact of the COVID-19 crisis. Prioritizing air pollution reduction and climate concerns and recognizing environmental health as an economic asset can benefit the country and its residents in various ways. One of the government initiatives that should be taken during this crisis is to achieve their target on elements of urban transportation under the Low Carbon City Framework (LCCF).

A good example is the action of Majlis Bandaraya Shah Alam (MBSA) which supports LCCF. MBSA has established efficient transportation and mobility services, such as electric cars, e-parking, community buses, free bus service (Smart Selangor), cycling tracks, and EV (electric vehicle) chargers in the Shah Alam area, as well as free car days for all Shah Alam residents (Nasrudin et al., 2020). MBSA also provides parking in areas outside the city center to encourage people to walk around the city center and upgrade disabled-friendly and

pedestrian paths (Nasrudin et al., 2020). Dewan Bandaraya Kuala Lumpur is the other city council actively participating in the Low Carbon City (LCC) initiatives. They use effective variable message signs in communicating green information to the public, such as slogans such as "Reduce Congestion; Together, We Use Public Transportation" to remind Kuala Lumpur citizens of the importance of reducing private cars usage daily (Nasrudin et al., 2020).

'Free Bus Rides inside Downtown KL' is another clever technique to encourage people to take public transportation during peak hours. DBKL has run the 'Kuala Lumpur Car Free Morning Programme' to complement the LCC activities on weekends (Nasrudin et al., 2020). To encourage residents to adopt non-motorized transportation, DBKL also constructs dedicated cycling lanes in Kuala Lumpur's downtown area. Apart from that, solar energy is used to power air-conditioned elevated pathways, reducing carbon emissions. Furthermore, both Shah Alam and Kuala Lumpur have implemented the free bus service (Nasrudin et al., 2020). In addition, the city council has started to operate the Selangor Smart Bus (SSB) for Shah Alam inhabitants. From 6 a.m. to 9 p.m., residents can take the bus every 15 minutes at a frequency of 15 minutes per stop.

MBSA and DBKL's efforts to promote public transport will be beneficial in reducing emissions since many studies have proven the efficiencies of public transportation. For example, in a study by Wang et al. (2015) in China, they determined the efficiency of all modes of transportation by comparing the share of passenger volume and carbon emission. Cars account for just 39 percent of passenger volume, but they account for 75.5 percent of carbon emissions. On the other hand, rail transportation only accounts for 20% of passenger volume but only produces 6.7 percent of carbon emissions. Thus, public transportation and buses are much more effective than cars and taxis (Wang et al., 2015).

Basagaña et al. (2018) also suggested that individuals aiming to reduce their energy consumption and carbon footprints should take advantage of public transportation by reducing travel that would typically be made private. For example, a single person commuting alone by a car who passes a 20-mile round trip commute to existing public transportation will reduce annual CO₂ emissions by 4,800 pounds per year. This reduction is equivalent to a 10% reduction in total greenhouse gas emissions. Therefore increased use in public transportation will reduce traffic congestion, resulting in higher fuel efficiency for vehicles driving along the same corridors (Buchanan, 2019).

The role of an individual is also crucial in reducing air pollution. Improvement and changes in driving habits by individuals show a significant effect on fuel consumption and carbon emission. As an example, driving with the accelerator pedal depressed slowly or without sudden bursts of speed can improve fuel economy by up to 20% (Kastanek, 2020). Additionally, poor practice during driving, such as engine idling, must be avoided. From the literature, the engine's idling has a significant impact on its fuel consumption and emissions. For hydrocarbon (HC), CO₂, CO, PM, and NO, idling emissions can be as high as 86.4 g/h, 16,500 g/h, 5130 g/h, 4 g/h, and 375 g/h, respectively (Rahman et al., 2013). However, engine idling is expected in the cities during traffic congestion, mainly in peak hours. Reducing congestion during peak hours can be achieved by systematic planning such as computerized traffic signals, ramp meters, and lane usage management. Traffic Demand Management (TDM), non-automotive travel modes, and land use management are examples of advanced management protocols implemented by the city planner (Afrin & Yodo, 2020).

Even though individual action towards traffic-related air pollution reduction is undeniably necessary, the government and city council intervention is more important in the long run. Implementing LCC concepts, sustainable transportation, and effective traffic management is a more accomplishable and sustainable way to reduce traffic-related air pollution and carbon emission. Moreover, the LCC concept also supports Sustainable Development Goals 11, targeting to promote inclusive, safe, resilient, and sustainable cities.

Sustainable Waste Management During Pandemic

The control of the Coronavirus pandemic and constraints on human activities, mobility, and the industrial sector has significantly impacted waste management in general. According to Sarkodie & Owusu (2020), increasing waste production during pandemics is critical to human development and health effects. Furthermore, researchers found that the quantity of waste production is towering globally and might have the same effect worldwide. Sarkodie & Owusu (2020) also mention that this is due to the food delivery using single-use products or plastic as well as panic buying among the people, increased production of waste and consumption of the resources, hence upsetting the efforts towards reducing plastic pollution and food waste production.

Snowballing plastic pollution and food waste by consumers elucidates of high producing carbon and methane emission to the environment. Moreover, the dumping of these wastes in open landfills contributes to the global production of greenhouse gases (Bian et al., 2021). Be that as it may, landfills produce environmental footprints such as methane and carbon dioxide, contributing significantly to GHG emissions. Thus, climate change has many negative consequences for the environment and human health. Besides, the effect of greenhouse gases will accelerate with the release of gas methane, and carbon dioxide due to excessive burning of fossil fuels in the future (Hettiaratchi et al., 2021). In short, the COVID-19 pandemic generates a large amount of waste linked to an increase in GHG emissions.

Thus, Malaysian authorities consider this is a significant problem that must be addressed. Ismail et al., (2020) mention that nationally, the country produces more waste especially food waste during the pandemic. The majority of people stay at home and practice home cooks, resulting in a rise in food waste from every household across the country. Yet, as the initiative to build a climate-resilient and sustainable cities during the pandemic, the Malaysian government, hand in hand with other organizations such as Solid Waste Cooperation (SWCorp), Petrolia National Berhad (Petronas), and local authorities like Majlis Bandaraya Shah Alam (MBSA), has started to initiate Circular Economy to replace the national Linear Economy starting 2018. The Malaysian government has also initiated Act 673, which requires every household to segregate their garbage mandatorily. Moreover, the government has three plans to reduce trash production: distributing knowledge through the media, forming partnerships, and recognizing waste segregation practices.

According to Fass (2021), the circular economy intends to improve resources and minimize consumption and waste generation. Nevertheless, specific segments and guidelines in the Environmental Quality Act 1974, Solid Waste and Public Cleansing Management Act 2007, and Environmental Quality (Scheduled Waste) Regulation 2005 correspondingly encourage national resources rotation. Other than that, the government initiatives to endorse a circular economy include integrating sustainable manufacturing and consumption, reducing 40% of GHG. Solid Waste Corporation (SWCorp) is a national organization that manages waste management nationwide. SWCorp has an initiative and now vigorously spreads awareness and promotes sustainable solid waste management services such as school campaigns, social media awareness, and providing more facilities to promote recycling.

SWCorp and MBSA have started promoting Zero Food Waste to all the food and beverage industries during the pandemic crisis, including small vendors on the street. As food waste is one of the significant sources of carbon emission, the authorities suggest the society should schedule the food production or convert the food waste to be the self-made fertilizer. Thus, this initiative can both rescue the environment and make a profit from it. In addition, if food waste is not upcycled, methane gas will be released into the atmosphere and speeding up global warming. Petronas, Malaysia's fully integrated oil and gas company, also took a step by allocating all the commercial buildings under Petronas provisions to provide the recycle bin all over the city. Petronas also proposes the New Plastic Economy by altering the mindset of plastic as a resource. They employ a holistic approach

by focusing on four areas: education, cleanups, infrastructure, and innovation (Ganapathy & Tiing, 2020).

Non-Government Organisation Zero Waste Malaysia is also one of the non-profit organizations and advocates for sustainable development and upsurges sustainable living in the cities. The vision of this organization is to encourage a zero-waste lifestyle, thus minimizing the general waste footprint and embrace a circular economy by the government (Zero Waste Malaysia, 2021). Nevertheless, Malaysia is still far beyond achieving zero waste production but it is not possible. Harun et al. (2019) stated that zero waste could be achieved by cooperation between consumers and the industries. Both parties must work together to produce and consume the alternative of plastic usage. The reduction of plastic waste is aligned with SDG Target 12.3, which seeks to halve global food waste at retail and consumer levels and reduce food loss during production and supply.

One method to achieve the target is to start with changing the existing model, linear economy, to circular economy (Ibn-Mohammed et al., 2020). Researchers also mention that it is essential that companies and consumers change their mindsets and attitudes. Companies must be starting to design products sustainably. Moreover, consumers are suggested to use environmentally friendly products and responsibly apply the 3R rules (Reduce, Reuse, and Recycle). Thus, the wealthy and the poor, the formal and informal, businesses, governments, and the community must work together to reduce the waste and achieve SDG 12 which is to ensure responsible consumption and production patterns. During this unprecedented COVID-19 crisis, the world community has to do it much more effectively once they recognize waste management as a powerful driver of sustainable development.

CONCLUSION

To sum up, everything that has been stated so far, the urban world population nowadays is towering. To date, it is estimated that 4.4 billion inhabitants reside in the city area. Cities have become the hubs of the world economy. Thus, it is crucial for the government and NGOs to the individual to play the role to initiate and take action to build a better city environment and reduce the potential impacts of climate change. However, based on current conditions, the pandemic is anticipated to prevail in the coming 3-5 years. As a result, building a long-term systemic approach and strategy is critical for improved energy usage, traffic control, and municipal solid waste management, particularly in urban areas. Moreover, rapid urbanization is known as the major cause of environmental health hazards in many countries (Kasmani et al., 2021).

Besides, education and community awareness are fundamental actions to sustaining sustainable living during the pandemic. Proper education and awareness such as single disposable use face masks, reducing plastic consumption, taking public transport, reuse the existing food container and our daily waste are essential practices during this crisis. Unprecedented times need unprecedented measures. Therefore, spreading education and awareness at all levels of society are critical initiatives to do right now to deal and adapt to the current situation sensibly and become a habit in future sustainable environmental living practices.

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