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SHORT REVIEW ON RENEWABLE ENERGY POLICY AND ENERGY CONSUMPTION OF BUILDINGS IN MALAYSIA

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Abstract: The energy generation sector has contributed a large percentage of greenhouse gases (GHG) emissions in Malaysia. Carbon dioxide emissions from the burning of traditional energy source like fossil fuels to meet the ever-growing demand for electricity contributes to global warming. Therefore, transitioning into a greener and more sustainable energy alternative has been a priority to the government and stakeholders. As Malaysia is a developing country, renewable energy development is growing relatively at a slow pace and therefore public and private sectors are taking initiatives as well to reduce electricity consumption. A case study was done on public higher institutions in Malaysia to analyze electricity consumption by comparing the building energy index (BEI) with the standards proposed by MS1525. This paper also includes a brief summary of practices and strategies done by buildings in Malaysia to promote energy efficiency and reduce electricity consumption that can be used as an example and implemented by others to incorporate energy efficient practices. With the participation of all stakeholders, a future with a more sustainable energy source and reduce the dependency on fossil fuels is possible.

Keywords: Building energy index; Electricity consumption; Energy efficiency; Green building.

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1. Introduction

Most countries continue to experience rapid urbanization and population growth due to the ever-changing fast paced environment that we live in today. Population as well as income growth are the key factors that influence the growing demand for energy. The demand for electricity is constantly growing in tandem with the Gross Domestic Product (GDP) growth of a country. According to the World Bank, Malaysia's GDP in 2019 is 364.7 billion USD with a 1.6% increase compared to 2018 (The World Bank, 2019). As a developing country, Malaysia has a rising energy demand due to the growing development in industrial, transportation and agriculture sectors. The growth demand of electricity in Peninsular Malaysia from 2016 to 2019 is 21,773 MW to 23,344 MW (Malaysia Energy Statistics Handbook, 2018) and is expected to reach peak demand by the end of 2035.

In 2018, the electricity consumption in Malaysia stood at 152,866 GWh with the industry sector dominating the consumption with 76,088 GWh, The industrial sector had dominated 49.8% of the electricity consumption followed by the commercial sector taking up 29% of the consumption, 20.5% from residential, 0.4% from the agriculture sector and 0.3% from the transportation (Energy Commission, 2018) as illustrated in **Figure 1**. **Table 1** shows the breakdown of electricity consumption by sectors in Malaysia.

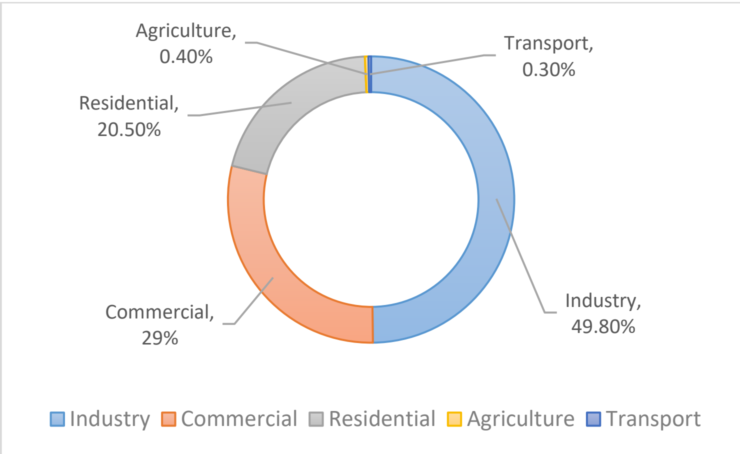

Figure 1. Electricity consumption by sector in 2018 (Energy Commission, 2018)

Table 1. Electricity consumption by sector in GWh, 2018 (Energy Commission, 2018)

Region	Industry (GWh)	Commercial (GWh)	Residential (GWh)	Transport (GWh)	Agriculture (GWh)	Total (GWh)
Peninsular Malaysia	53,388	39,124	27,006	482	617.3	120,617
Sarawak	21,297	2,844	2,478	-	-	26,618
Sabah	1,404	2,377	1,850	-	-	5,630
Total	76,088	44,345	31,334	482	617	152,866

Malaysia is one of the many countries that have been relying on fossil fuel resources for its energy input in power stations (Moey et al., 2020). According to the Energy Commission Malaysia, the total amount of installed energy capacity in year 2020 is 36,182.8 MW. The biggest contributor to the installed energy capacity are from natural gases, producing 14,403.4 MW of electricity, followed by 13,283.9 MW from coal, 6,190.1 MW from hydroelectric sources, 1,056.3 MW from solar, 588.6 MW from biomass and bio-gas and 576.5 MW from diesel (Energy Commission, 2020). **Figure 2** shows the percentage of installed energy capacity by sources in Malaysia from the year 2020.

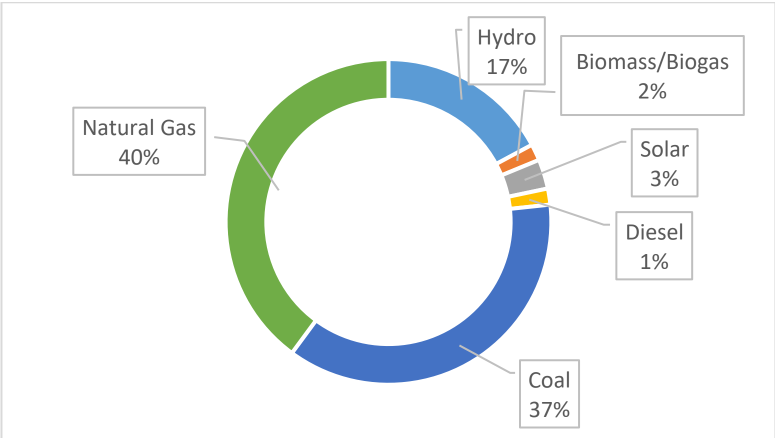

Figure 2. Installed energy capacity for Malaysia in 2020 (Energy Commission, 2020)

1.1 Greenhouse gas (GHG) emissions

The power generation industry contributes a large portion of GHG emissions in Malaysia. As a developing country which intends to be a high-income economy in the near future, the rise in energy demand has pressured the government to opt for relatively cheaper non-renewable energy sources to fulfil those demands (Babatunde et al., 2018). The topic of GHG emissions has been a concern among many climate change communities, mainly regarding the release of

CO_2 gases generated through power generation being unsustainable for the environment (Wasiu et al., 2015). A study was done to analyze the correlation between the energy consumption as well as carbon emissions in Malaysia. In the study, it was revealed that there was a significant rise in CO_2 emissions because of the rising population and GDP growth in Malaysia (Ali et al., 2020). CO_2 emission has the largest direct global warming contribution due to its high natural concentration measured in parts per million (ppm) of air (Norasyiqin et al., 2021). Ministry of Environment and Water stated that the electricity and heat production was the highest contributor at 103,047 Gg of CO_2 emissions, contributing 39% of the CO_2 emissions in 2016 (Ministry of Environment and Water, 2020).

Figure 3 shows the annual CO_2 emissions in million tonnes from power plant in Malaysia, by resources from 2010 to 2019 (Global Carbon Project, 2020). The annual CO_2 emissions has shown a rise in trend since year 2010. Throughout the years, oil has dominated the CO_2 emissions followed by gas and coal.

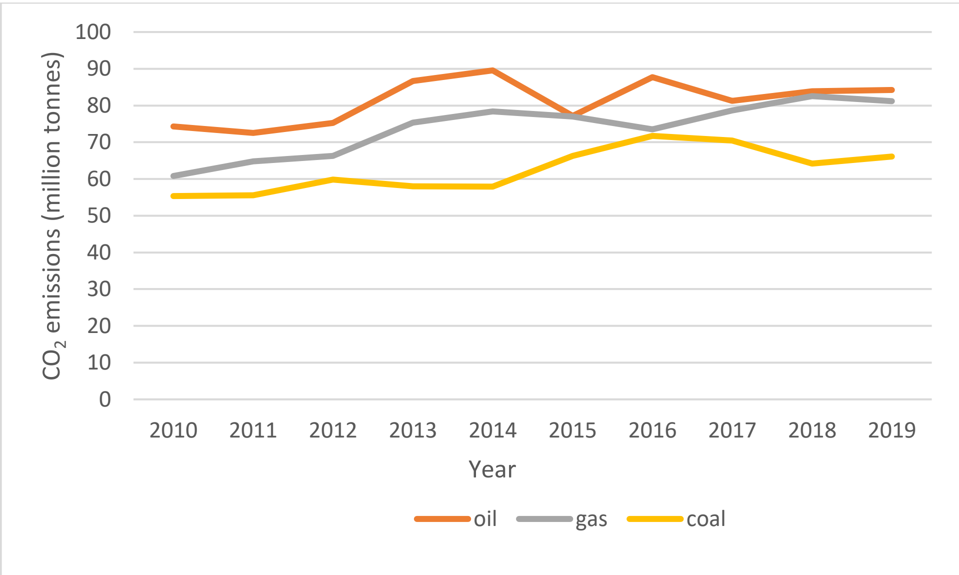

Figure 3. CO_2 emissions from Malaysia electricity generation sector from 2010 to 2019 (Global Carbon Project, 2020)

Because of the release of carbon dioxide and other greenhouse gases, GHG emissions have become dominant contributors to global warming and climate change which increases the average surface temperature of the earth by trapping heat in the atmosphere. The rising temperature caused by global warming negatively impacts lives of species inhabiting the planet. The high rise in temperature causes the ice to melt in cold icy regions like Arctic and

Antarctica which raises the sea levels thus causing floods that severely affects agricultural and fishing activities (Mikhaylov et al., 2020).

Aside from contributing to global warming, the question of the depletion and the availability for this generation and future generations to come has been raised by many due to the fact that fossil fuels are non-renewable. The quest for new solutions in reducing the negative impact of energy systems and finding a more sustainable energy resource have been a priority in governments and stakeholders (Martins et al., 2018).

1.2 Energy alternatives

In recent years, the search for alternative sources of energy has been a priority to the government and stakeholders due to the rising demand for power as a result of economic growth. There has been a dire need to meet these demands while finding a more sustainable supply of power and reducing the negative environmental impacts that comes with power generation (Shamsuddin, 2012).

Table 2 shows the amount of renewable energy (RE) generated under the feed-in tariff (FiT) system, in megawatt-hours (MWh) from 2012 to 2021 (SEDA, 2021). Throughout the decade, solar power has made the most dramatic increase in power generation, contributing 3,022,261 MWh into the generation fuel mix. In 2021, biomass is the second largest RE contributor, generating 1,934,219 MWh of power, followed by biogas, small hydro and solid waste. By the year 2025, Tenaga National Berhad (TNB) aims to achieve 40% renewable energy (RE) of the total capacity mix (Tenaga Nasional Berhad, 2020).

Table 2. Annual power generation from renewable energy (SEDA, 2021)

Year	Biogas (MWh)	Biomass (MWh)	Solid Waste (MWh)	Small hydro (MWh)	Solar PV (MWh)	Total (MWh)
2012	7,564	101,310	3,235	28,681	6,945	147,735
2013	32,022	310,718	14,379	107,730	65,508	530,357
2014	95,781	506,533	18,727	177,307	266,606	1,064,954
2015	169,302	741,412	40,252	237,960	546,588	1,735,514
2016	276,411	969,327	75,362	288,239	918,310	2,527,649
2017	507,262	1,253,447	94,033	363,791	1,395,219	3,613,752
2018	759,046	1,498,359	102,151	453,462	1,891,402	4,704,420
2019	1,073,336	1,714,644	111,082	674,065	2,372,273	4,979,400
2020	1,496,733	1,870,137	120,926	962,755	2,834,317	7,284,868
2021	1,668,936	1,934,219	130,685	1,082,973	3,022,261	7,839,074

1.2.1 Solar energy

There are a variety of renewable energy sources in Malaysia, solar energy presents potential for an environment-friendly and sustainable electricity generation while being able to provide modern energy to billions of people in developing countries that are still heavily dependent on traditional energy sources. The ample amount of sunlight and high irradiance levels that Malaysia receives due to its strategic geographical location near the Equator gives it an advantage of receiving copious amount of solar radiation (Energy Commission, 2017).

According to Malaysia's Ministry of Energy and Natural Resources (KETSA), the National Renewable Energy Policy targets to achieve 35% renewable energy share in the national generation fuel mix by year 2025 and 40% by 2035. The projected installed capacity for RE is estimated to go up to 18,000 MW by year 2035, doubling the present installed capacity. Given that solar energy has the highest potential to increase RE in the capacity mix, Malaysia plans to introduce battery energy storage systems with a total capacity of 500MW from year 2030 to year 2034 (Ministry of Energy and Natural Resources, 2021).

In efforts to encourage the Malaysia's Renewable Energy (RE) uptake, the government has introduced the Net Energy Metering Scheme (NEM) in November 2016. KETSA has recently launced the new Net Energy Metering 3.0 program (NEM 3.0) due to the overwhelming response. The new program allows residential and commercial electricity consumers to install solar PV systems on the roofs of their properties to cut down their electricity bill in addition in addition to boost the usage of solar energy (SEDA, 2021).

1.2.2 Hydroelectric power

The high rainfall volume and humidity makes Malaysia one of the biggest hydropower potential areas (Abdullah et al., 2019). As of 2019, the total amount of electricity generated by hydropower is 15.66 TWh and has an installed capacity of 6,174 MW. The state of Sarawak is anticipated to experience a large share of upcoming developments, due to its high rainfall and geography. In recent years, the Bakun plant developed by Sarawak Hidro opened in 2011, generating 2,400 MW of electrical energy followed by Sarawak Energy's 944 MW Murum plant in 2015, making it the largest hydropower plant in Malaysia. It is estimated that 60% of Sarawak's power generation is to be sourced from hydropower by 2020, an increase of 35% from the year 2012 (International Hydropower Association, 2020).

1.2.3 Biomass and solid waste

Resources from rice husks, sugar cane waste, palm oil waste, municipal waste, forestry waste and coconut waste produced about 168 million tons of biomass in Malaysia (Ozturk et al., 2017). Malaysian municipal solid waste (MSW) is expected to increase 3% to 5% in annual generation rate as well as a 4% to 8% rise in electricity demand (Yong et al., 2019). Being one of the largest palm oil producer in the world, Malaysia has excess to resources for biomass. Biomass has an added advantage in terms of availability, can be easily stored and reduce landfills. Malaysia has the potential to generate up to 2400 MW of energy from biomass (Yong et al., 2019).

1.2.4 Biogas

As of 2019, Malaysia has managed to achieve about 68 MW installed biogas capacity under the FiT scheme. In 2018, approximately 226 GWh of renewable energy was generated from biogas which resulted in 464 kilotons of unwanted CO_2 emissions. The biogas industry grew by 400% in year 2017 since the year 2014. The highest rise in activity in the biogas sector was in 2017 when a total of 30 biogas FIT projects had installed capacity of 55.83 MW as compared to 18 biogas plants with 30.89 MW capacity in 2016.

1.3 Challenges of RE developments in Malaysia

Fossil fuels will continue to remain as a large contributor in the Malaysian energy consumption. Aside from the possibilities of fossil fuels being exhausted one day, it also contributes to the emissions of GHGs from their combustions which leads to global warming (Oh & Chua, 2010). Although increasing the RE resources into the generation fuel mix seem like the perfect remedy to meet the future demands for energy while combatting the rise in GHGs emission, developing countries like Malaysia face many challenges in hopes of developing a more sustainable energy sector.

Since RE energy resources are fairly new in Malaysia, it requires high investment values. These new technologies bear uncertainty which in turn creates a barrier for its development (Abdullah et al., 2019). Due to these uncertainties, it requires high financial costs for research and development which leads to the rise in prices of renewable energy options. As of today, there is an insufficient amount of infrastructure to cater for renewable electricity. Electrical firms are needed to specifically find regulatory acceptable sites equipped with significant resources and access to transmission lines. There is a risk of supply disruption due to lack of infrastructure and installation issues (Fernando & Yahya, 2015).

As the Malaysian economy continues to grow, the rise in carbon dioxide emission is inevitable unless there is a change in development towards a greener and more sustainable path (Begum et al., 2015). Currently, the renewable energy sector in Malaysia is developing at a slow pace which means the electricity generation sector will still be emitting a large amount of GHGs. In efforts to ensure environmental sustainability in Malaysia, the National Energy Policy was established in 1979 to increase the nation’s energy efficiency and conservation as well as promote effective energy use and reduce wastage (Ministry of Energy, 2015).

2. Energy assessment tool

Energy audits and assessments are used in identifying, monitoring and analyzing the use of energy in a building. The objective is to improve energy efficiency without compromising the comfort and quality of the building. This will aid building owners to reduce electricity consumption and cost in electricity bill.

2.1 Green building index (GBI)

Green buildings have been gaining popularity in Malaysia over the past years due to the environmental benefits it offers. The existence of green buildings enables dramatic changes to the growing concern over pollution and negative environmental impacts as it promotes the independency of natural resources and increasing the demand for a more sustainable building design and construction (Aliagha et al., 2013).

The Green Building Index (GBI) was developed by Pertubuhan Arkitek Malaysia/Malaysian Institute of Architects (PAM) with the Association of Consulting Engineers Malaysia (ACEM) as a green building rating system. It is used to promote sustainability in built environment in the Malaysian building industry. This tool gives an opportunity to building owners and designers to produce a more sustainable building that allows energy and water savings, the adoption of recycling and a healthier indoor environment in the efforts of reducing the impact on the environment (Green Building Index, 2020). GBI buildings are rated in four categories depending on how green they are through a points-based rating system as shown in Table 3:

Table 3. GBI rating system

Category	Points
Platinum	86 – 100
Gold	76 – 85
Silver	66 – 75
Certified	50 - 65

Buildings which obtain a minimum of 50 points in the GBI assessment are classified as green buildings with sub categories outlining improved performance beyond this score. Under the GBI assessment framework, buildings are measured across six areas:

- Energy efficiency
- Indoor environment quality
- Materials and resources
- Sustainable planning and management
- Water efficiency
- Innovation

2.1.1 GBI growth

As of June 2021, among the 1,021 buildings that have registered under GBI, only 579 have successfully been certified as illustrated in **Table 4**. More than half of those buildings are non-residential new constructions (NRNC) with 301 certified properties, followed by residential new construction (RNC) with 211 properties certified, non-residential existing buildings (NREB) and industrial new construction (INC) with 22 and 21 properties certified respectively. 15 of those buildings are townships (T), making up 2% of the margin, 5 interior (ID) and lastly 4 of those are existing industrial buildings (IEB) (Green Building Index, 2020).

Table 4. Number of applied, registered and certified GBI buildings as of June 2021(Green Building Index, 2020)

Stage	Total	NRNC	RNC	NREB	INC	IEB	ID	T
Applied	1,094	595	364	48	45	8	10	24
Registered	1,021	555	343	45	38	7	10	23
Total Certified	579	301	211	22	21	4	5	15

Table 5 shows the number of rated GBI buildings by rating level as of June 2021. Out of 579 buildings that obtained GBI certification, 22 of those buildings are platinum rated which is the highest certification given by GBI. 117 buildings have successfully achieved gold certification, 71 buildings certified silver and the more than half of the buildings at certified level (Green Building Index, 2020).

Table 5. Number of rated GBI buildings as of June 2021 (Green Building Index, 2020)

Rating level	Total	NRNC	RNC	NREB	INC	IEB	ID	T
Platinum	22	14	6	1	-	-	-	1
Gold	117	64	42	2	2	1	3	3
Silver	71	42	19	2	3	-	-	5
Certified	369	181	144	17	16	4	2	6
Total certified	579	301	211	22	21	3	5	15

2.1.2 GBI rated buildings in Malaysia

Malaysia has taken initiatives to build a more sustainable development in regards to global environmental concerns as well as sustaining resources for generations to come. In the year 2009, the government introduced the National Green Technology Policy (NGTP) to implement green initiatives for the country which includes green technology research and innovation as well as promoting awareness of green technology to the public. Specifically, for buildings, the government encourages the use of renewable energy (RE) sources as well as energy efficient practices (Sood et al., 2011). **Table 6** shows examples of GBI rated buildings in Malaysia and the green initiatives taken (Fan, 2020).

Table 6. Examples of GBI rated building in Malaysia (Fan, 2020)

Location	Category	Green Initiatives
Eco Ardence (Shah Alam, Selangor)	Certified Level (50-65 points)	1. Design and placement of windows for natural lighting 2. Designated cycling lanes 3. Waste recycling and active composting 4. Greenery like gardens and lakes in township
Bandar Rimbayu Township (Telok Panglima Garang, Selangor)	Silver Level (66-75 points)	1. Green roof deck and football field located in the social hub 2. House with solar-powered water heaters, indoor ventilation and rain harvesting systems 3. Open green spaces lakes surrounding the township
Marvelane Homes By	Gold Level	1. Residential design that reduces interior heat

The Lake (Subang Jaya, Selangor)	(76 - 85 points)	through insulation, low-energy glass, natural ventilation and solar PV
Energy Commission Headquarters (Putrajaya)	Platinum Level (86 - 100 points)	1. Automatic roller-blind system that responds automatically to the intensity, allowing the right amount of sunlight in the central atrium 2. Inverted pyramid design to gain maximum surface exposure to enable sunlight catchment through the façade's glazed glass cladding 3. The photovoltaic (PV) solar panels located at the roof that supplies 10% of the energy used. 4. Pipes are embedded in the concrete floor to reduce temperature to 21 degrees. 5. Harvested rainwater for toilets and gardens.

2.2 Building energy index (BEI)

In efforts to minimise energy demand and increase energy efficiency, the energy consumption of buildings are forecasted in order to achieve its goal. To implement this strategy, a variety of methods and indicators for measuring building energy performance have been proposed. However, there are various factors that affect the energy consumption of a building like weather conditions, types of activities carried out in the building, heating, ventilation, air-conditioning (HVAC) system and building materials which contributes to the inaccuracy of measuring a building's energy system (Bakar et al., 2015). The Building Energy Index (BEI) is a metric that is used to track the performance of a building's energy consumption by calculating the total annual energy utilized in the premise in kilowatt hours (kWh) divided by the floor area in square meters (m^2) as shown in Equation 1 (Energy Commission, 2021).

$$BEI = \frac{Total\ energy\ consumption\ (\frac{kWh}{year})}{Net\ floor\ area(m^2)} \qquad (1)$$

The BEI of a typical office building in Malaysia is 210kWh/m^2 per year according to Energy Commission. The Diamond Building which is also the Energy Commission's headquarters located in Putrajaya is the first office building in Malaysia to be classified under Platinum in the Green Building Index (GBI). The BEI of the building is 85kWh/m^2 per year at 2,800 hours usage, reducing about 65% of its energy consumption. The building's average BEI is currently at 65kWh/m^2 per year (Energy Commission, 2017). According to MS1525:2014, the recommended BEI for commercial buildings in Malaysia is 136kWh/m^2 per year (Department of Standards Malaysia, 2014).

2.3 Case study of public universities in Malaysia

The development of Malaysia has contributed to the growth and development of higher-education institutions to cater for the increasing number of local and international students. Currently, there are 20 public universities, 47 private universities, 34 university colleges and 10 foreign university branch campuses in Malaysia (Education Malaysia Global Services, 2021). In efforts to commence energy-saving programs, the Malaysian Ministry of Education (MOE), The Malaysian Ministry of Higher Education (MOHE) along with the Ministry of Science, Technology and Innovation (MOSTI) has urged all education centres to initiate energy saving practices and reduce electricity consumption.

A study was conducted to investigate the energy use in three public university buildings in Malaysia. The main quantitative approach in evaluating the electricity usage of these buildings is to identify the BEI of each building. The basic information and data such as yearly electricity bill and gross floor area has been identified as shown in **Table 7** (Noranai et al., 2020; Tahir et al., 2017). For the purpose of this study, the buildings were coded anonymously as Building A, Building B and Building C.

Table 7. BEI of building A, B and C (Noranai et al., 2020; Tahir et al., 2017)

Parameter	Building A	Building B	Building C
Annual energy consumption (kWh)	8,550,879	11,146,818	1,814,769
Net floor area (m^2)	50,766	73,173	8,983
Building energy index (BEI) ($kWh/m^2/year$)	168.44	152.34	202.02

The net floor area is defined as the total area of all floors of the building as measured to the outside surfaces of exterior walls, including areas like flat roofs, halls, stairways, elevator shafts, excluding car parks and external corridors (SEDA, 2013). The annual energy consumption of each building was analyzed through the collection of monthly electricity bills within one whole year from January to December. The energy used in all three buildings are typically used for air conditioning and ventilation system, lighting system and electrical appliances like projectors, computers and printing machines.

The BEI value of all 3 buildings in this study exceeds the recommended BEI for commercial buildings, which is $136kWh/m^2$ per year. With proper energy saving implementations, building A has the potential to reduce 32.44 $kWh/m^2/year$ of energy consumption per year to meet the standards of an energy efficient commercial building where else building B has the potential to reduce 16.34 kWh/m^2/year of energy consumption per year. Building C has the highest potential to reduce its energy consumption by 66.02 kWh/m^2/year.

3. Literature review of buildings in Malaysia

A literature review was conducted on the energy efficiency strategies taken by different types of buildings in Malaysia. The strategies were categorized according to parameters that contribute to electricity consumption. The literature review is summarized in **Table 8** according to building types.

Table 8. Strategies for energy efficiency of buildings in Malaysia

Literature	Building type	Parameter	Strategy for Energy Efficiency
(Tahir, et al., 2021)	Office buildings in public universities	Lighting system	1. Compact Fluorescent Lamps (CFLs) 2. Light-emitting diode (LED) tube lamps
		HVAC system	1. Water-cooled chiller
		Building envelope	1. Mini garden planted on roof of medium-height buildings
			2. External louvers 3. Double glazing windows 4. Exterior & roof landscape for shade 5. White painted roof & walls
(Julaihi, et al., 2017)	GBI certified office building	Lighting system	1. ENERGY STAR Qualified LED Bulb
		HVAC system	1. Inverter air-conditioning system
(Abidin, et al., 2019)	Institution of Higher Learning	Lighting system	1. Presence Sensor with Lux Control 2. Top lighting (skylights and clerestories) 3. T8 electronic ballast
		HVAC system	1. Variable Air Volume (VAV) 2. Air-conditioning installed with Variable Frequency Drives
		Energy saving	1. Energy monitors (occupancy & motion sensors) 2. Solar photovoltaic
(Ng & Akasah, 2011)	Commercial building	HVAC system	1. Chilled Metal Ceiling (CMC) 2. Trickling Cool Roof 3. Phase Change Material (PCM) 4. Installation of Fan Coil Unit (FCU)
		Energy	1. Building Integrated Photovoltaics

		saving	(BIPV) panel functioned as a roof 2. Usage of laptop or personal computer (PC) with LCD monitor
		Building envelope	1. Internal and external walls installed with a rock wool insulation layer 2. Roof section of the building installed with Styrofoam
(Habibullah, et al., 2012)	Airport building	Lighting system	1. Day light sensor at all day lit spaces 2. Occupancy sensor in occasional use spaces 3. Scheduled management
		HVAC system	1. Fans with minimum efficiency of 77% and air foil type 2. Chilled water pumps with variable speed drives
		Building envelope	1. Walls attached to air-conditioned spaces have a maximum effective U-value of 1.2 W/m^2K 2. Light weight roof shall have a maximum U-value of 0.4 W/m^2K. 3. Concrete flat roof shall have a maximum U-value of 0.6 W/m^2K.
		Energy saving	1. Energy Harvesting Speed Bumps at the car parks to generate the electricity 2. Biogas generation at the septic tank
(Yusof & Jamaludin, 2013)	Hotel building	Lighting system	1. Lighting of Exit Signage change to LED 2. Auto sensor controlled lighting (dimmer) 3. Bioclimatic design more daylight penetration
		HVAC system	1. Air conditioner set to 23 to 24 degrees 2. Regular maintenance of air-conditioning system
		Building envelope	1. Use of low VOC paints and coatings
		Energy saving	1. Install occupancy-based room unit controllers 2. Sub metering
(Shaikha, et al., 2016)	Energy efficient office building	Lighting system	1. Strategically positioned workspaces exposed to optimum sunlight 2. Reflective ceilings 3. Mirrored lighted shelves
		HVAC system	1. Radiantly cooled floor-slabs embedded in the floors
		Building envelope	1. Building faced north and south utilizing 100% of natural day light
		Energy saving	1. Photovoltaic (BIPV) panels with 4 types of solar cells (mono-crystalline,

			polycrystalline, semi-transparent and amorphous)

4. Discussion

Energy efficiency has been gaining increased attention from the government to reduce the national carbon emission. A case study was conducted on the BEI of higher learning institution buildings in Malaysia to monitor the annual electricity consumption. In the study, three individual office buildings in public universities has shown a high electricity consumption, based on its BEI. This method of energy audit brings awareness on its energy consumption in order to achieve its goal in accordance to the standards of MS1525.

A short review was done on the various strategies done and proposed by a number of buildings in Malaysia to reduce electricity consumption and promote energy efficiency as summarized in **Table 8**. These approaches or strategies were concentrated on the lighting system, HVAC system, building envelope and energy saving methods based on a preliminary energy assessment. Among the strategies implemented, LED lights were the most common ways to reduce electricity consumption in lighting system among buildings due to its high efficiency as compared to standard florescent lights. Occupancy sensors was also a common approach in reducing unnecessary electricity consumption in lights and air conditioning. A number of buildings took advantage of the abundance of sunlight in Malaysia and incorporated solar photovoltaic panels onto the design of the building, primarily on the roof. To maintain the cool indoor environment of the air conditioned building, shades and double glazing windows are added to reduce external heat from entering the building.

Unfortunately, the road to going green among Malaysians is moving slowly due to the lack of awareness on the significance of it. The impact of private sectors should not be taken lightly therefore, the government is planning incentive for private sectors to adopt more green technology to reduce energy consumption in regards to the Paris Agreement for all countries, including developing countries to take action to minimize the impact of climate change by mitigation of GHGs emissions (Sagar, 2017). Apart from that, the Government of Malaysia introduced the Twelfth Malaysia Plan (12MP) with the ambition of continuing the national development agenda over the next decade with the implemented framework. The 12MP aims to set initiatives among social re-engineering, economic empowerment and environmental sustainability towards a more prosperous society (Twelfth Malaysia Plan, 2020).

5. Conclusion

The power generation industry is one of the biggest contributors of greenhouse gases released into the atmosphere. Developing countries like Malaysia relies mainly on fossil fuels to supply the energy demand. In regards to the 12MP and the Paris Agreement, many public and private sectors have taken initiatives to reduce the electricity consumption in buildings. The shift towards a greener and more sustainable future is feasible if every party plays a part to reduce electricity consumption by promoting energy efficiency. All corporations should not disregard sustainable practices due to the slight additional cost considering there is no price tag for a greener and more sustainable future. Qualitative, sustainable and environmentally sound strategies and practices should be of upmost priority to contribute to a cleaner environment. The developments of renewable energy technologies are closely related to a more well-planned use of energy source in order to reduce the dependency of traditional fossil fuels.

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