Final Report for Commissioned Projects FY2021
MOEJ City-to-City Collaboration for Zero-Carbon Society project

（Project developing a policy and implementation framework for building energy efficiency through city to city collaboration between Kuala Lumpur Government and Tokyo Metropolitan Government）

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Institute for Global Environmental Strategies

Tokyo Metropolitan Government

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1 Summary

T2KLLCS (implementation period: FY 2019 - FY 2021) is a city to city collaboration project between the Tokyo Metropolitan Government and Kuala Lumpur City Hall (hereinafter "KL City Hall") in which the two cities work towards KL City's realization of a low-carbon society and KL City's goal to become a virtual zero-carbon city by 2050. It aims to establish a system to realize and promote KL City Hall's version of low-carbon and zero-carbon buildings while transferring Tokyo's know-how. The project provided assistance in surveying the energy consumption of 1955 public buildings owned by KL City Hall, estimating their reduction potential, selecting public buildings to be retrofitted for energy efficiency, and establishing guidelines. As a result, KL City Hall established refurbishment plans for four public buildings and secured its own budget. Furthermore, when the mayor of KL City Hall announced plans for a new carbon-neutral district, the Tokyo Metropolitan Government's support paved the way for KL City to begin planning for decarbonization by 2050 through their introduction to AEON Malaysia who could serve as a driving force for the private sector. In addition, Tokyo Metropolitan Government's various initiatives and know-how were introduced, including the recent 2030 Carbon Half Initiative.

This year, the final year of the project, the Tokyo Metropolitan Government will introduce the methods they use to promote energy efficiency in their own facilities in order to systematically save energy in the 1955 public buildings in KL City, and also make suggestions for the KL version of a "Standard Specification and Design for Energy Efficiency and Renewable Energy Installation" to efficiently refurbish city-owned facilities within the limited number of KL City Hall officials. Suggestions were also made for a draft of a simplified estimation tool for reduction potential, and guidelines for energy management of city-owned buildings in KL, with the aim of establishing a permanent institutional foundation for low-carbon buildings in KL's city-owned facilities.

The KL City Hall also began work on an urban development concept for the Wangsa Maju area, which was announced as a new carbon neutral growth center, and together with UTM-LCARC identified 20 promising actions from focus group discussions.

2 Global Trends

The oil crises of 1973 and 1979 triggered energy efficiency in the EU, the U.S., and Japan, particularly in the manufacturing industry, and led to the development of energy-efficient products. This led to the gradual standardization of technical specifications in the EU, which had previously varied among member countries (Economidou et al., 2020). In the

United States, the Energy Policy and Conservation Act also established minimum energy consumption efficiency standards to be achieved by home appliances and rolled them out nationwide (Department of Energy 2021). Japan's Top Runner standards differed slightly from those in the EU and the U.S. in that they found the most energy efficient models on the market and standardized the efficiency of those models over a period of time. By a given year, appliance manufacturers must have a weighted average of the energy efficiency of all products in that particular category that is better than the top-runner models (Kimura, 2010). The energy efficiency performance of appliances in circulation was regularly examined by regulators, and low efficiency products were removed from the market in the EU, the U.S., and Japan.

In the 1990s, the global debate on climate change became more active, and countries began to set targets for energy and climate change and to develop long-term action plans for the transition to a low-carbon society. Following home appliances, the insulation performance of buildings became a target for improvement, and EU building performance standards added requirements for insulation; EU member states set minimum levels of energy efficiency to be achieved by new buildings and existing buildings undergoing major renovations, and these were reflected in building codes. The EU Energy Performance Certificate (EPC) ranks a building's energy performance from A to G, with A being the highest and G being the lowest and is a legal requirement for all real estate transactions. Building owners are required to disclose their EPC rank to prospective tenants and buyers (Economidou et al, 2021). The United States does not have a mandatory benchmarking system like EPC, but voluntary programs such as the Energy Star Portfolio Manager and LEEDS programs for commercial and public buildings recommended by the U.S. Environmental Protection Agency are well known, which also calculate energy use from design values. In Japan, owners of large and medium-sized office buildings are required under the Building Energy efficiency Law to comply with energy efficiency standards when a new construction or for major renovations, as a requirement for building permits (IBEC, 2021). In addition, several municipalities, including the Tokyo Metropolitan Government, have introduced local benchmark indicators for buildings exempted by national legislation.

Next, the EU and the U.S. have introduced market mechanisms to induce behavioral changes in energy suppliers and consumers. Energy efficiency obligation schemes (EEOSs), introduced by several EU countries, provide energy efficiency obligations for energy suppliers and energy retailers. In some countries, it is associated with emission trading schemes. For example, France's white certificate scheme trades on the market the energy savings that energy suppliers gain by helping their customers, energy consumers, improve the energy efficiency of their buildings (EU Commission, 2021). There are also various other measures, such as tax incentives to encourage the purchase of specific technologies and measures to relax floor-area ratios when energy-efficient equipment or renewable energy generation systems are installed (Tokyo Metropolitan Government, 2021).

Despite these various policies implemented by the government, the energy-saving performance of buildings has yet to reach an optimal level. Building and homeowners are often unable to choose retrofits that achieve energy efficiency due to financial constraints and complexities that require engineering, financial, and legal expertise specific to the building sector. (Bertoldi et al, 2021). A variety of energy advisory services have emerged as a solution: one-stop stores (OSS), which are gaining momentum in the EU, offer customers a package of energy efficiency measures appropriate for small home renovations, and in some cases, for a fee, propose financial solutions appropriate for the size of the investment (Bertoldi et al, 2021). In London and Nantes, for example, local neighborhood associations act as intermediaries, and building and home owners receive services from the OSS.

The EU has set a target of refurbishing 3% of the total floor area of public buildings owned by the central government, and governments themselves are actively using new technologies in public facilities to promote technological progress and reduce costs. (Economidou et al, 2000).

In Malaysia, the target country of this project, green buildings are expected to be one of the driving forces for green growth and sustainable development. Therefore, several green building rating systems have been introduced to assess the environmental quality of buildings. Due to the tropical climate, the majority of energy consumed in buildings is used for air conditioning and ventilation, and there is room for this to continue to increase as the economy develops. It is hoped that the general trend to reduce the heat load of buildings by insulating roofs and exterior walls and shading with eaves will effectively increase ventilation and cooling capacity of air conditioning.

In Malaysia, MS 1525 has been established as a guideline for energy efficiency and renewable energy for non-residential buildings (Malaysian Bureau of Standards, 2017). It is also trying to expand the use of renewable energy generation by establishing fiscal schemes, roof rental programs, and other policies (SEDA, 2021). Unfortunately, however, there is no government department in Malaysia with the authority to regulate energy use in buildings, so MS1525 is a voluntary program with no penalties.

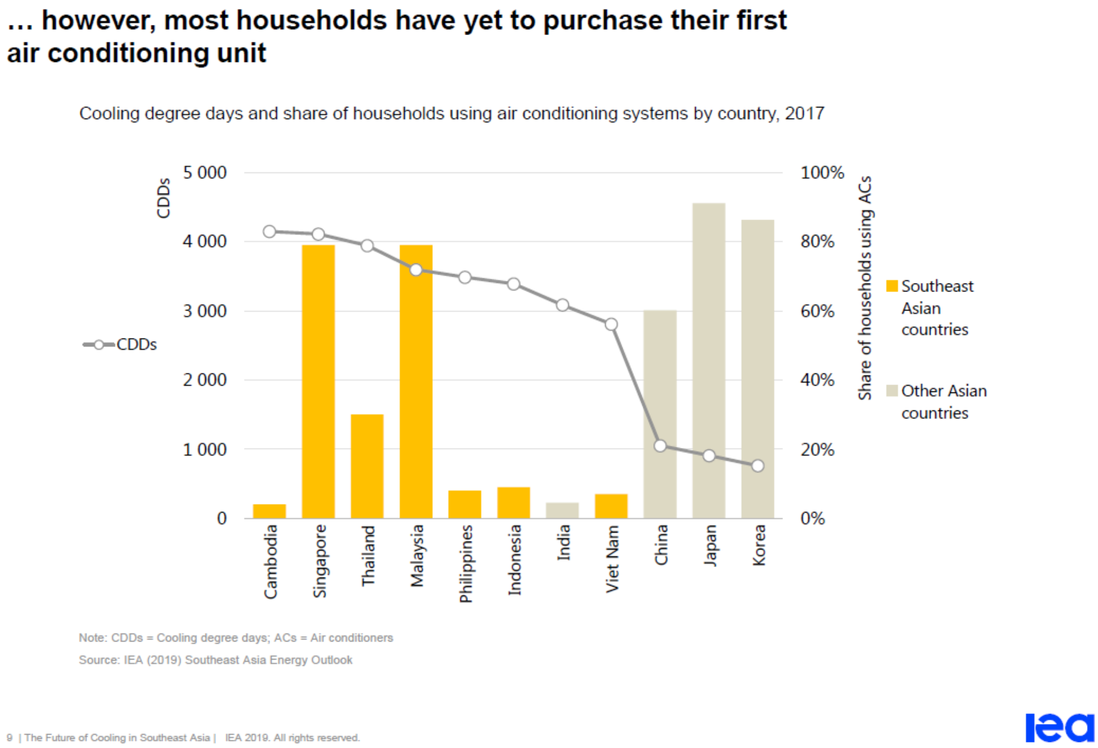

Figure 1：Share of home owners using air conditioners in Southeast Asia（IEA、2019）

In parallel with national efforts, city governments in metropolitan areas such as KL City and Johor Bahru have also formulated climate change action plans to reduce energy use in their cities. KL City, for example, aims to achieve citywide carbon neutrality by 2050. As a role model for private building owners, KL City Hall is working to improve the welfare of local residents by installing energy-efficient equipment and photovoltaic (PV) systems in public buildings and announcing the development of a new carbon neutral district (Kuala Lumpur, 2021).

3　Purpose of the project

The Paris Agreement, which entered into force in November 2008 and the implementation phase in 2020, calls for accelerating climate change by non-governmental entities including municipalities and cities in addition to national governments. At the Ministerial Meeting on Recovery from the New Coronavirus and Climate Change and Environmental Preparedness held in September 2020, the need for decarbonization policies by local governments, which are directly linked to communities, was also recognized. In Japan, the target of establishing a decarbonized society by reducing greenhouse gas emissions to zero by 2050 has been declared, and the number

of municipalities declaring carbon neutral has surged to more than 300.
As described above, the role of cities and municipalities in considering and implementing specific local climate change measures and projects is becoming increasingly important. In order to realize a decarbonized society in the world as a whole, it is necessary to accelerate the movement toward building a sustainable decarbonized society, especially in Asia, where economic growth is substantial, and there is a growing international movement to support the efforts of cities to decarbonize. Cities are places of activity that support social and economic development. The number of companies that are currently in the process of developing their own business models to achieve carbon neutral is increasing.
In addition, covid-19 has forced cities to readjust and consider new measures to achieve sustainable development while dealing with challenges related to the spread of the virus, and it is extremely important to build new methods and new cities through collaboration among cities.
In this project, Japanese research institutes, private companies, universities, etc., together with Japanese cities that have experience and know-how in the formation of decarbonized and low-carbon societies, will conduct a research project to support efforts to form decarbonized and low-carbon societies in KL City and other overseas municipalities, to realize the decarbonization domino, and to introduce facilities that will contribute to the formation of a decarbonized and low-carbon society.

4 Description of work and review of the first and second year

In this project, the Tokyo Metropolitan Government, in view of KL City Hall's target to become a Zero Carbon City by 2050, provided support for the establishment and implementation of a system to promote environmentally friendly buildings. Before describing this year's work, the final year of the three-year project, we will first summarize the work conducted in the first and second year.

(a) First year (FY 2019)

Based on KL City Hall's desire to create a low-carbon showcase of its own buildings, the Tokyo Metropolitan Government decided to transfer its expertise in climate change-related measures, mainly energy efficiency measures in Tokyo Metropolitan Government owned facilities, to KL City Hall.

In the first year of the project, the overall picture of building measures being taken by the Tokyo Metropolitan Government and examples in the energy efficiency and renewable energy guidelines for TMG-owned facilities were presented to KL City Hall, and measures (building operation measures and equipment renewal measures) were discussed per building type (new buildings, existing buildings, etc.). Based on the advice from the Tokyo Metropolitan Government that it is necessary to first collect basic data on buildings in order to promote the reduction of CO_2 emissions from buildings, KL City Hall worked on building a database of 1,955 city-owned facilities in KL City with key items such as address, floor space, year of construction, installed equipment, and timing of installation. A decision was made to work on the estimation of reduction potential, etc. For the database, it was decided to use BeDOS (Building Energy Demand Online System), an online platform of SEDA (Sustainable Energy Development Agency, Malaysia), based on the existing system in Malaysia. The Tokyo Metropolitan Government provided advice for various aspects of the database and shared good practices for reduction measures based on its past experience.

Creation of a database of buildings owned by the KL City Hall

To implement the project, KL City Hall set out to develop the energy-related database. The data collection committee, chaired by then Deputy Mayor Mahadi, was provided with 3076 electricity bills from Tenaga Nasional (TNB), an electric power company, for 1955 city-owned facilities, and information on items such as account number, department name, monthly consumption, and type of contract (commercial, factory, street lighting) was developed. The city shared this information with Tokyo Metropolitan Government. As data collection progressed, it became clear that the difficulty in collecting electricity consumption data and bills for KL City Hall owned buildings and facilities was greater than anticipated. Even after receiving the monthly usage figures from Tenaga Nasional, the utility company, KL City realized that the electricity bills were not linked to the facilities, and began "cleaning" the data to clarify the energy consumption and GHG emissions of the city-owned facilities. Since it would take time to complete the "cleaning," Tokyo Metropolitan Government and the team first analyzed 405 sites (out of a total of 1955 buildings) based on Tokyo's knowledge and experience with buildings, and found that 63% of the energy share of KL City Hall owned facilities come from air conditioning, followed by lighting.

Tokyo Metropolitan Government proposed that KL City Hall prioritize the replacement of equipment with high energy consumption, and introduced a simple calculation method for the reduction potential of heat source equipment and lighting equipment in order to estimate the benefits of purchasing high-efficiency equipment.

Furthermore, as an example of energy efficiency measures in buildings, Tokyo Metropolitan Government shared their standard specification for energy efficiency and renewable installations for metropolitan-owned facilities as a standard for updating equipment to higher efficiency (specifications for building envelope, equipment, and renewable energy to be observed when new construction or renovation is undertaken).

Next, Tokyo Metropolitan Government shared examples (building operation measures) that could be implemented at low or no cost through cooperation between building managers, tenants, and facility users. Since operational measures are extremely important for energy efficiency, Tokyo Metropolitan Government advised that these operational measures should also be actively addressed.

Data Analysis Results

The data collected from 13 offices (out of a total of 35) and 14 parks (out of a total of 16) were then analyzed, and as shown in the figure below, the potential for reduction in energy consumption and GHG emissions is promising. Scenario 1 is ambitious, and Scenario 2 is even more ambitious, requiring high technology and investment.

	Scenario 1	Scenario 2
CO_2 EMISSION IMPROVEMENT	35%	47%
Approach	Moderate	Aggressive
CO_2 EMISSION REDUCTION	12.5 million kgCO2e/year	16.9 million kgCO2e/year
Monetary saving	MYR 7 million/year	MYR 9 million/year

Figure 2： Reduction potential of 27 KL City Hall owned facilities

Four model facilities (Menara 1 (City Hall 1), Menara 2 (City Hall 2), Menara 3 (City Hall 3), and IDB (Institut Latihan Dewan Bandaraya, a municipal training facility) were selected, and using the online platform BeDOS, SEDA estimated the capital investment based on energy consumption trends and reduction potential, and it was decided that these model facilities would be the subject of pilot projects in the following years and beyond.

Table 1: Energy reduction potential in four of KL City Hall's model facilities

	Menara 1	Menara2	Menara 3	IDB	TOTAL
Usage (kWh/year)	7,761,095	3,922,623	4,433,750	1,283,350	17,400,818
Savings [kWh]	3,647,715	1,843,632	2,083,863	603,175	8,178,384
Energy efficiency	2,328,329	1,176,786	1,330,125	385,005	5,220,245
Renewables (solar PV)	1,319,386	666,845	753,738	218,170	2,958,139
Cost Energy Efficiency	10,943,144	5,530,898	6,251,588	1,809,524	24,535,153
Cost Renewables	9,235,703	4,667,921	5,276,163	1,527,187	20,706,973
Total cost [RM]	7,761,095	10,198,819	11,527,750	3,336,710	45,242,127

（currency exchange rate :27.50JPY/Malaysia RM Mizuho Bank 2022/3/1）

(b) Second year (FY2020)

In the second year, an attempt was made to establish a mechanism for low-carbon building measures while developing a refurbishment plan for KL City Hall owned facilities. The four model facilities identified in the first year were chosen as pilot projects. Based on the results of the first year's data analysis, detailed data on the number of heat source equipment, cooling towers, air conditioning pumps, air conditioners, and packaged air conditioners installed, year of installation, manufacturer, COP, and cooling capacity were collected by the KL City Hall, and an inventory of air conditioning-related equipment was created for each facility. Equipment that was due for renewal was identified and included in KL City's 2021-2022 budget.

In response to a request from KL City Hall, the Tokyo Metropolitan Government offered an overview of how they reduced the consumption of fossil fuel-derived grid electricity by installing photovoltaic power generation equipment in government premises. Learning from Tokyo Metropolitan Government's presentation, KL City Hall established KL's version of the installation requirements for photovoltaic power generation equipment, identified where new solar panels could be installed on KL City Hall buildings, and reviewed 10 potential sites. The year also saw the launch of a new initiative for private-sector buildings called Kuala Lumpur Solar PV.

Through such series of work, it became clear that it would take a great deal of effort to collect detailed data on all the equipment. The importance of a simple calculation tool to derive a rough estimate of the reduction potential, when developing an investment retrofit plan for all 1955 buildings, was once again confirmed.

While other developed cities such as Tokyo, London, and Paris have identified target years to achieve virtually zero carbon, KL City Hall has also developed a scenario to achieve the same by 2050. As reference information, the "Kuala Lumpur Low-Carbon Society Blue Print 2030" adopted by KL City Hall in 2018 was used to show multiple cases of pathways to 2050, which is expected to be the first attempt among major Asian cities to become a zero-carbon city. The Kuala Lumpur Low-Carbon Society Blue Print 2030 was followed by the Kuala Lumpur Structure Plan (PSKL 2020) and the Kuala Lumpur City Plan (KL City Plan) which are statutory development plans that guide and manage the city's growth. Kuala Lumpur Structure Plan 2040" and "Kuala Lumpur Local Plan 2040" followed.
The results of the 2050 scenario revealed the importance of reducing emissions, especially in the commercial sector (including buildings), freight transport, and passenger transport. The results of this simulation and the process of developing KL City Hall's version of low-carbon building measures and refurbishment mechanisms also led to Mayor Mahadi's concept of a new carbon-neutral district, the "Wangsa Maju Carbon Neutral Growth Center," which began to take shape in the third year of this project (FY2021).

5 Methodology

As mentioned above, for the past two years, the Tokyo Metropolitan Government has supported KL City Hall in creating a system to systematically convert all city-owned facilities (1955 buildings) to become energy efficient by introducing Tokyo Metropolitan Government's methods and systems for energy efficiency in Tokyo Metropolitan Government-owned facilities.
This fiscal year (FY2021), the final year of the project, will not only introduce the methods, but also suggest a draft for the KL City Hall’s version of the "Standard Specifications and Design for Energy Saving and Renewable Energy Installation" to efficiently upgrade city-owned facilities by the KL City Hall’s limited number of officials, and the KL City Hall’s version of a simplified reduction potential estimation tool and an operational structure for KL City departments to comply with the application of the "Standard Specifications and Design for Energy Saving and Renewable Energy Installation", which was approved as useful by Prof. Ho of Universiti Teknologi Malaysia, who supports KL City Hall.

Continuing from the second year, the team also supported KL City Hall in developing a refurbishment plan for city-owned facilities, this time for 2022 and beyond, with the aim of making the policy of upgrading city-owned facilities to low-carbon buildings a constant.

Last and not least, KL City Hall began to develop a specific concept for the Wangsa Maju area, which was announced as a new carbon neutral district, and 20 promising actions from the focus group discussions.

Chapter 6 describes the procedure for formulating the "Standard Specification and Design for Energy Saving and Renewable Energy Installation" for KL City Hall-owned facilities, Chapter 7 describes how to estimate the reduction potential, Chapter 8 describes the mechanism for each department to comply with the application of the "Standard Specification and Design for Energy Saving and Renewable Energy Installation" (guidelines), Chapter 9 describes the development of the refurbishment plan for 2022 and beyond, Chapter 10 describes the actions in the Wangsa Maju area, and Chapter 11 describes the project achievements.

6 Standard Specifications and Designs for Energy Efficiency and Renewable Energy Installation for KL City Hall-owned facilities

The next section describes the procedure for developing the “Standard Specifications and Designs for Energy Efficiency and Renewable Energy Installation for KL City Hall-owned facilities”

(a) Gather and organize information on the characteristics of KL City Hall owned buildings

The first step in developing the “Standard Specifications and Designs for Energy Efficiency and Renewable Energy Installation for KL City Hall owned facilities” was to identify the characteristics of KL City Hall owned buildings.

Functions and Composition of KL City Hall owned buildings

KL's municipal facilities are used for offices, theaters and entertainment venues, medical clinics, government buildings, libraries, markets, and stores, and play an important role in disseminating information, selling goods and providing services, and serving as centers for civic life.

The role expected of these public buildings is to provide comprehensive functions such as convenience, comfort, safety, hygiene, and cleanliness for users. In order to fulfill these functions, high quality facilities must be properly operated and managed.

No	Type of Building	No. of Buildings
1	Quarters	1,063
2	Offices	35
3	Clinic for Pregnant Women & Children	15
4	Library	8
5	Building under *NADI*	13
6	Building under *Jabatan Penilaian & Pengurusan Harta*	592
7	Guesthouse	23
8	Public Toilet	34
9	Market	38
10	Hawker Centre	45
11	Kiosk	26
12	Community Centre & Multipurpose Hall	30
13	Stadium & Sport Complex	15
14	Park	16
15	Others	2
	Total	**1,955**

Figure 3： An overview of KL City Hall-owned buildings (1955 in all)（as of Jan 2020）

In the City of KL, it is of utmost importance to reinforce the "energy management" perspective when managing and updating building facilities. The reasons for this are

Malaysia has provided stable and affordable energy resources to the domestic market in order to maintain sustainable economic growth. However, compared to other countries, generous fuel subsidies have placed a heavy burden on the national treasury, and regulations for the efficient management of electricity (2008) have been enacted.

The role of green technology in green growth and sustainable development is significant and is expected to be one of the driving forces for the future of Malaysia.

As a net energy exporter, Malaysia has recently been striving to diversify its power sources by expanding the use of coal and LNG, and promoting hydroelectric and solar power generation, in order to avoid using oil, a valuable resource for earning foreign currency, for power generation.

Prevention of global warming has become an urgent issue, and the greenhouse gases that cause it are likely to increase due to the generation of carbon dioxide from the combustion of fossil energy.

Highly efficient equipment that enables reduction of running costs are already available for air conditioning, lighting, and other equipment used in buildings. In addition, it is also possible to save energy through the use of new technologies such as IT-based energy management, energy storage batteries, and photovoltaic power generation, but in general, inexpensive models with low energy efficiency tend to be used.

Energy Consumption Trends in KL

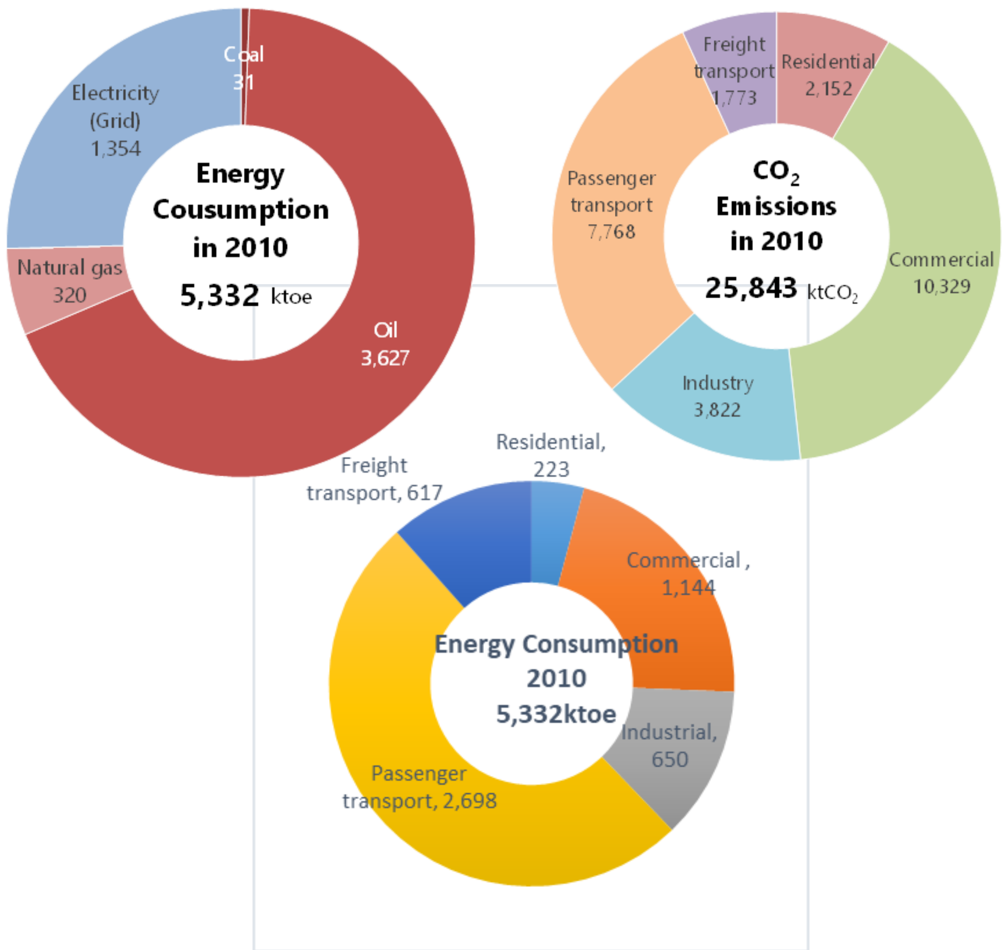

Figure 4 KL City's energy consumption and CO_2 emissions（2010）

Next, energy consumption trends in KL City were identified (in the second year): energy consumption and CO_2 emissions in KL City in 2010 are shown in Figure 4, with petroleum accounting for nearly 70% of energy consumption. CO_2 emissions by sector were highest in the business sector, clearly indicating that energy efficiency measures in the buildings (public and private buildings) targeted by the project are expected to be implemented.

Estimates of CO_2 emissions show that the business sector is the largest source of CO_2 emissions in the BaU scenario for 2050, following 2010.

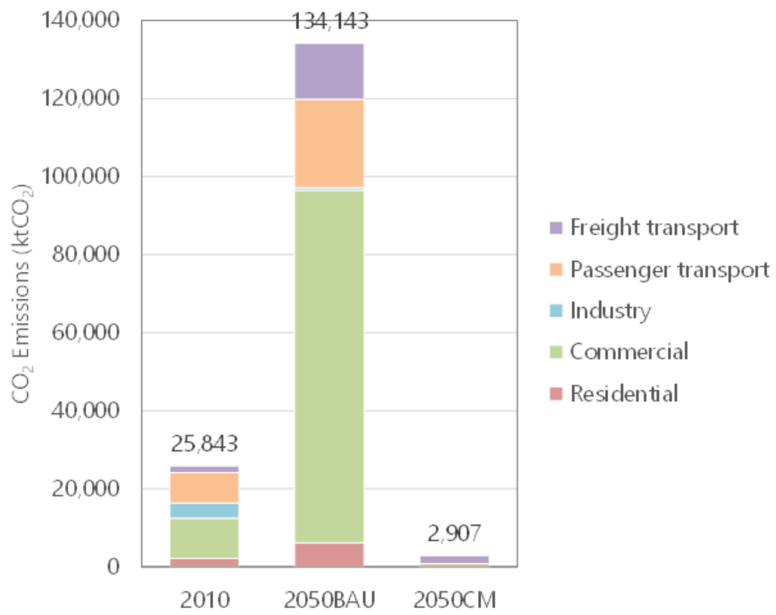

Figure 5 Estimate for CO_2 emissions

Specific Intensity by Use

Buildings are constructed under a wide variety of conditions, including location, use, size, structure, and equipment. In addition, the way they are operated differs according to their purpose, so energy consumption varies as well. In the case of the Greater Kuala Lumpur Metropolitan Area (in this case Putrajaya City), the energy consumption intensity and CO_2 emission intensity per building area for each use are shown in the table below. Since the figures for recreational facilities were not available in the SEDA presentation material, we assumed that they are similar to those of schools, using Japanese examples as a reference.

Table 2 Kuala Lumpur metropolitan area building intensity (2010)

Building usage	Energy intensity (kWh/m2/yr)	Carbon intensity ($kgCO_2$/m2/yr)
Hotel	521	354
Hospital	357	242
Office	202	137
School	43	29

Reference: SEDA presentation material

Ratio of Energy Consumption by Equipment by Destination

The team further broke down the energy consumption of city-owned facilities in KL City by equipment/device type and destination. In general, energy consumption is divided into the following categories: energy for air conditioning (heat source and transport), energy for hot water and steam, energy for lighting and electrical outlets, energy for power (elevators, pumps for water supply and drainage, etc.), and others (computers for BEMS, etc.). In the case of office buildings in KL, air conditioning accounts for a larger proportion of total energy consumption than in Japan due to the tropical climate, while the consumption rate of lighting and power outlets is smaller.

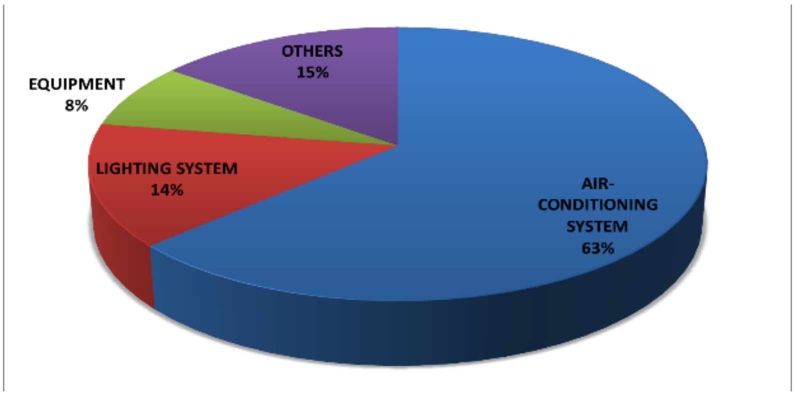

Figure 6 Energy consumption of city-owned facilities in KL City by destination (office) (provided by KL City)

In calculating the breakdown of consumption for each facility, we set proportional values while referring to the Tokyo Metropolitan Government's example and taking into account Malaysia's unique characteristics (large weight for air conditioning), and shared the table below with the KL City.

Table 3 Estimated breakdown of consumption by energy source (unit: %)

Broad category	HVAC (heat source)		HVAC (heat transfer)		Water supply	Light	Power			others
Sub-class	Heat source	Accessory	Water cool	Air cool			Ventilation	Waste water	EV	
Office	36	7	4	17	1	13	5	1	2	14
Cultural recreation	36	7	6	22	0	17	4	1	2	5

Figures is being reviewed by KL City Hall

(b) Gathering and organizing information on energy efficiency policies in Malaysia

Next, the team collected and organized information on energy efficiency policies for buildings in Malaysia with the aim of designing a system that complies with national regulations and guidelines. We referred to the Energy Commission, the regulator of energy policy, and SEDA, the implementing agency, for government published values and publications. We also referred to manufacturers' product catalogs and peer-reviewed articles for the Asian market to understand the performance of building materials and equipment distributed in the Malaysian market.

Table 4 Reference material for Malaysia's energy efficiency policy

Name	Author	Type
National energy efficiency action plan	Ministry of Energy Green Technology and Water, 2015	Action plan
Energy efficiency and use of renewable energy for non-residential buildings- code of practice MS1525	Department of Standards Malaysia, 2014	Guideline
Cogeneration	Energy Commission	Guideline
Guideline on no-cost and low-cost	Energy Commission, 2016	Guideline
Guideline on Advanced Metering Infrastructure	Energy Commission, 2020	Guideline
The future of cooling in Southeast Asia	IEA, 2019	Report
Review on maintenance issues toward	Dzulkifli et al	Journal

building maintenance management best practices		paper
Energy and economy statistics handbook	The Institute of Energy Economics, Japan	Statistics

Table 5 Reference material for building material and appliances

Name	Author	Type
A Comparative Simulation Study of the Thermal Performances of the Building Envelope Wall Materials in the Tropics	Jannat et al, 2020	Journal paper
Retrofitting heritage building by implementing sustainability concept in Malaysia	Yee et al, 2020	Journal paper
Potential of shading devices and glazing configurations on cooling energy savings for high-rise office buildings in hot-humid climates: The case of Malaysia	Lau et al, 2016	Journal paper
The effect of building envelope on the thermal comfort and energy saving for high-rise buildings in hot–humid climate	Mirrahimi et al, 2016	Journal paper
Integrated automation for optimal demand management in commercial buildings considering occupant comfort, Sustainable cities and societies	F. Sehar et al, 2017	Journal paper
HVAC Catalogue for Malaysia	Daikin	Catalogue
HVAC Catalogue for global market	Mitsubishi electric	Catalogue
Glass catalogue for Asian market	AGC Asia Pacific	Catalogue
Datasheet for Energy Management	EECJ	Data
Ashrae Handbook 2020 HVAC systems and equipment	Ashrae research	Guideline

(c) Proposed energy efficiency measures for new construction and renovation

Energy efficiency methods for buildings can be roughly classified into seven categories: (1) elimination of energy waste, (2) energy efficiency to the extent that comfort is not compromised, (3) active use of natural energy, (4) elimination of energy loss in buildings and facilities, (5) improvement of equipment and facility efficiency, (6) recovery of waste heat, and (7) consideration of demand adjustment contracts with power suppliers. In addition, each of these items has four methods: a). those related to the remodeling of buildings and facilities; b). those related to the operation and management of facilities; c). those related to the maintenance of facilities; and d). those related to how buildings and facilities are used.

In order for KL City to become a decarbonized city by 2050, as declared, one of the solutions is to realize buildings that apply the highest level of energy efficiency and renewable energy specifications. As part of the Tokyo Metropolitan Government's initiative to become the city with the lowest environmental impact in the world, the Tokyo Metropolitan Government has formulated "standard specification and designs for energy efficiency and renewable installation " to convert Tokyo-owned buildings to the highest level of energy-efficient specifications, strengthen efforts to reduce electricity consumption and carbon emissions, and apply these specifications to the construction of government buildings and other facilities. While sharing the essence of this system with KL City Hall, we aimed to establish measures unique to KL City.

KL City currently adopts the MS1525 (Malaysia’s national guidelines for energy efficiency and use of renewable energy for non-residential buildings). This project suggested developing KL City Hall’s version of "standard specification and designs for energy efficiency and renewable installation ", which aims for a higher energy performance level than MS1525, as a guideline when developing investment and renovation plans.

The guidelines are designed to provide energy efficiency measures for new construction and renovations by:

- Installation of highly efficient equipment and devices. (eg. air conditioning, ventilation, lighting, etc.)
- Installation of renewable energy power generators
- By reducing heat load with a better building envelope. (eg. double-glazing, eaves, etc.)

The following were recommended: replacing air-conditioning equipment, which has particularly large potential for reducing energy consumption; installing BEMS, which measures, diagnoses, and controls the power consumption of the building in detail; and installing photovoltaic power generation equipment, which can reduce the use of grid electricity with a high emission factor. The selected energy-saving measures were of the highest Malaysian standards, easy to install, and capable of efficiently reducing CO_2 emissions. Equipment with higher reduction potential was divided into those that must be considered for installation at the time of retrofitting, and those with lower reduction potential were divided into optional additional measures. It was suggested that the project would proceed more smoothly if the senior executives of KL City Hall could agree on making it compulsory to replace and budget heat source equipment, which have reached the end of its useful life, with those of higher efficiency.

The energy efficiency measures are summarized in the table below, but technological innovation is progressing day by day, so there may be other new technologies that qualify for inclusion in this list. Tokyo Metropolitan Government recommended that technical experts in KL City collect information from service providers on a regular basis.

Table 6： List of energy efficient technical options for refurbishment

I. Essential	Wall insulation (40mm)
	Exterior overhang (60cm)
	Double glazing windows
	High efficiency chiller or packaged air conditioner
	Heat transfer fan (VAV)
	Heat transfer pump (VWV)
	Elevator VVVF inverter equipment
	High efficiency transformer for electricity wiring
	BEMS
	Solar PV
II. Optional	Thermal insulation of roof
	Urban rooftop garden
	High efficiency cooling tower
	Improving the efficiency of cooling water pumps with an inverter
	High efficiency lighting
	Others

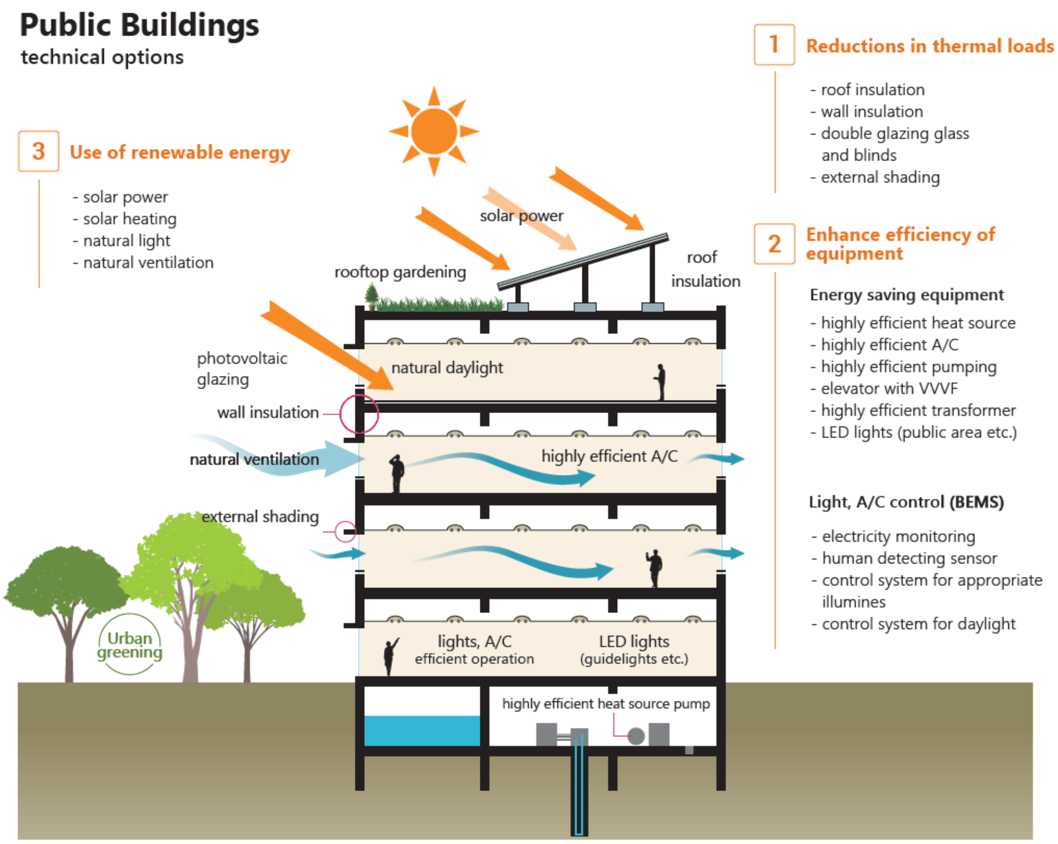

Figure 7 : Low carbon configuration for a KL City owned building (drafted with reference to Tokyo Metropolitan Government's standard specification and designs for energy efficiency and renewable installation)

7 Simple Estimation Method for Reduction Potential (KL Version)

For the energy efficiency measures mentioned above that must be considered for installation during renovation, a tool was developed to enable simple calculation of the potential for reductions in energy consumption and CO_2 emissions. The calculation sheet for reduction potential was created based on Tokyo Metropolitan Government's experience and know-how, and was developed as a tool to efficiently identify measures with large potential for energy efficiency and CO_2 emissions reduction in city-owned facilities under budget constraints, and to reflect them in refurbishment plans. The estimation formulas are shown below.

(a) Reduction potential of energy efficiency by replacing with highly efficient equipment

The formula for the reduction potential if the heat source equipment which is typically the largest electricity consumption in a building, is replaced with high-efficiency equipment is as follows.

$$\mathrm{R} = \mathrm{E} \times \left(1 - \frac{rated\ COP_{before}}{rated\ COP_{after}}\right)$$

R= Reduction potential of electricity consumption of heat source equipment （kWh）
E: Electricity consumption of the entire building (kWh) x Percentage used by heat source equipment (%)
$rated\ COP_{after}$ = Cooling room capacity (kW) / Power consumption (kW)
$rated\ COP_{before}$ =$rated\ COP_{after}$ $\times 80\%$

The renewal period of heat source equipment in KL City is about 20 years. We estimated the energy reduction potential from the difference between the $rated\ COP_{before}$ of 20 years ago and the $rated\ COP_{after}$ of the highest efficiency equipment that exists. The data for the $rated\ COP_{after}$ of the highest efficiency equipment was gathered from product catalogues and the average was placed in the table below. In the case of chillers, the average was calculated per chiller type: air cooled with condenser; water cooled (rotary screw) and water cooled (centrifugal). For the $rated\ COP_{before}$ a figure 20% less than the MS1525 was used after discussions with SEDA.

Table 7：Chiller COP （Malaysia）

Type	Capacity	MS1525	Max	▽
Air cooled with condenser		2.79	3.7	133%
Water cooled (reciprocating, scroll, rotary screw)	<75RT	4.34	4.7	108%
	>75RT, <150RT	4.34	4.7	108%
	>150RT, <300RT	4.95	6.15	124%
	>300RT	5.41	6.15	114%
Water cooled (centrifugal)	<300RT	5.33	TBD	-
	>300RT, <600RT	5.86	TBD	-
	>600RT	5.96	TBD	-

Reference：MS1525、Daikin’s catalogue for the Asian market

Table 8：Packaged air conditioner COP （Malaysia）

Type			MS1525	Max	▽
air cooled non inverter w/ condenser	(single split/package)	<19kWr	2.8	3.43	123%
	(multi-split)	<19kWr	2.8	TBD	-
		>19kWr, <35 kWr	2.8	3.24	116%
		>35 kWr	2.7	3.66	136%
air cooled w/ inverter & condenser	(single split/package)	<19kWr	3.0	4.03	134%
	(multi-split)	<19kWr	3.2	4.95	155%
		>19kWr, <35 kWr	3.5	4.29	123%
		>35 kWr	2.9	3.95	136%
water and evaporatively cooled non inverter		<19kWr	3.6	TBD	-
		>19kWr <35kWr	3.7	TBD	-
		>35kWr	3.8	TBD	-
water and evaporatively cooled w/ inverter		<19kWr	4.0	6.20	155%
		>19kWr <35kWr	4.4	4.57	104%
		>35kWr	4.4	5.96	135%

Reference：MS1525、Daikin’s catalogue for the Asian market

The reduction potential of BEMS is based on figures from Rocha et al. who documented test results in Spain and elsewhere.

Table 9：BEMS energy saving potential per type

	Energy savings for whole building
Metering device without EMS function	0.00%
EMS with light only control (motion sensor, daylight control)	8.32%
EMS with HVAC only control (control with CO2 density)	1.82%
EMS with light, HVAC and plug load control	9.57%

Reference：Rocha et al 2015

(b) Reduction potential from installation of renewable energy generation appliances

If some or all of the electricity consumed could be provided by renewable energy generation equipment installed on the building site, the CO_2 emissions would be zero for that amount. Surplus power could be connected to the power grid or stored in rechargeable batteries for later use or during power outages. Buildings should install as much solar PV on-site as possible, depending on the weight load the structure can hold and the space available. The formula for the reduction potential of photovoltaic energy efficiency measures is as follows

$$Ep = H \times P \times 365$$

Ep: Projected annual power generation (kWh/year)
H: Power generation efficiency
P: Assumed output of the photovoltaic system (kW). Roof area available for installation (m2) x power generation capacity per m2 (kW/m2).

(c) Reduction potential of energy efficiency measures for building envelope

By increasing the insulation performance of the building envelope, it is possible to save energy on the air conditioning equipment needed for cooling. Therefore, we calculated the approximate cooling load for the relevant building. The cooling load is the sum of the structural load, glass surface load, and indoor generated load. The reduction potential can be calculated by multiplying the ratio of the difference in cooling load resulting from the addition of insulation, the replacement of single-pane windows with double-pane windows, and the addition of eaves, by the current power consumption of the heat source equipment. The following table shows the basic data for the cooling load calculation formula and the heat transfer coefficient of building materials in Malaysia required for the calculation.

Table 10: Construction of cooling load

Structure load	Heat passing through walls, windows, and other building structures, etc. $q = \sum K_n \cdot A_n \cdot ETD_n$ q : Heat load through walls, windows, etc. (W)

	K_n : Thermal transmittance of walls, windows, etc. (W/ (m2・K)) A_n : Area of structure (m2) ETD_n : Running temperature difference (degrees centigrade)
Glass surface load	Heat penetration through window glass surfaces, etc. $q_G = q_{G1} + q_{G2}$ q_G : Glass surface load (W) q_{G1}: Heat load passing through glass surface (W) q_{G2}: Solar radiation load on glass surface (W) $q_{G1} = A \cdot K \cdot \nabla t$ A : Glass surface area (m2) K : Thermal transmittance of glass ∇t :Temperature difference between indoors and outdoors $q_{G2} = (\mathrm{IG} - \mathrm{IG}_s) \times \mathrm{SG} + \mathrm{IG}_s\} \times SC$ IG : Standard solar heat gain on glass surface (W/m2) SC :Shading coefficient IG_s :Shaded glass surface standard solar heat gain （W/m2） SG : Sunlit area of glass surface/total area of glass surface A :Total area of glass surface
Indoor generated load	Heat generated by lighting, human body, etc. Heat from light $q_E = A \cdot \mathrm{WL}$ A : room area（m2） WL : Power consumption per unit area (W/m2) Heat from human body $q_H = n \cdot q_{HP}$ n : Number of staff in each room (persons)

	q_{HP}: Heat generated from a single person
Heat storage load due to intermittent air conditioning blower, duct, pump, and piping loads	Not included in this estimated value formula.

Table 11：The thermal transmittance of external walls in Malaysia

Configurations	Maximum U-value(W/m2 K)	Building type
13mm plaster, 105mm fired brick, 50mm clear cavity, 105mm fired brick, 13mm plaster	1.25	Brick
13mm plaster, 40 mm insulation board, 105mm fired brick, 50mm clear cavity, 105mm fired brick, 13mm plaster	0.58	Concrete block
12 mm plaster, 5mm rock wool, 35 mm clear cavity, 150 mm concrete, tile	0.76	Reinforced concrete
13mm plaster, 105mm fired brick, 50mm clear cavity, 100 mm aerated concrete block, 13mm plaster	0.93	Brick
13mm plaster, 40 mm insulation board, 105mm fired brick, 50mm clear cavity, 100 mm aerated concrete block, 13mm plaster	0.5	Concrete block

Reference：Jannat et al (2020)

Table 12： The thermal transmittance for windows in Malaysia

Glazing types	Maximum U-value(W/m2 K)
Single glazed clear 6mm	4.1
Double glazed tinted low-e 8/12/8 mm	1.8

Reference：AGC catalogue for the Asian market

Table 13： Solar radiation load on glass surface with shadings

Standard solar heat gain on glass surface Shaded glass surface standard solar heat gain	187.5 （W/m2） 43 （W/m2）
Shading coefficient （single glazed）	0.69

Reference：the average figure for a building facing east from 9:00-16:00 in Okinawa was used for the standard solar heat gain on glass surface. The shading coefficient was referenced from the AGC catalogue.

Table 14：Heat generated from lightings and human bodies

Power consumption of lightings per unit area	10 （W/m2）
Heat generated from a single person	69 （W/person）

Reference：Average in Japan

8 Guidelines for energy management of city-owned facilities in KL City

There are several energy efficiency methods for buildings, including those related to modification of buildings and facilities, operation and management of facilities, maintenance of facilities, and the way buildings and facilities are used. In Japan, based on the Energy efficiency Law, it is recommended that each business site create an "energy management regulation" or "energy management outline" that organizes these methods along with management systems, organizations, personnel assignments, education, and standards.

Therefore, KL City Hall was presented with a draft guideline of an energy management system for KL city-owned facilities, which reflects KL City Hall's building operation method and system as far as it is known, while referring to the energy management standard published by the Energy efficiency Center in Japan.

In addition, as a mechanism for more proactive planning and execution of building and equipment upgrades using the list of technical options in Table 6, we proposed the establishment of benchmarks based on the metropolitan government's expertise and other factors. In general, a benchmarking system for buildings is intended to promote energy-efficiency efforts through comparisons with other buildings by setting targets (levels to aim for) based on common indicators (benchmark indicators). By publicizing the names of buildings that have achieved the target level as excellent energy efficient buildings, the social reputation of such buildings can be enhanced. In Malaysia, the Building Energy Index (BEI) (energy use per gross floor area (kWh/m2)) is usually used as the energy consumption intensity to evaluate performance. Learning from SEDA that the application of the MS1525 standards on an actual public building resulted in BEI = 148 kWh/m2/year, the team suggested to KL City Hall to use this when developing a benchmark indicator.

Table 15：Example of KL City Hall's Building Energy Performance Level Targets

Building type	Level 1	Level 2	Level 3
Office	150 kWh/m2	112 kWh/m2	75 kWh/m2
School	40 kWh/m2	30 kWh/m2	20 kWh/m2
Community center	100 kWh/m2	75 kWh/m2	50 kWh/m2

Level 1: Performance of buildings constructed in accordance with MS 1525.
Level 2: Performance level 25% higher than Level 1.
Level 3: 50% higher performance level than Level 1.

Furthermore, the team proposed the following PDCA cycle to allow a limited number of KL City Hall officials to refurbish the city owned buildings using the guidelines and energy performance level targets.

① The Building Management Department identifies candidate city-owned facilities to be planned for facility renewal, etc., using the selection rules described in the next chapter.
② Calculate the estimated energy/GHG emission reduction potentials if the technology options in Table 6 are installed in the identified city-owned facilities.
③ Establish the performance levels that the identified city-owned facilities should target for retrofitting.
④ Create a renewal plan for city-owned facilities, taking into account the size of the reduction potential through retrofitting, etc.
⑤ Allocate a budget for the selected technologies, and implement the refurbishment of city-owned facilities through the prescribed procedures.
⑥ After installation, the actual energy consumption of the installed equipment will be monitored using BEMS and meters in cooperation with the equipment manufacturer, and compared with that before installation. Confirm that the performance level set in ③ has been achieved, and fine-tune the operation method if necessary.
⑦ The building management department will report the energy performance level of the building to the energy management committee of the city hall (if any) and display it near the entrance, on electronic bulletin boards/publications, etc. -> Return to action ⑤.

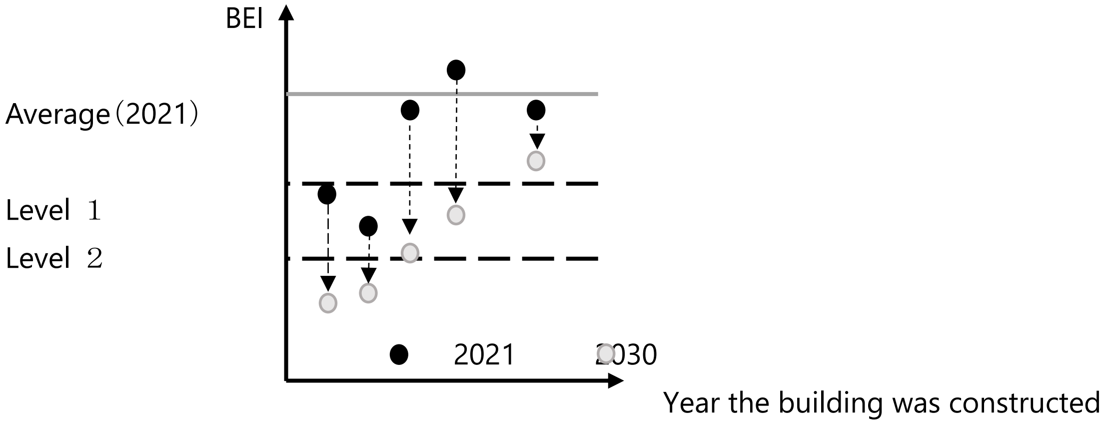

Figure 8：The PDCA cycle should enable the building energy efficiency to improve

9 Development of refurbishment plans for 2022 and beyond

(a) Rules for selecting buildings to be renovated

So far, we have looked at the rules for selecting materials and equipment that should be kept in mind when making refurbishment plans. In order to budget for energy-efficient refurbishment on a sustainable basis, it is necessary to establish selection rules for the buildings themselves. In this project, we analyzed 90 public buildings owned by KL City Hall (out of a total of 1955) and found that many of them are not only high-rise buildings, such as the four model buildings that were the subject of the pilot project, but also medium-sized buildings, as shown below.

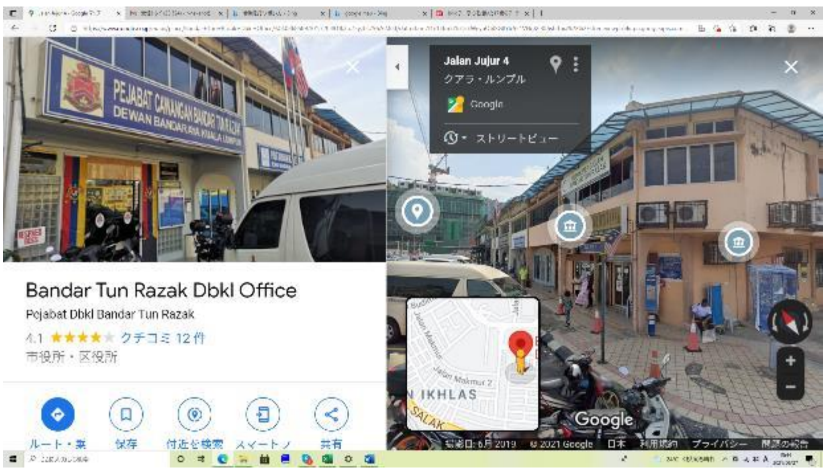

Figure 9-1：Example of a KL City Hall owned building

Figure 9-2： Example of a KL City Hall owned building

In order for KL City Hall to realize its target of decarbonizing by 2050, it is desirable to make a decision to reduce energy consumption efficiently and significantly, despite budget constraints. The proposed building selection rules are as follows:

- Large-scale buildings with annual energy consumption of 120,000 kWh/year or more
- The year of completion of the building is before 2000, and there are no plans to rebuild until 2040.
- Air conditioning equipment was installed before 2000 and is currently being used beyond its useful life.
- (Located in low-carbon development zones designated by DBKL)

(b) Refurbishment Plan

In FY2020, the equipment and budgeted amounts for the replacement of HVAC-related equipment in three of KL's city-owned model facilities, which have particularly high energy consumption, have been finalized and the bidding process is underway.

Table 16：Appliances to be refurbished in model buildings

Model building	Appliance replaced	Budget	Replacement in
Menara 1-tower	AHU	4,000,000 RM	2021
Menara 1-auditorium	Heat source, cooling tower, pumps, AHU	3,500,000 RM	2021
Menara 3	Heat source, cooling tower, pumps, AHU	10,000,000 RM	2022
IDB training center	VRF to be introduced	2,500,000 RM	2021

（currency exchange rate： 27.50JPY/Malaysia RM   Mizuho Bank 2022/3/1）

Figure 10： Appliances scheduled to be refurbished

This year (FY2021), plans were presented to upgrade equipment and install a photovoltaic power generator at the same model facility between 2022 and 2025.

Figure 11： Examples of solar PV installations

Four photovoltaic power generator installations at Pude Ulu Recreational Park, Taman Botani Perdana, Hawker Centre Jalan Jujur, and Sky Arena Sport Centre were conducted during the project period.

Table 17： Refurbishment plan for model buildings（2022～2025）

Menara 1 Chiller, Pumps upgrade to higher efficiency
Menara 1 AHU upgrade fan
IDB VRV for Air Conditioning
Menara 1 Elevators
Menara 3 Replacement and upgrade to energy efficient chiller
Menara 3 Replacement and upgrade to efficient cold and chilled water pump
Menara 2 Elevators
Menara 1 Electric Wiring
Menara 2 Electric Wiring
Menara 3 Electric Wiring
Menara 3 Main pipeline
PV solar: Sentul Perdana Community Centre
PV solar: Ampang Hilir Hall and Community Centre
PV solar : Kuala Lumpur Wholesale Market
PV solar: Bandar Tun Razak Commercial Centre
PV solar: Kuala Lumpur City Hall Training Centre (IDB)

PV solar: Kuala Lumpur Public Library
PV solar: Titiwangsa Takraw Stadium
PV solar: Pudu Ulu Recreational Park
PV solar: Jalan Jujur Hawker Centre

10 Collaboration with the private sector begins in planned low-carbon urban district

(a) Wangsa Maju Carbon Neutral Growth Center

KL City Hall has decided to install renewable energy as well as high-efficiency equipment in its city-owned facilities in order to achieve more comprehensive and sustainable energy management through the implementation of a pilot project. And, as mentioned above, the vision of going carbon neutral by 2050 was announced by KL City Hall, after the Tokyo Metropolitan Government announced its 2050 Zero Emissions Strategy, and ahead of many cities in developing countries. KL Mayor Mahdi chose the Wangsa Maju area as a demonstration site for climate change action and the "Wangsa Maju Carbon Neutral Growth Center". As of the beginning of March 2022, UTM-LCARC (Universiti Teknologi Malaysia-LCARC), at the request of KL Mayor Mahadi, has prepared an action plan for the district ("Wangsa Maju Carbon Neutral Growth Center 2050 Action Plan"). Once drafted, the plan is to gradually transform the district from the suburban, dormitory-centered town it is today into a carbon-neutral, vibrant, and livable growth center.

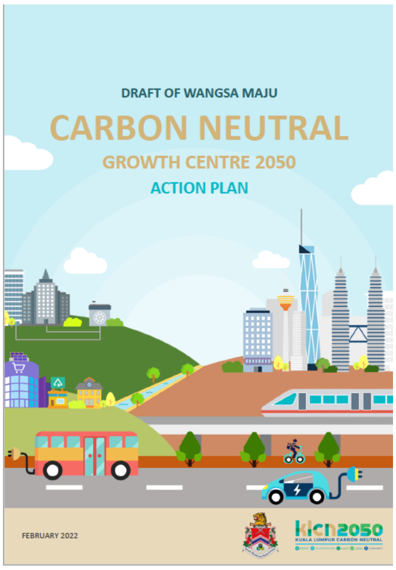

Figure 12： Wangsa Maju Carbon Neutral Growth Center 2050 Action Plan

The Wangsa Maju Carbon Neutral Growth Center 2050 Action Plan, utilizing the Asia-Pacific Integrated Model (AIM), outlines a clear and feasible path to carbon neutrality by 2050. The plan describes a realistic and gradual transition to a low-carbon society by 2030, a carbon-neutral society by 2040, and a carbon-neutral society by 2050.

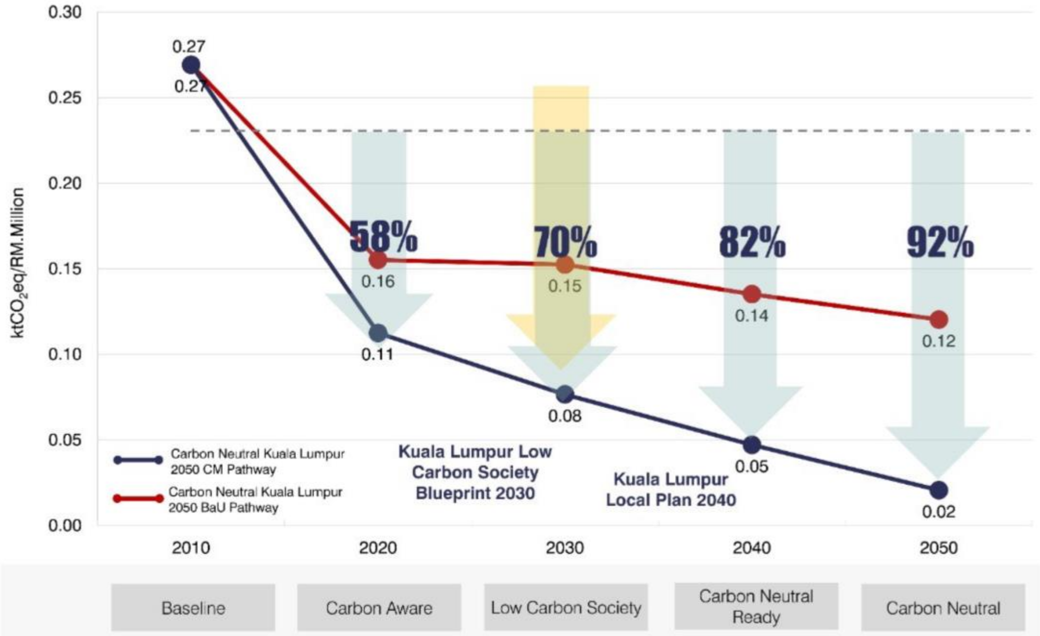

Figure 13：Wangsa Maju Carbon Neutral Growth Center's GHG intensity

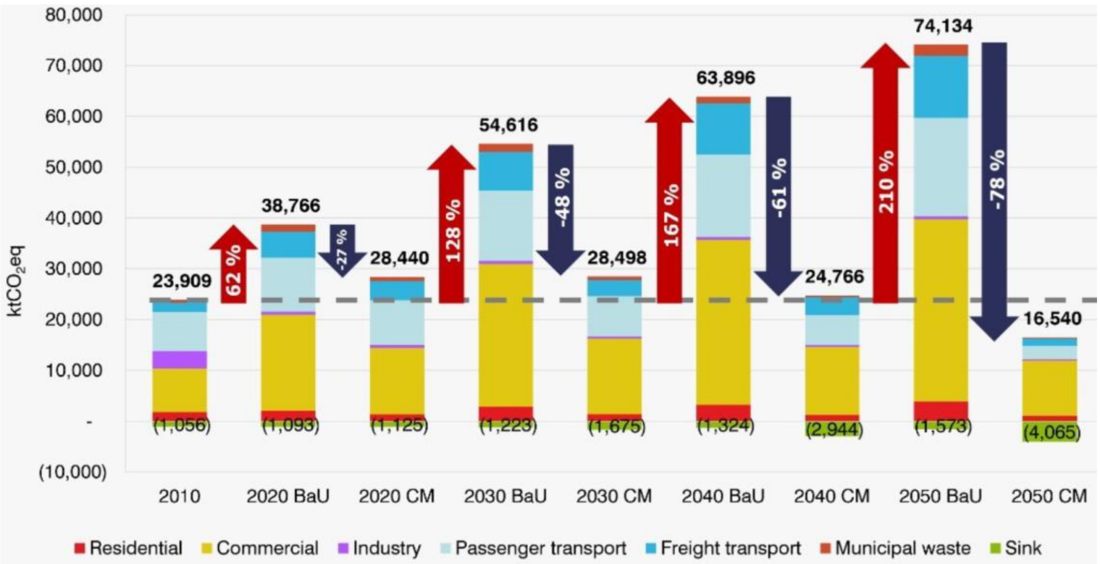

Figure 14：Wangsa Maju Carbon Neutral Growth Center's GHG emissions

The Wangsa Maju Carbon Neutral Growth Center is located in the northern part of the

Wangsa Maju - Maluri Strategic Zone, a 2,649.20-acre area of commercial and residential properties centered on AEON Mall.

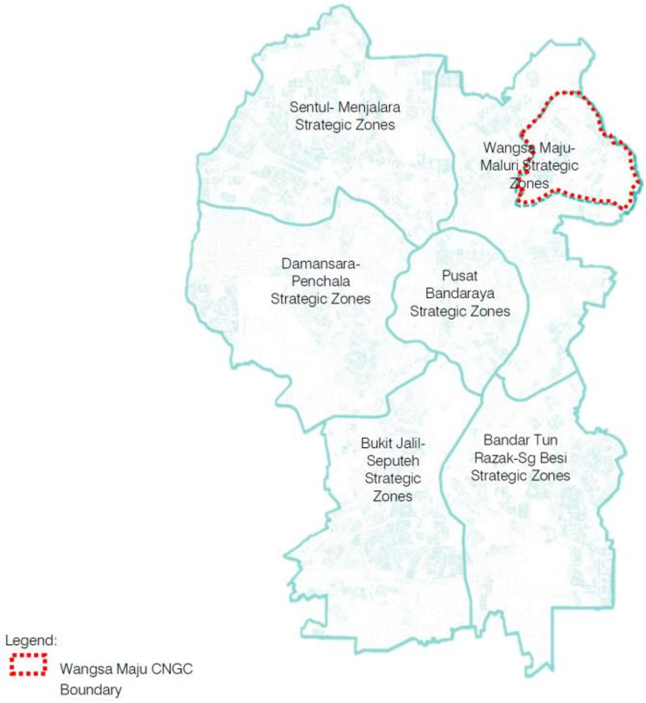

Figure 15： The location of the Wangsa Maju Carbon Neutral Growth Center

KL City Hall was among the first to address urban policies related to climate change with the adoption of the Kuala Lumpur Low Carbon Society Blueprint 2030 in 2018. The Kuala Lumpur Structure Plan (PSKL2020) and Kuala Lumpur City Plan (KLCP2020) were then adopted as statutory development plans to guide and manage the growth of KL City, and the Kuala Lumpur Structure Plan 2040 (PSKL2040) and Kuala Lumpur Local Plan 2040 (PTKL2040) followed. The Kuala Lumpur Structure Plan 2040 sets "Climate Smart and Low Carbon City Kuala Lumpur" as one of the goals, while the Kuala Lumpur Local Plan 2040 sets "Green Technology, Low Carbon and Renewable Energy" as a new area. Low-carbon policies have been mainstreamed into KL City Hall's plan.

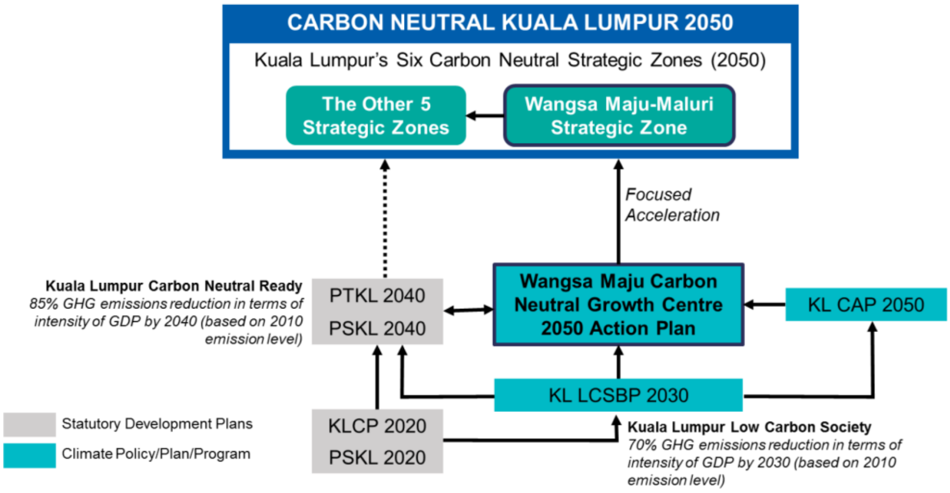

Figure 16： Relation between KL City Hall's plans and the Wangsa Maju Carbon Neutral Growth Center

(b) Estimated 2050 GHG emissions for the Wangsa Maju-Maluri Strategic Zone

UTM-LCARC estimates that GHG emissions in the Wangsa Maju-Maluri Strategic Zone are projected to increase from 4,334 ktCO2eq in 2010 to 13,357 ktCO2eq in 2050 under the BaU scenario. However, depending on future measures, GHG emissions could be reduced to 2,960 ktCO2eq by 2050.

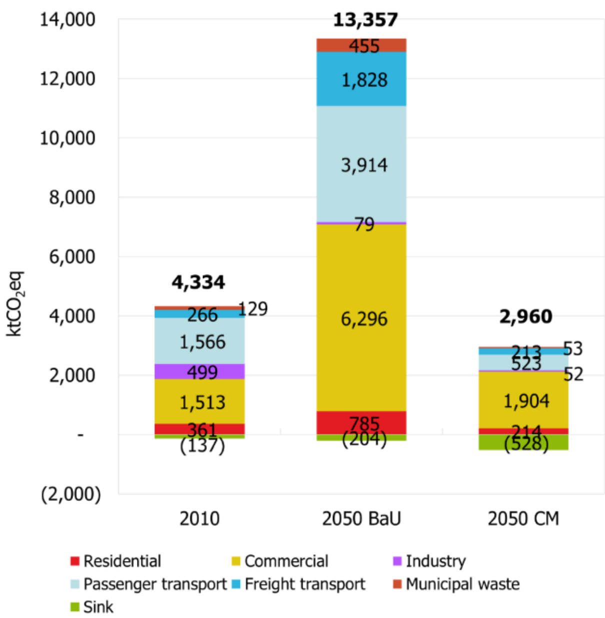

Figure 17： GHG emission estimates in Wangsa Maju-Maluri Strategic Zone

UTM-LCARC estimates that GHG emissions from the business sector will quadruple from 2010 levels under the 2050 Business as Usual (BaU) scenario, accounting for about 47% of total GHG emissions. GHG emissions from the passenger transportation sector are also found to be about three times the 2010 level under the 2050 BaU, and its share of total GHG emissions is 29%. This shows that there is great potential to reduce GHG emissions in the Wangsa Maju area by strategically focusing efforts on the operations and transportation sectors.

(c) Potential for achieving decarbonization in "Wangsa Maju Carbon Neutral Growth Center"

With resource, financial, technological, and time constraints, strategic prioritization of emission reduction measures through a "focused acceleration" approach is critical, especially for cities in developing countries. The "focused acceleration" approach effectively focuses on the implementation of a small number of high-value, high-impact projects that have the potential to achieve up to 90% of emission reduction targets within a city's available capacity. In the "Wangsa Maju Carbon Neutral Growth Center," the focus will be on projects in five strategic areas: Power and Energy, Mobility, Waste, Greening, and Community. The diagram below is used by KL City Hall as a guideline for identifying feasible and implementable projects suitable for the "Wangsa Maju Carbon Neutral Growth Center".

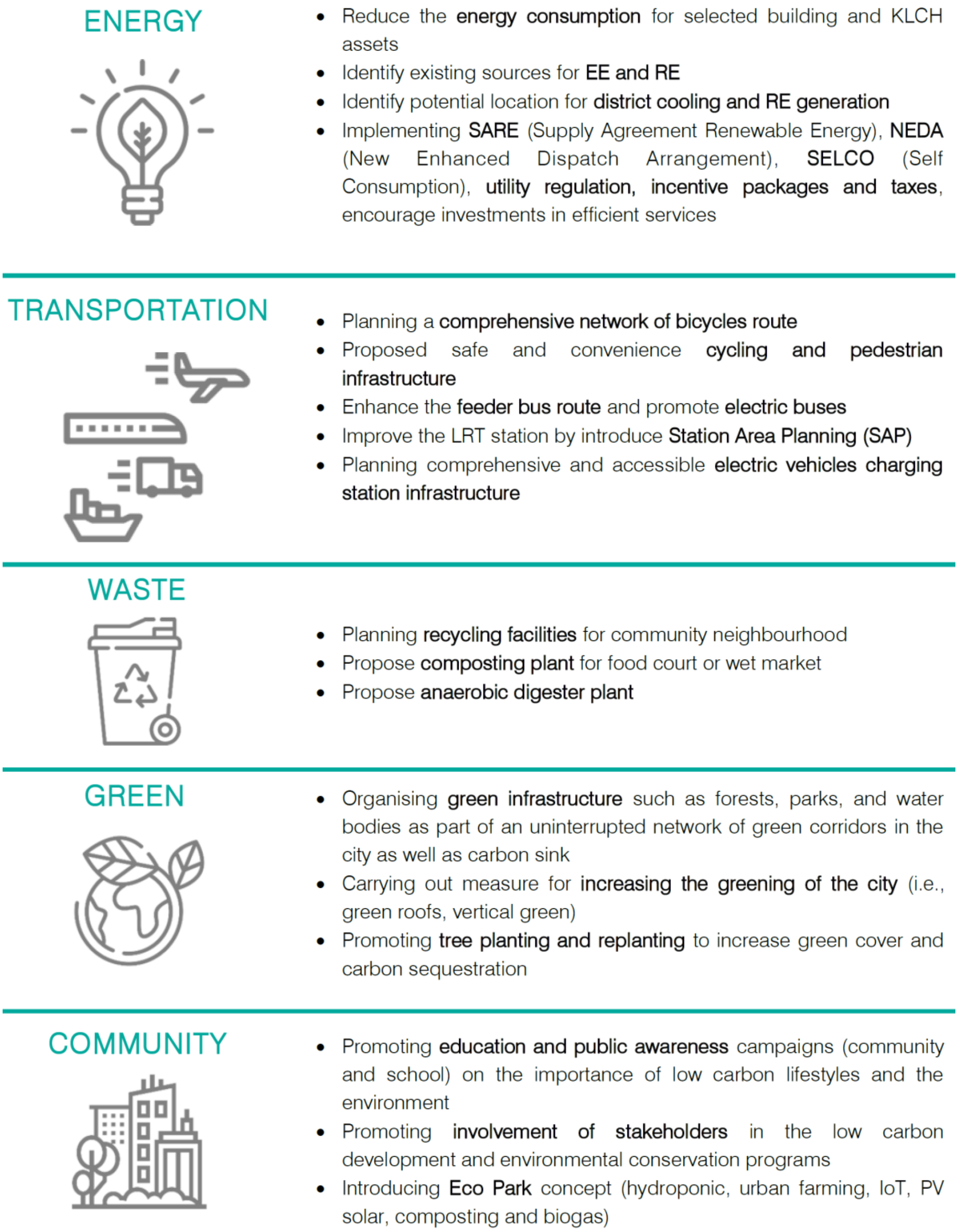

Figure 18: Five strategic areas

The KL City Hall has held focus group discussions and identified 20 proposed actions under the five strategic areas that will lead the "Wangsa Maju Carbon Neutral Growth Center" to carbon neutrality by 2050, considering emission reduction potential, climate change resilience, equitable stakeholder benefits, community integration, and the capacity of KL City Hall officials.

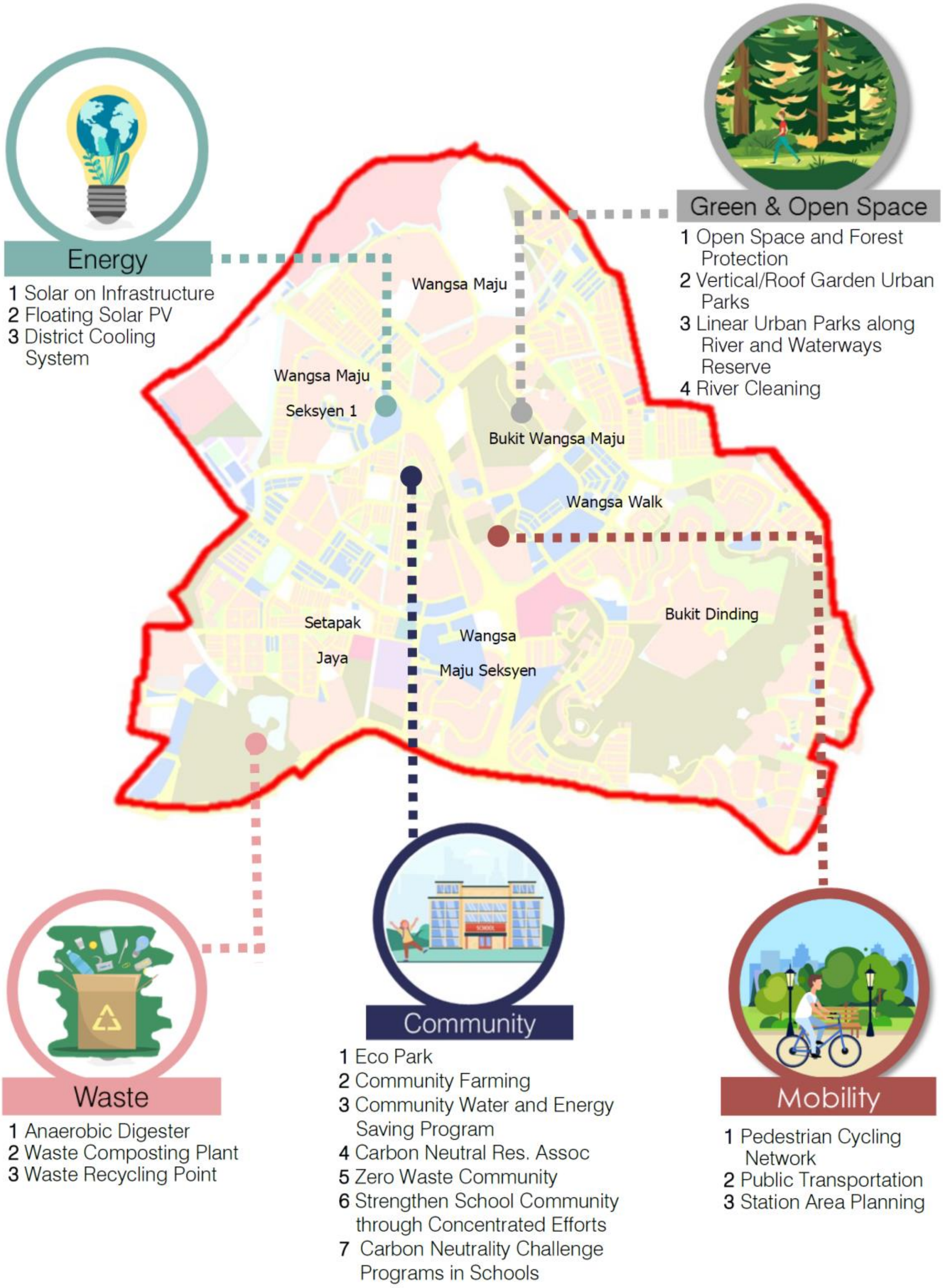

Figure 19： 20 actions for carbon neutral

(d) Proposed project implementation schedule

Specific initiatives for the short term (2021-2025), medium term (2026-2030), and long term (2030 and beyond) in the "Wangsa Maju Carbon Neutral Growth Center 2050 Action Plan" set forth by the KL City Hall are shown in the figure below.

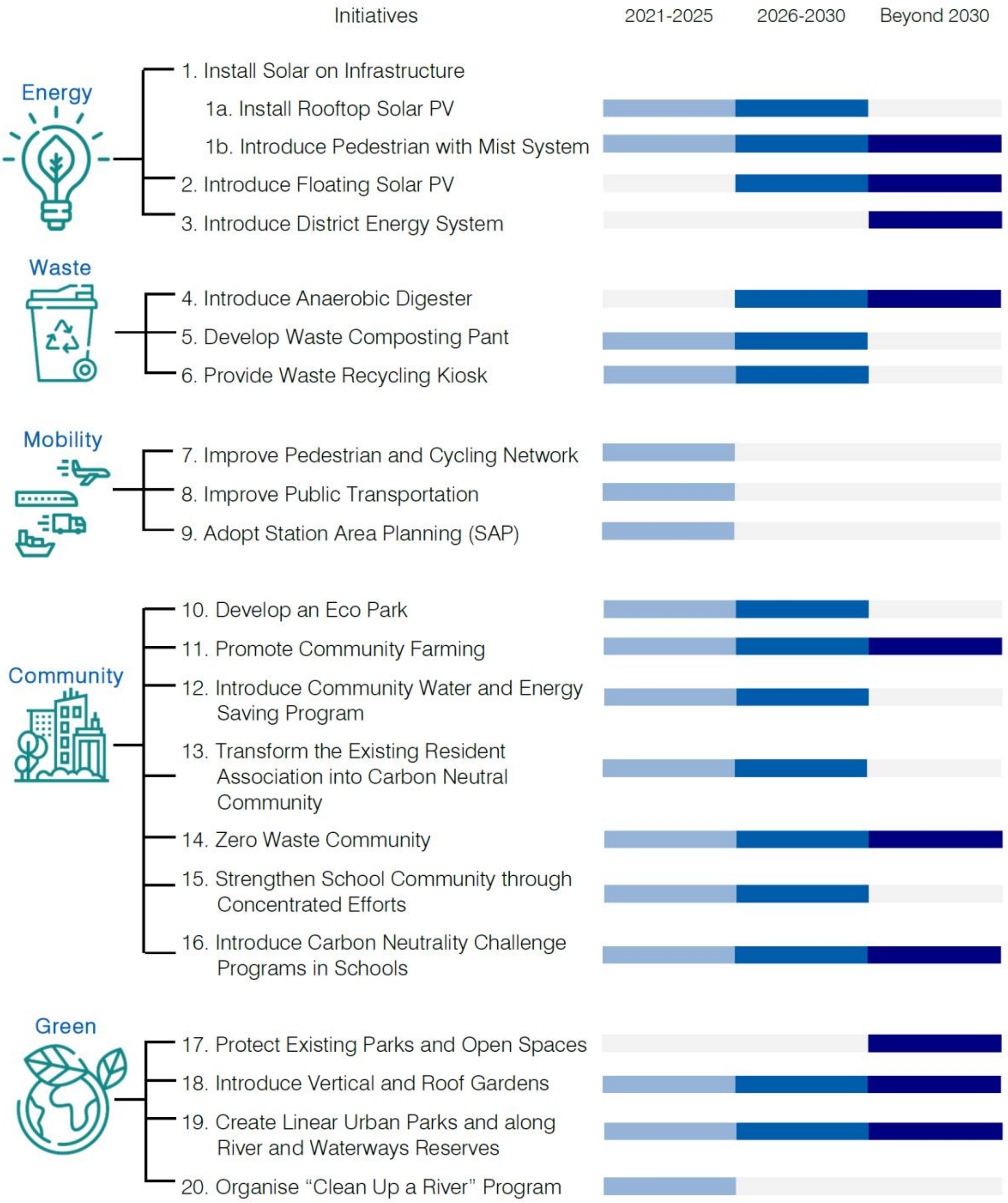

Figure 20: Project implementation schedule (draft)

(e) Cooperation with the private sector

KL Mayor Mahadi's plan to update the Wangsa Maju area into a livable, carbon-neutral growth center became more feasible with the first meeting between the mayor and Aeon Malaysia.

Date and time：2021/10/15 15:00-16:30(MYT) 16:00-17:30(JST)
Venue: Online
Participants

- DBKL Mayor Mahadi,
- Datuk Zulkurnain Hassan (Director, City Planning Dept., DBKL),
- Mr. Rosli Nordin (Senior Deputy Director, City Planning Dept., DBKL),
- Mr. Nik Mohammed Faizal Nik Ali (Deputy Director, Project Implementation and Building Maintenance Dept., DBKL),
- Ms. Nurul Hidayah Zawawi (Senior Town Planner, City Planning Dept., DBKL),
- Mr Mohd Shazni, Bin Saringat (Electrical Engineer, Mechanical and Electrical Engineering Dept., DBKL),
- Ms. Fauziah binti Mohamad Ghazali, (Senior Assistant Director, Project Implementation and Building Maintenance Department, DBKL),
- Ms Norazlina binti Mohd Saad, (Director from Internal Audit Dept., DBKL)
- Ms Izmah Noor Binti Haji Mohd Idris, (Deputy Director from Legal and Prosecution Dept., DBKL)
- Prof TPr Dr HO Chin Siong, Director, LCA, Universiti Teknologi Malaysia (UTM-LCARC)
- TPr CHAU Loon Wai, Co-Director, LCA, Universiti Teknologi Malaysia (UTM-LCARC)
- Mr. Hambali, SEDA

- 千葉稔子、東京都環境局　地球環境エネルギー部，計画課　統括課長代理 (Ms. Toshiko Chiba, Deputy Director of Carbon Policy Planning section, Tokyo Metropolitan Government)
- 菅原久美子、東京都環境局　地球環境エネルギー部、総量削減課　課長代理 (Ms. Kumiko Sugawara, Deputy Director of Tokyo Cap-and-Trade Program, Tokyo Metropolitan Government)
- 新野拓己、東京都 環境局 総務部 環境政策課 国際環境協力担当（Mr. Takumi Niino, Senior Staff Member for International Relations, Bureau of Environment, Tokyo Metropolitan Government）
- 藤野純一、地球環境戦略研究機関　サスティナビリティ統合センター　プログラム･ディレクター (Dr. Junichi Fujino, Program Director, Integrated Sustainability Center, IGES)

・ 中野綾子　地球環境戦略研究機関都市　タスクフォース　リサーチマネジャー　(Ms. Ryoko Nakano, Research Manager, IGES)
・ 井上美智子　地球環境戦略研究機関　戦略マネージメントオフィス　(Ms. Michiko Inoue, Project Officer, Strategy Management Office, IGES)

・ Mr. Shafie Shamsuddin President, AEON Malaysia
・ Mr. Tsutomu Motomura Vice President, AEON Malaysia
・ Dr Kasuma Satria, Head of HR, AEON Malaysia
・ Mr. SALMIEAH MOHD ZIN Public Affairs, AEON Malaysia
・ Ms. Rajeswari Dhanam (project leader for retrofits) AEON Malaysia
・ Mr. Tsunenori Futagi, Strategy Dept, Senior Director, AEON Malaysia
・ Mr. Hamidah Bohri, Strategy Dept, Senior Manager, AEON Malaysia
・ Mr. Farquar Haqqani bin Fadhlullah Suhaimi, Strategy Dept Senior Manager, AEON Malaysia
・ Mr. Nobutada Hanaoka Chief Governance Officer -> POC for DBKL
・ Mr.Masafumi Okuda, Environment and social contributions, AEON

Mayor Mahadi introduced the plan to make the Wangsa Maju area a livable carbon neutral growth center by 2025 and the idea of establishing a new Climate Action Center of Excellence next year.
Prof. Ho introduced the concept of the Wangsa Maju Carbon Neutral Growth Center and called for cooperation in Aeon Malaysia's CSR activities such as rooftop solar power installation, support for community agriculture, tree planting, and waste recycling. It was suggested that the large roof of AEON Wangsa Walk located in Wangsa Maju could be one of the first pilot projects for the carbon neutral growth center.
Mr. Shafie Shamsuddin, President of AEON Malaysia, introduced plans to refurbish AEON Wangsa Maju Alpha Angle Shopping Center from November 2021 at a cost of RM40 million. Among AEON Malaysia's initiatives were rooftop solar power generation, an urban farm on the roof of Alpha Angle, environmental education for children, waste recycling, EV stations, and bicycle promotion.
The Tokyo Metropolitan Government expressed its gratitude to Aeon Co. for serving as the Japanese counterpart for this collaboration and paid tribute to this memorable moment of collaboration between the two parties.

11 Project achievements

As a result of this project, KL City Hall will be able to build on the Tokyo Metropolitan Government's accumulated knowledge and experience in buildings such as: create an energy database of city-owned facilities, which is an important component of permanent measures for low-carbon buildings; establish guidelines for a list of measures to be applied when building new or renewing city-owned facilities; and establish guidelines for energy management systems. The "standard specifications and design for energy efficiency and renewable installment" to be applied to new construction and refurbishment of city-owned facilities was created based on Tokyo Metropolitan Government's similar guideline shared in the first year of the project.

KL City Hall, furthermore, developed a 5-year investment refurbishment plan for 4 public buildings for the period 2021-2025 and secured a portion of the city's own budget. The standard specifications and design for energy efficiency and renewable installment developed through this project will be applied as an internal administrative guideline when renewing facilities owned by KL City Hall. Together with the other guideline for energy management system in city-owned facilities, KL City Hall will further review and update the guidelines to make them more effective for use.

This project, which started in 2019, was able to achieve such results based on a strong sense of mutual trust and cooperation among the parties involved, which was more firmly established in the process of project implementation. This project was also an opportunity for KL City Hall to not only establish measures for low-carbon buildings, but also to promote the Mayor's 2050 zero emission strategy and other measures to promote decarbonization in many areas. It also led to the initiation of the KL Mayor's idea of "introducing new KL City regulations for real estate developers to use at least 30% renewable energy-derived electricity," and the KL Mayor has been working with the private sector in realizing plans to make the Wangsa Maju area a livable, carbon-neutral growth center.

(a) Final workshop

Date and time: 2022/2/16
Venue: Online
Participants:

- YBhg. Datuk Seri TPr. Hj. Mahadi Bin Che Ngah (Mayor of Kuala Lumpur City Hall, Malaysia)

- Nik Mohammed Faizal Nik Ali, Deputy Director, Project Implementation and Building Maintenance Department, Kuala Lumpur City Hall (DBKL)
- Mohd Shazni, Bin Saringat Electrical Engineer Street Lighting maintenance, Mechanical and Electrical Engineering Department, Kuala Lumpur City Hall
- Fauziah binti Mohamad Ghazali, Senior Assistant Director, Project Implementation and Building Maintenance Department, Kuala Lumpur City Hall
- Prof TPr Dr HO Chin Siong, Director, LCA, Universiti Teknologi Malaysia (UTM-LCARC)
- TPr CHAU Loon Wai, Co-Director, LCA, Universiti Teknologi Malaysia (UTM-LCARC)

- 木村　真弘、東京都　環境局　政策調整担当部長　（Mr. Masahiro Kimura, Senior Director for Policy Coordination, Bureau of Environment, Tokyo Metropolitan Government)
- 大久保明子、東京都　環境局　総務部　国際環境協力担当課長 (Ms. Akiko Okubo, Director for International Relations, General Affair Division, Bureau of Environment, Tokyo Metropolitan Government)
- 千葉稔子、東京都環境局　地球環境エネルギー部，計画課　統括課長代理 (Ms. Toshiko Chiba, Deputy Director of Carbon Policy Planning section, Tokyo Metropolitan Government)
- 菅原久美子、東京都環境局　地球環境エネルギー部、総量削減課　課長代理 (Ms. Kumiko Sugawara, Deputy Director of Tokyo Cap-and-Trade Program, Tokyo Metropolitan Government)
- 唐木良子、東京都　環境局　総務部　環境政策課　国際環境協力担当課長代理 (Ms. Ryoko Karaki, Deputy Director for International Relations, Bureau of Environment, Tokyo Metropolitan Government)
- 新野拓己、東京都　環境局　総務部　環境政策課　国際環境協力担当 (Mr. Takumi Niino, Senior Staff Member for International Relations, Bureau of Environment, Tokyo Metropolitan Government)
- 藤野純一、地球環境戦略研究機関　サスティナビリティ統合センター　プログラム・ディレクター (Dr. Junichi Fujino, Program Director, Integrated Sustainability Center, IGES)
- 中野綾子　地球環境戦略研究機関都市　タスクフォース　リサーチマネジャー (Ms. Ryoko Nakano, Research Manager, IGES)
- 井上美智子　地球環境戦略研究機関　戦略マネージメントオフィス (Ms. Michiko Inoue, Project Officer, Strategy Management Office, IGES)
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A final session on the results of this project was held online on February 16, 2022. At the beginning of the meeting, Mayor Mahadi thanked the city to city collaboration with Tokyo Metropolitan Government which had created a readiness in KL City to transition to a low-carbon society and improved the capacity of KL City Hall officials to plan and budget for low-carbon buildings. It was also shared that during the project period, KL City Hall announced its zero-emission strategy for 2050, which was welcomed by the Prime Minister of Malaysia.

Figure 21 : Participants

Mr. Kimura, Director of the Bureau of Environment, Tokyo Metropolitan Government, then gave an opening speech, followed by an overview of recent efforts by the Tokyo Metropolitan Government to reduce greenhouse gas emissions in Tokyo by half by 2030. In order to achieve the "Carbon Half by 2030," the Tokyo Metropolitan Government will: (1) further promote efficient energy use; (2) expand the use of renewable energy in order to reduce GHG emissions in the metropolitan area; (3) promote the use of renewable energy outside of the metropolitan area; and (4) reduce the consumption of natural resources. Tokyo Metropolitan Government also shared that the period between now and 2030 is positioned as a period to lay the groundwork for further emission reductions between 2030 and 2050, and that they are considering strengthening the metropolitan government system for buildings.

Mr. Nick, Acting Director of KL City Hall, expressed his appreciation for the advice he had received from various experts over the past three years and the various tools proposed by the Tokyo Metropolitan Government. He also shared how the pilot project was launched and how KL City officials began to formulate investment plans with a long-term perspective, taking economic feasibility into consideration. Lastly, he introduced KL City Hall's new regulation being considered that will require real estate developers to use at least 30% renewable energy-derived electricity.

Mr. Chau of UTM-LCARC summarized the three years of the project, introducing how the project was an attempt to establish a KL version of a low-carbon building system by transferring Tokyo Metropolitan Government's know-how while developing refurbishment plans for four public buildings in order to create a zero-carbon city in KL City by 2050. It was shared that the scope of cooperation did not stop at the building system, and that the Tokyo Metropolitan Government's support paved the way for KL to become a decarbonized city, such as when the KL Mayor announced plans for a new carbon neutral district, the Tokyo Metropolitan Government introduced AEON Malaysia who could serve as drivers for the private sector. He explained that since the kickoff, the project was an international cooperation project where the dissemination of know-how went in many directions, with meetings held almost every month and speakers at numerous international conferences.

12 Presentations at International Conferences

(a) 26th Conference of the Parties (UNFCCC-COP26)

Date and time: 2021/11/10
Venue: COP26 (Official side event venue Derwentwater)
Hosted by the Institute for Global Environmental Strategies (IGES) and University of Technology Malaysia (UTM-LCARC)

The 26th Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC-COP26) was held in Glasgow, UK, from Sunday, October 31 to Saturday, November 13. On Wednesday, November 10, the Institute for Global Environmental Strategies (IGES), in collaboration with the University of Technology Malaysia (UTM-LCARC), hosted the official UNFCCC side event "Call for an integrative approach: Climate, biodiversity, disaster risk reduction and SDGs". In his opening remarks, Professor Sr Dr. Hishamuddin Mohd Ali, Deputy Vice Chancellor of UTM, referred to the role of universities and other research institutions in supporting local government initiatives.

Prof. Ho Chin Siong, Director of UTM Low Carbon Asia, gave a presentation on the development of low-carbon and decarbonization society quantitative scenarios in KL and other cities in Malaysia. A presentation by the Bureau of Environment of the Tokyo Metropolitan Government (on the measures the Tokyo Metropolitan Government is taking to decarbonize buildings and housing, and the future direction) was read by IGES Dr. Fujino, who also served as moderator.

Figure 22：From left Maimunah Jaafar, Director of Iskandar Regional Development Authority, Datuk Seri Mahadi Che Ngah, Mayor of Kuala Lumpur City, Prof. Ho Chin Siong, Director of UTM Low Carbon Asia, Dr. Junichi Fujino, Principal Researcher of IGES

Presenters and panelists （in order of presentation）
Datuk Seri Mahadi Che Ngah, Mayor of Kuala Lumpur City Hall
Toshiko Chiba, Deputy Director of Carbon Policy Planning Section, Bureau of Environment, Tokyo Metropolitan Government （read by the moderator）
Datuk Ismail Ibrahim, Chief Executive of Iskandar Regional Development Authority
Yulia Yulia, Policy Manager of DKI Jakarta Government、
Maimunah Jaafar, Director of Iskandar Regional Development Authority。
Loon Wai Chau, Senior Lecturer of UTM-LCARC

(b) Zero Carbon City International Forum

Date and time: 2022/3/9～10
Venue: Online
Hosted by Ministry of Environment Japan
Secretariat: Institute for Global Environmental Strategies（IGES）

The Zero Carbon City International Forum, organized by the Ministry of the Environment, was held from 3/9 to 3/10. The forum was divided into thematic meetings to discuss actions that will support the transformation of social systems toward decarbonization. This year's forum, which was attended by many cities from Europe, the U.S., Asia Pacific, and other regions, is one of the actions of the "U.S.-Japan Global Local Zero Carbon Initiative" announced at the UNFCCC-COP26. Prof. Ho Chin Siong, Director of UTM Low Carbon Asia gave a presentation on low-carbon urban development in KL City.

(c) Knowledge sharing with Jakarta City

Date and time：2021/7/7 15:30-17:00 (JST) 13:30-15:00 (IST)
Venue: Online
Purpose：Knowledge sharing of low carbon and decarbonizing strategies and actions between KL City Hall and Jakarta City Hall
Participants: Jakarta City Hall, Tokyo Metropolitan Government (listen only), KL City Hall (listen only),Universiti Teknologi Malaysia (UTM-LCARC), Institute for Global Environmental Strategies(IGES)

The KL City Hall and Jakarta City Hall’s knowledge sharing meeting on low carbon and decarbonization strategies and actions was held online on July 7, 2021. The Institute for Global Environmental Strategies (IGES) showed how specific activities to improve energy efficiency and promote renewable energy in KL's 1,955 municipal buildings were determined through learning from the experience of the Tokyo Metropolitan Government, which has worked on 4,000 public buildings, and with the support of the Sustainable Energy Development Agency (SEDA). UTM-LCARC introduced the low-carbon urban development concept (Wangsa Maju Carbon Neutral Growth Center) in the Wangsa Maju area. Jakarta City Hall introduced its efforts to become a climate resilient city in the building sector.

13 Annual Activities

2021/4/8	Tokyo Metropolitan Government, IGES
2021/5/28	Tokyo Metropolitan Government, IGES
2021/6/3	Ministry of the Environment, Tokyo Metropolitan Government, IGES (Pre-kick-off)
2021/6/3	Tokyo Metropolitan Government, UTM-LCARC, IGES
2021/6/9	UTM-LCARC, SEDA, IGES
2021/7/7	Knowledge sharing with Jakarta City (International Conference)
2021/7/9	UTM-LCARC,IGES
2021/7/9	Tokyo Metropolitan Government/IGES
2021/7/19	KL City Hall, Tokyo Metropolitan Government, UTM-LCARC, SEDA, IGES (Kick-off)
2021/7/29	KL City Hall, Tokyo Metropolitan Government, UTM-LCARC, SEDA, IGES (Working-level meeting)
2021/8/1	Tokyo Metropolitan Government, IGES
2021/8/2	UTM-LCARC, KL City Hall
2021/8/18	KL City Hall, Tokyo Metropolitan Government, UTM-LCARC, SEDA, IGES (Working-level meeting)
2021/9/6	UTM-LCARC, KL City Hall
2021/9/14	Tokyo Metropolitan Government, IGES
2021/10/6	UTM-LCARC, KL City Hall
2021/10/15 KL	City Hall, Tokyo Metropolitan Government, UTM-LCARC, SEDA, IGES (AEON introduction)
2021/11/10	UNFCCC-COP26 Official Side Event (International Conference)
2021/12/7	Menara 1 Share draft of simplified calculation tool for abatement potential (via email)
2021/12/9	Share draft standard specification and design and guidelines for energy management (email)
2021/12/20	KL City Hall, UTM-LCARC, IGES (working-level meeting)
2021/12/22	Tokyo Metropolitan Government, IGES
2021/12/23	Tokyo Metropolitan Government, IGES
2021/12/24	KL City Hall, Tokyo Metropolitan Government, UTM-LCARC, SEDA, IGES (working-level meeting)
2022/1/5	Interim report to Ministry of the Environment
2022/2/11	IGES, UTM-LCARC, Ministry of the Environment

	KL City Hall, UTM-LCARC, IGES
2022/2/16	Final workshop
2022/3/1	Final report to Ministry of the Environment
2022/3/9-10	Zero Carbon City's International Forum (International Conference)

14 Reference material