

Sustainable Infrastructure Concept: Empowering The Initiatives in Construction

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Abstract

This qualitative research was done to study the initiatives on empowering the concept of sustainable infrastructure around Iskandar Puteri, Johor. The main aspect of this research was focusing on the concept and strategies for both ongoing and future projects that will be implemented, which involve the areas around Iskandar Puteri. Hence, Majlis Bandaraya Iskandar Puteri (MBIP), the local authority located at Medini, Iskandar Puteri has been chosen as the respondent throughout our research. MBIP is one of the local authorities that frequently collaborates with various agencies from government and non-government to perform the sustainable infrastructures at Iskandar Puteri. Thus, an interview was conducted at MBIP's Engineering Unit, involving two engineers from the Drainage and Road & Traffic Departments. 10 sets of questions provided were utilised as the instrument for this research. Then, the collected data was analysed based on the sharing of both respondents. The analysis showed that MBIP had implemented the developments and strategies for creating Iskandar Puteri as a sustainable area. The hurdles such as cost, the acceptance from the community, and the restricted laws can lead to the main reasons why this sustainable infrastructure concept cannot be fulfilled. As a result, it is essential to introduce the sustainable infrastructure concept not just to society, but also to other sectors, by creating more sustainable-related programmes such as innovative competitions in the future to achieve the 9th Sustainable Development Goal introduced by the United Nations in Malaysia.

Keywords: Sustainable, Infrastructure and Construction, Environmental Management, Green-Building Concept, Community

Introduction

In recent times, sustainable development has emerged as a critical issue that has garnered the attention of all nations across the globe. It is aimed at addressing the challenges that lie ahead, with the United Nations' Sustainable Development Goals (SDGs) serving as reference points for sustainable development initiatives. According to the United Nations, SDGs called the Global Goals, were introduced in 2015 as a global term to act to stop poverty,

preserve mother nature, and make certain that everyone in this world is enjoying peace, comfort, and most importantly the good life by 2030 (United Nations, 2023). To ensure that sustainability will be carried out successfully, SDGs will focus on three crucial elements: the growth of economics, the involvement of the community, and environmental preservation. When these elements are successfully achieved and implemented globally, communities worldwide will experience comfortable living and a cleaner and safer environment (United Nations, 2023; Wu *et al.*, 2023).

SDG Goal 9, related to Industry, Infrastructure, and Innovation, aims to establish a strong and sustainable foundation while promoting inclusive and eco-friendly industrialisation (Wu *et al.*, 2023). At the same time, SDG 9 acknowledges the significance of research and innovation in searching for the best resolutions to face social, economic, and environmental issues. SDG 9 aims to develop reliable, sustainable, resilient, and high-quality infrastructure, including regional and transborder infrastructure to support economic development and human well-being. The infrastructure should be affordable and accessible, focusing on equity (Our World in Data team, 2023). With the theme “Digitalising Construction Sector” proposed in National Construction Policy (NCP) 2030, introduced by the Ministry of Works Malaysia, the policy will focus on optimising productivity within the sector using technology while inspiring digitalisation and innovation publicly, and at the same time entrusting the governance of human resource (Bidin *et al.*, 2023).

The main objective of implementing the sustainable infrastructure concept is to maintain the harmony of the ecosystem, especially in our country. This is because, nowadays, large-scale developments and environmental management made by the construction industries are not following the plans provided by the government. As a result, the negative impacts caused by excessive developments are increasing. For example, uncontrolled deforestation can lead to higher pollution levels, desertification, and the extinction of animal species (Baloch *et al.*, 2022; StudySmarter, 2023). Excessive property developments such as the placement of condominium constructions and industrial centres also cause negative damage to the environment, if the sectors are not following the sustainability plans thoroughly. For example, at Medini, Iskandar Puteri, Johor, until recently, many house property developments were ongoing.

Although this development offers a comfortable and safe lifestyle for the community, the downside is there are no replacement areas to conserve and preserve the existing forests. As a result, the occurrence of soil erosion especially during the rainy season will become more often. For example, in 2022 and early 2023, flash floods and landslides frequently happened in Kuala Lumpur due to excessive deforestation for urbanisation development. Consequently, unwanted incidents such as flat houses and roads collapsing happen because of deforestation and soil erosion. One of the worst-case scenarios that ever happened in Malaysia was in December 2022, where there are 31 of 92 persons died due to the landslides at Batang Kali, Selangor. The main reason why this incident happened is because of the non-existence of a support system from the tree roots, which can prevent soil erosion from occurring frequently and reduce the pressure on the land due to the construction (Mwango *et al.*, 2014).

When these plans to develop and manage sustainable urbanisation are not well-planned and comprehensive, the problems stated above will arise, thus causing serious damage not just to the ecosystem, but to the economy, social equality, and the culture of the community as well (Ivey, 2019; Mohanty & Kumar, 2021). Even worse, the escalation of carbon dioxide emissions can cause global warming and climate change, and natural disasters such as flash floods and landslides frequently happen, and the excess of clean water decreases

due to pollution as well (Mughal, 2016). Hence, both the government and private sectors play a crucial role in applying sustainable infrastructure in Malaysia. Plus, society also needs to give a hand so that this vision made by the government can achieve the goals provided in SDGs.

One of the ways to enhance sustainable construction is by creating a smart infrastructure and construction concept. This concept shows how to create and develop all of the point themes related to a smart city, along with exceptional quality, economics, better living and comfortability, great governance, and environmental-friendly (Mohanty & Kumar, 2021; Padmavanthi & Aruna, 2022). This is because the sustainability construction concept includes development plans, design implementations, green procurement, construction management plans, operational and maintenance of assets, assets management, structural demolition and modification, and low-carbon emission development (Mohamed, 2019; Yüksel, 2018). Industries have undertaken various initiatives to introduce sustainability elements in the community to promote the concept of sustainable infrastructure. The elements included are the consumption of the land, the impact of materials usage, the source, and waste management at the construction site in terms of ecology and environment (Greenly, 2023).

Other aspects such as the project and construction design also need to be highlighted when entrusting sustainability to the environment and society. There are six criteria related to green-building construction aspects, which are energy efficiency, management and sustainable construction sites, water efficiency, design and innovation, sources and materials, and conducive indoor environmental quality (Mohamed, 2019; Radwan *et al.*, 2019). Implementing the concept makes it easier to achieve sustainable urbanisation by following green-building guidelines from the United Nations Conference on Environment and Development (UNCED) in 1992. At the same time, this helps to generate more awareness in society about the importance of taking care of the environment (Mohamad, 2021). Therefore, this concept can be implemented alongside the green-building concept in our country. Plus, this concept will help to produce structures and procedures that preserve the environment.

Literature Review

In this paper, the sustainable construction and development will be explained accordingly. The definitions of sustainable construction will be also included in this paper, as well as the description of the sustainable construction concept.

Sustainable Construction and Development

Nowadays, every country strives to implement sustainability for a better environment, especially in Malaysia. One of the top consumers of natural resources, the construction industry, needs to search for alternatives to preserve these limited resources while maintaining the ecosystem in balance. This is because, when the natural resources started to decrease, these problems related to the ecosystem such as climate change and the thinning of the ozone layer due to the high production of greenhouse gases caused the concern to grow dramatically (Jackson, 2021). Hence, the implementation of the sustainable construction concept was introduced. When this concept is implemented in the industry, it not only reduces the pressure in the construction industries from both the government and private sectors but can also provide a healthier and more comfortable living to society (Toyinbo, 2019). One of the examples that leads to sustainable construction is the installation of solar panels for the household, which has been introduced by Tenaga Nasional Berhad

(TNB). Hence, the main points such as the definition of sustainable construction, and the sustainable construction concept in terms of economics, environmental and social aspects will be included in this article.

Definition of Sustainable Construction

Sustainability involves meeting the needs of the present while not compromising future generations. It requires balancing economic growth, environmental protection, and social well-being (Becas Santander, 2023). Construction can be defined as the work of building or producing something, for example, buildings, bridges, and houses (Lingard *et al.*, 2017; Cambridge Dictionary, 2023). Hence, sustainability construction, in other words, is described as green construction, which requires the utilisation of environmentally friendly and energy-saving operations in the design (Toyinbo, 2019), —for example, the installation of solar panels on each house for energy conservation. Sustainable construction technology also helps to maintain the longevity of the building and increase the tenants' comfort, and health for their living (Steinemann *et al.*, 2017). For example, in Hong Kong, the utilisation of motion sensors in the building can help tenants reduce the usage of electrical energy in their households. As a result, the electric bills become cheaper than using conventional energy.

Sustainable Infrastructure Concept

Infrastructure can be termed as the fundamental system of structures, facilities, and amenities that are important to sustain the operation of an economy, comprising energy, including fuel production and distribution, transportation, telecommunications, and water and sanitation, especially waste products (Bhattacharya *et al.*, 2016; Brauch, 2017). The sustainable infrastructure concept is a concept that involves appliances and systems that are created for the residents' essential service needs, such as streets, bridges, telephone posts, and geothermal power (Iberdrola, 2021). Hence, to create a sustainable infrastructure concept, it must follow the conventional three-pillar definition of sustainability, which includes economic, social, and environmental (Bhattacharya *et al.*, 2016).

The social pillar refers to the benefits that offer equality and respect for individual rights, such as combating social exclusion and discrimination, offering solidarity by reducing social inequalities through collaboration with both local and international organisations, and contributing to the well-being of stakeholders by creating suitable working places to both normal and disabled people without any discrimination (Greenly, 2023). The environmental pillar is initiated with a responsibility to protect the environment by bringing down the risks and measuring the environmental effects of companies' activities. Lastly, the economic pillar is according to the companies' ability to contribute to economic development and growth. The use of recycled products and the utilisation of solar panels are some of the examples that have a positive impact on the economic pillar (Greenly, 2023).

Research Methodology

For this study, researchers have decided to use a qualitative research design using the interview as the approach. Qualitative research design is a type of research that involves deeper insight, which helps to produce hypotheses for further data analyses that are not related to numbers like quantitative research (Tenny *et al.*, 2022). Hence, throughout this research, the researchers have chosen Majlis Bandaraya Iskandar Puteri (MBIP), one of the local authorities in Johor Bahru as the respondent. The operational framework for this research was constructed in general as shown in Figure 1:

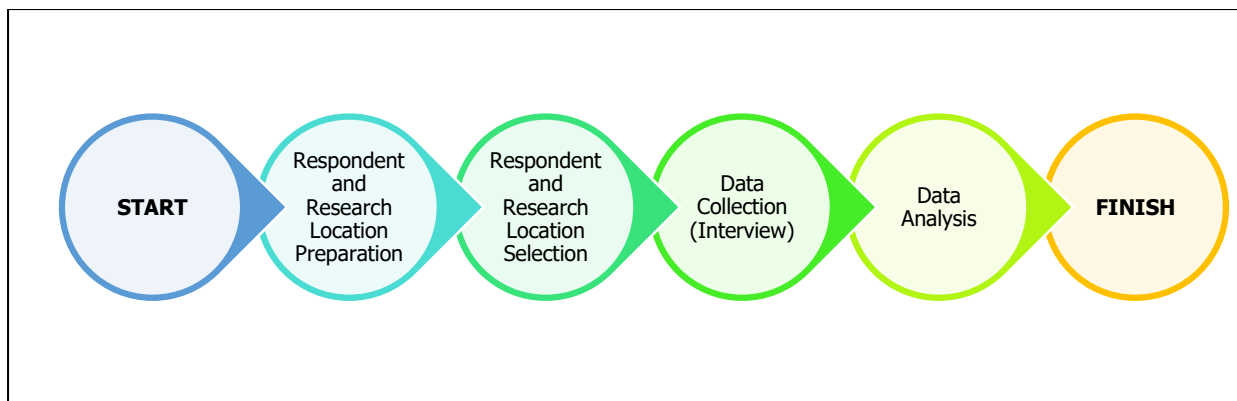


Figure 1 The operational framework of research in general.

Population and Research Sample

Population refers to a group of individuals, objects, or occasions with similar characteristics and want to be studied by researchers. Each object or individual has a different kind of population in every aspect, but it must have at least not less than one similar characteristic among them (Banerjee & Chaudhury, 2010). In contrast, sampling for qualitative research is different from sampling for quantitative research. In qualitative research, the non-probability sampling techniques are always utilised because the main target is not to evaluate a hypothesis related to a big population, but to be a starter point to understand the minor population (McCombes, 2023). The most suitable search is using purposive sampling. This type of sampling, also known as judgment sampling, includes the researchers using their mastery to choose a sample that is more suitable to the objectives of the research (McCombes, 2023).

Hence, for this research, the researchers have chosen engineers from Majlis Bandaraya Iskandar Puteri as the research population. Next, the samples are chosen by specifically selecting two engineers as the respondents throughout the research. The engineers involved are Mr. Raja Sofian bin Raja Azhari and Mr. Mohammad Shahrul Izwan bin Azman. Both engineers are from different departments at Majlis Bandaraya Iskandar Puteri (MBIP), which are the Road and Traffic Department and the Drainage Department.

Research Instrument

During this research, the researchers used the interview approach to collect data from the respondents, by giving them 10 different kinds of questions to answer, which are related to their initiatives on implementing the sustainable infrastructure concept at MBIP territories. An interview is one of the research instruments that has always been selected for qualitative research. An interview, in other words, is an interconnection or relationship between researchers and selected respondents through verbal questions prepared by the researchers. These questions are utilised to gather verbal answers and responses from the respondents (Adosi, 2020). Several types of interviews can be conducted, such as structured, unstructured, non-directive, focus, and focus group interviews. For this research, the focus group interview method has been chosen because MBIP has implemented sustainable construction practices and the selected respondents are required to answer specific questions related to it. This interview session was organised by Miss Afiqah, the person responsible for arranging the appointments between the researchers and the respondents.

Data Analysis

Data analysis is a crucial part of every research. In qualitative research, data analysis is the procedure of structurally finding and organising the interview transcripts observation notes, or any non-textual information or data that the researchers collect to add more the understanding of the event or phenomenon (Wong, 2008). The procedure of analysing the data in qualitative research mostly includes coding or grouping the data. This is the most crucial part of processing the data because it is related to separating the enormous amount of raw data or information and dividing them into particular groups. In other words, all kinds of data are gathered by the researcher whether from the respondents or collected the data from journals, or even diaries and images that are not related to numbers, all of these can be counted as raw data in qualitative research (Bhatia, 2017; Jansen, 2023). The interview is the easiest approach for the researchers to collect the raw data because the data is directly received from the respondents, thus it is clearer and easier to collect and analyse from the respondents. At the end of the interview, the hypotheses for each question are recorded and analysed.

Data Analysis and Findings

After collecting the information from the respondents, the data was analysed using thematic analysis. Thematic analysis is a qualitative data analysis technique that involves a comprehensive examination or reading of a collection of data, such as interview transcripts. The process involves identifying the patterns within the data by categorising the data based on the themes that emerge (Delve & Limpaecher, 2020). Throughout this research, the answers collected from the sets of questions given were subdivided into two divisions under the same theme which is sustainable. The subdivisions were related to the resolutions and plans to authorise that have been made by MBIP to achieve a successful implementation of sustainable development and construction concepts at Johor Bahru. Since there are only two respondents involved in the research, the focus group interview method has been chosen as the research instrument, as stated before.

Based on the interview, the respondents stated that there are four resolutions for the sustainable infrastructure concept that have been implied by MBIP. The resolutions are the company's initiatives, professional employees, the company's challenges, and the empowerment of the sustainable infrastructure concept at the company, as shown in Figure 2. Some resolutions that have been initiated by MBIP have already started and are still ongoing until the recent.



Figure 2 Resolutions for the Sustainable Infrastructure Concept by MBIP.

The Company's Initiatives and Professional Employees

In terms of MBIP's architectural and infrastructural aspects, they use the Industrialised Building System (IBS) in the early construction phase. IBS is commonly known for its environmentally friendly function and energy-saving (CIDB Malaysia, 2022; Mydin *et al.*, 2014). IBS is a development or construction procedure that includes the manufacturable components being transferred, located, and built in a controlled condition whether internally or externally (Kazaz & Ulubeyli, 2004). These components are constructed into a formation using fewer additional site jobs, along with strict observation and checking by quality control departments in the manufacturers. The IBS system was introduced by the Ministry of Housing and Local Government in the 1960s to symbolise the acquisition of household construction plans gathered from visits to European countries (Mydin *et al.*, 2014). This system has been introduced to the Malaysian Construction Industry by the Construction Industry Development Board (CIDB), one of the government's agencies (Bohari *et al.*, 2011). The main purpose of introducing IBS in Malaysia is to increase the reasonably priced and cheaper households with high quality, safe, and environmental-friendly that can be bought by Malaysians, especially for B40 and M40 workers.

Besides that, MBIP also uses sensor technology at their premises, for example, the air-conditioners and lights will turn on when the sensor detects motion, and automatically turn off when there is no motion detected anymore. MBIP also provides a green environment outside their premises and access for pedestrians, which also contributes to one of the green building criteria. This company also has professional employees who are responsible for creating a green environment around the premises, such as engineers, surveyors, technology experts, and urban planners.

The Empowerment of the Sustainable Infrastructure Concept and the Challenges

Although MBIP is eager to implement sustainable development as the foundation of construction at Iskandar Puteri, several challenges must be overcome. For instance, the

regulations related to construction must be updated periodically. Additionally, society must change its mindset by learning and understanding the advantages of sustainable development for the community. Another challenge in implementing sustainability is the high cost, due to the scarcity of materials and suppliers for constructing green buildings. Even though the IBS system can be used as an alternative to the conventional method utilised by most contractors, in Malaysia, the lack of number of labour workers is the main problem for the government to implement this system (Mydin *et al.*, 2014), especially the Johor state government in creating an eco-green city. Hence, to ensure the successful implementation of sustainable development, the MBIP management has developed a specific form called the C1 form. Contractors applying for construction contracts must fill out this form. Once selected, the contractors must follow green building criteria and achieve the target of using 95% of IBS technology. This is a very crucial part because the sources and the materials used can support the building structures longer, and can provide a safe and healthy lifestyle to the consumers (Mydin *et al.*, 2014).

Plans on Authorising the Sustainable Infrastructure Concept

Based on the results gained from the interview, there are four plans to authorise the sustainable infrastructure concept, which are creating Iskandar Malaysia Bus Rapid Transit (IMBRT), a garbage trap system, traffic light technology, and a unit for the safe city, as shown in Figure 3.

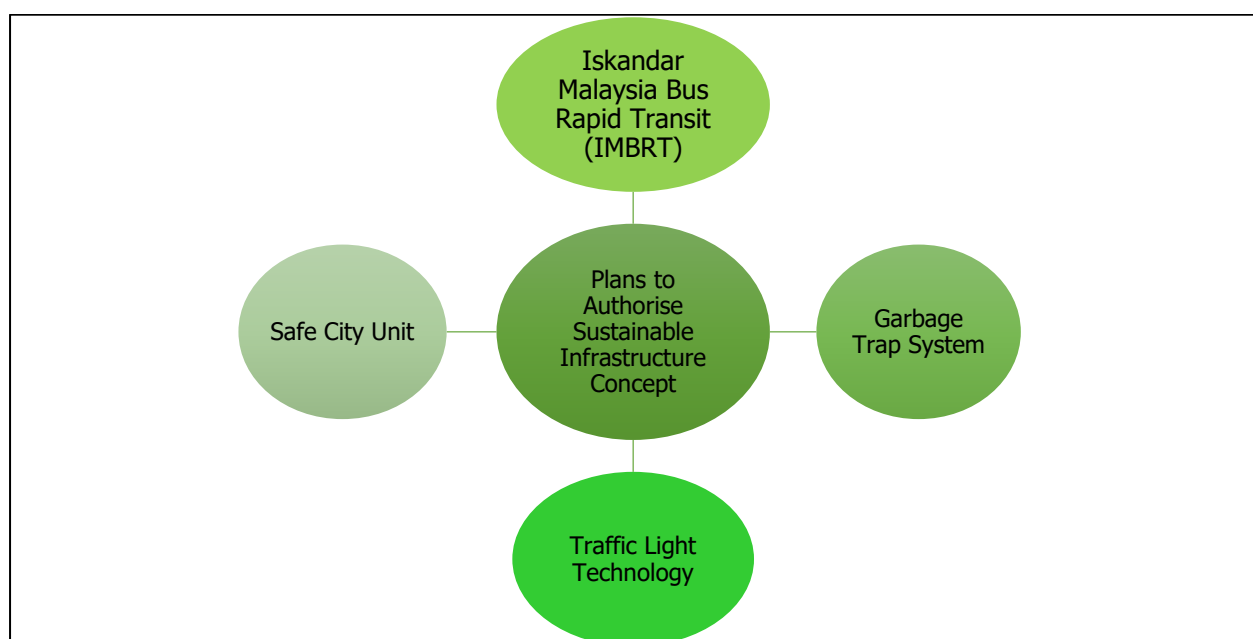


Figure 3 Plans to Authorise the Sustainable Infrastructure Concept by MBIP.

MBIP has collaborated with both government and non-government (NGO) organisations to develop eco-friendly public transport. Hence, IMBRT is the first project conducted by MBIP in collaboration with Universiti Teknologi Malaysia (UTM) using biodiesel as its fuel which is more environmentally friendly and less polluted, and was started at the end of year 2022. The garbage trap system project was already started at Kampung Laut, Skudai, Johor. As a result, 1 tonne of garbage has been collected using this system. Hence, it can be counted as a successful project because of the effectiveness of the system.

Another plan for developing sustainability at Iskandar Puteri is through the implementation of solar energy as a replacement for electrical energy for traffic lights, and the installation of smart cameras and motion sensors on the street to detect both motion and production of carbon dioxide by cars. Lastly, MBIP also plans to create a safe city by starting to provide a parking space called Park and Ride, where visitors can park their vehicles safely, and ride IMRBT to visit other places. MBIP management has also planned to build a charging station for electric vehicles (EVs) to emphasise the development of electric vehicles in Malaysia in the future.

Discussion and Conclusion

In conclusion, there are a lot of initiatives that have been carried out by MBIP to make sure that Johor Bahru can achieve the title of a green city, by collaborating with both government and non-government organisations, to implement the concept of sustainable infrastructure in development and construction aspects. This project also needs to be introduced to society by explaining the advantages of implementing the sustainability concept, the economic positive impacts, construction and infrastructure developments, and most importantly, the environment. The state government can learn and use examples from other countries such as Japan, Sweden, the United Kingdom, and the Netherlands as a reference to enhance the implementation of the IBS system.

Three main factors that have prevented Malaysia from comprehensively realising the concept of sustainable infrastructure are the drafting of acts and laws, the governance of the administrative government, and the community mentality. Furthermore, the lack of exposure to high technology and low level of expert skills in the field of infrastructure sustainability is a critical issue in implementing the concept in Malaysia. At the same time, the lack of labour workers and financial risks associated with implementing the IBS system present obstacles that require solutions. For example, in 1999-2000 the developments of households in Japan by the Japan Prefabricated Construction Suppliers and Manufacturers Association changed from concrete framed systems to steel framing systems (Thanoon *et al.*, 2003). This is because, steel framing systems are sturdier, more stable, low maintenance, and long-lasting compared to concrete framing systems.

Based on the interview, it has shown that MBIP has already executed some of the sustainable projects to create Iskandar Puteri as a green city, and so far, the projects have been successfully carried out. An eco-city, also known as a green city, is a metropolis that prioritises energy efficiency and sustainability in every aspect of its projects. A city that promotes sustainable development encourages the combination of different types of land use, utilizes compact land planning, and implements various social practices in its planning systems. Additionally, it prioritizes the principles of green growth and equity in local development to ensure a comprehensive approach towards sustainable development (Brilhante & Klaas, 2018).

In terms of a sustainable infrastructure approach, MBIP already developed its buildings according to the green building criteria and implemented IBS. As mentioned before, a green building is a building that can stabilise or improve the quality of living within the local climate, tradition, and culture (Sharma, 2020; Srivinas, n,d). A green building also focuses on the design in the construction to reduce the negative impacts, especially on human health and the surroundings, reduce waste, and pollution, and increase energy efficiency (Sharma, 2020). IBS has proven to be a successful system in conserving energy. This is because IBS has the

potential to be an alternative to the conventional system in Malaysia (Srivinas, n.d). Plus, this system has been implemented by MBIP for energy conservation, as stated before.

At the same time, MBIP also introduced IMRBT to the community, by using biodiesel as an alternative to the existing diesel as its fuel. Thus, to achieve the goal of SDG 9, which is sustainable infrastructure and innovation, it is important to expand the idea of sustainable infrastructure not only in the industrial sector but also in other sectors such as education and domestic sectors. For example, MBIP introduces programmes and activities that promote sustainability such as creating sustainability poster competitions, Sustainability towards Education LA 21 Competition 2023, the Colouring Competition for Kids in conjunction with National Environment Day 2023, and many more. This will help increase awareness and knowledge of the concept among society and encourage them to contribute to its application.

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