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SECTION 06

PHASE 1: PROJECT PROPOSAL & PLANNING

CARBON EMISSION MONITORING SYSTEM

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1.0 Introduction

Carbon makes up a huge portion of the environment, and the movement and presence of carbon are necessary for natural systems to function. The movement of carbon between various reservoirs, including the atmosphere, seas, land, and living organisms, is a crucial environmental activity referred to as the "carbon cycle". Comprehending the function of carbon in the environment is essential for mitigating climate change and preserving the equilibrium of ecosystems.

In this paper, we are going to introduce the Carbon Emission Monitoring System that is used to monitor, measure, and regulate the amount of carbon dioxide (CO2) in ecosystems. By reducing and controlling carbon emissions, Majlis Perbandaran Iskandar Puteri (MBIP) can mitigate global warming and promote sustainability in Iskandar Puteri. Features of this system might include gathering information from each client about their consumption of water and electricity as well as calculating their carbon footprint using a certain mathematical formula. Additionally, this system offers its clients helpful recommendations with the goal of limiting carbon emissions on the local scale. Since it won't take much of the clients' time, there's a greater chance that they'll participate in the activity to significantly improve the atmosphere collectively.

It is anticipated that clients will track the greenhouse gas emissions from various industries over time and in real time using an easy-to-use Carbon Emission Monitoring System. The system ought to have an easy-to-use interface and support customization for added needs. Additionally, the system needs to permit transparency and public access in order to comply with global requirements. To guarantee that the system is effective in guiding decisions and promoting environmental sustainability, regular updates and maintenance are also crucial. To make the client for emission data easier to use, early warning systems and other tools should be integrated as well.

2.0 Background Study

- **Low Carbon Initiatives and Strategies**

There is a lot of potential in MBIP's proposed construction of a platform for data collecting and analysis that would map carbon footprints, compute reductions, target different community segments, and produce a dashboard that can be monitored by itself. If carried out well, it might simplify operations, offer useful information, and enable communities to monitor and successfully lower their carbon footprint. In addition, encouraging organizations and people that make significant efforts to cut carbon emissions with incentives, awards, or recognition may encourage even more engagement and creative thinking regarding environmentally friendly practices.

- **Technological Landscape**

Provide sensible and easy-to-use interfaces so that everyone can access and comprehend data. For example, web-based portals, smartphone apps, or dashboards designed for specific user groups like citizens, companies, or legislators may fall under this category. Other than that, to analyze carbon emissions data in a meaningful way, make use of good data analytics techniques such as statistical models and machine learning algorithms. Make the data easier to understand by using interactive dashboards and reports.

- **Data Collection and Analysis**

Information from a variety of sources, such as water meters, waste management systems, energy meters, and community participation initiatives, is gathered throughout data collecting. The data is collected through users manual inputs through the monitoring system. For unified analysis, collected data from many sources must be combined into a centralized database. This led to implementation of scalable and secure data storage in order to accommodate various and huge amounts of data in order to produce much more accurate analysis.

- **Regulatory Framework and Targets**

Iskandar Puteri is one of the Malaysian cities that can use the framework provided by the Low Carbon Cities Framework (LCCF)to create and carry out low-carbon development policies. It establishes goals for environmental friendly practices and the decrease of carbon emission. Besides that, the Iskandar Puteri Low Carbon (IPRK) programme is one of the initiatives that the Iskandar Puteri City Council (MBIP) has developed. Its goal is to collect information on electrical and water consumption measures taken by the community, including residential areas, educational institutions, and other establishments. The Johor Education Department's e-Lestari system incorporates sustainability education into both the curriculum and extracurricular activities which align with academic objectives that emphasize sustainability and environmental awareness.

3.0 Problem Statement

The Iskandar Puteri City Council (MBIP) launched the Iskandar Puteri Rendah Carbon (IPRC) programme to address social, environmental, and economic challenges in order to advance sustainability. This effort aims to lower the carbon intensity in the Iskandar Puteri region by 58% by 2025. But this programme also ran into a number of issues, such as:

- **Manual handling of data**

The data that have been gathered for carbon reduction across sectors and neighborhoods are being calculated and published manually due to a lack of data analysis. Additionally, the data is manually verified, with each supplied detail being examined by MBIP staff members. Because it takes time and exposes the data to redundancy and human mistake, this procedure is unreliable. As a result, it will generate false data on the carbon emissions in the nearby areas of Iskandar Puteri.

- **Tedious data collection process**

The process of completing the Google Form and sending the necessary data to MBIP is laborious and time-consuming, making it inefficient. As a result, the participant is less likely to collaborate and share their findings. Additionally, it encourages laziness in participants and raises the possibility that they would lie and cheat during the procedure. For instance, six months' worth of utility, water, and recycling bills must be sent in for the analysis.

- **Poor interface**

The Google Form is complicated and poorly structured for people of all ages, making it extremely tough for participants to fill out. This results in MBIP having to spend additional money on installing specialised kiosks to make it easier for participants to complete Google Forms, which are costly and time-consuming over the long run due to maintenance cost.

- **Too diverse target groups**

The necessary data must come from a variety of industries and communities. This covers a wide range of Iskandar Puteri businesses, such as factories, residences, educational institutions, and schools. As a result, there isn't a single, universal approach to handling the volume of data gathered. Different industries and communities needed different approaches to data collection and analysis.

4.0 Proposed Solution

- **Implementation of automated system features**

These features can help with the data collection and calculation process, which would otherwise need to be done manually by MBIP employees. To guarantee data integrity, these features can also be trained to validate the participant's submitted information. As a result, it will simplify the data analysis process and make it easier to monitor the rate of carbon emissions and forecast future patterns. By taking into account the system requirements, technology stacks, data collection and integration, architectural design, data processing and analysis, scalability and performance, user interface and experience, etc., it is very possible to incorporate these features into the monitoring system using current technology.

- **Educate the community towards digital literacy**

Apart from transitioning to a low-carbon community, the participants, or older citizens in particular, could receive instruction on how to use contemporary technology to improve their digital literacy that requires calls for both technical and cognitive abilities. In this instance, we're teaching the locals how to utilize the available technology and avoid falling behind on recent advances in technology. This actually helps the communities to understand the technologies better which is a form of intangible benefits where it gives impact to the communities.

- **Develop user-friendly interface**

By creating a more user-friendly interface, the data collection procedure can be made simpler for participants, who will be able to submit their information without help from MBIP staff. They will be more willing to provide their information as such. As a result, MBIP is no longer required to offer kiosks in order to assist clients. Thus, this contributes to tangible benefit where cost can be saved during the process of gathering information from the communities. In addition to attracting in new users, the creation of an interface that makes research easier to

browse and more enjoyable to use encourages existing users to continue their digital explorations.

- **Create more efficient information gathering method**

Enhancing participation rates and motivating individuals to participate in low-carbon initiatives can be achieved by simplifying and optimising the data input process and concentrating on acquiring crucial information about the initiatives' objectives. This will also improve the accuracy of the data collected.

- **Giving more incentive for participation**

After data submission is successful, MBIP can provide participants with an electronic digital certificate as a way to recognise their hard work. However, as a sign of gratitude, MBIP can also think about reducing taxes for the factories that are collaborating to the best potential possible. Rewarding survey respondents will make it easier to reach audiences that are typically difficult to approach. The National Centre for Biotechnology Information (NCBI) states that reward-based approaches to boost response rates have been around for a while. Indeed, a monetary incentive increased the likelihood that participants would return a completed or partially completed questionnaire, according to their analysis of 49 research (Mahmutovic, 2020).

5.0 Objectives

1. Boost the effectiveness of the data collection and analysis process to get the best results and dependable output. Measuring carbon emissions and creating plans for future action are crucial tasks.

2. Boost community involvement in lowering carbon emissions and increase awareness by using a more user-friendly method. People will participate at a much higher rate when the system is appropriate and dependable because easy navigation and a user-friendly interface save search time and boost user confidence using it

3. Making the transition from manual to automated data collecting and computation will simplify the process, minimize human error, and provide reliable and secure data integrity. Thus, eliminating human mistakes brought on by physical labour will provide us details that are more accurate.

4. The utmost level of safety and security are provided for participant information to protect user privacy and data security when gathering and processing data to prevent theft and misuse.

6.0 Scope

1. **Data Collection Enhancement**

   Increase the current data collection method to make it more accessible, accurate, and user-friendly for a variety of community categories, such as homes, businesses, and educational institutions.

2. **System Development**

   Provide an effective software platform that can efficiently manage and evaluate gathered data to produce reports on energy usage, waste disposal, carbon emissions, and other sustainability indicators.

3. **User Interface and Engagement**

   Create user-friendly interfaces and strategies for engagement that are easy to use and welcoming to encourage feedback, ongoing involvement, and active participation from various user categories.

4. **Implementation and Deployment**

   Set up the developed system in the Iskandar Puteri region's designated areas, making sure that it works smoothly and functions well for everyone involved.

5. Testing and Optimization

   To improve the system, fix any bugs, maximise performance, and improve user experience, conduct thorough tests, gather feedback, and make iterative changes.

7.0 Project Planning

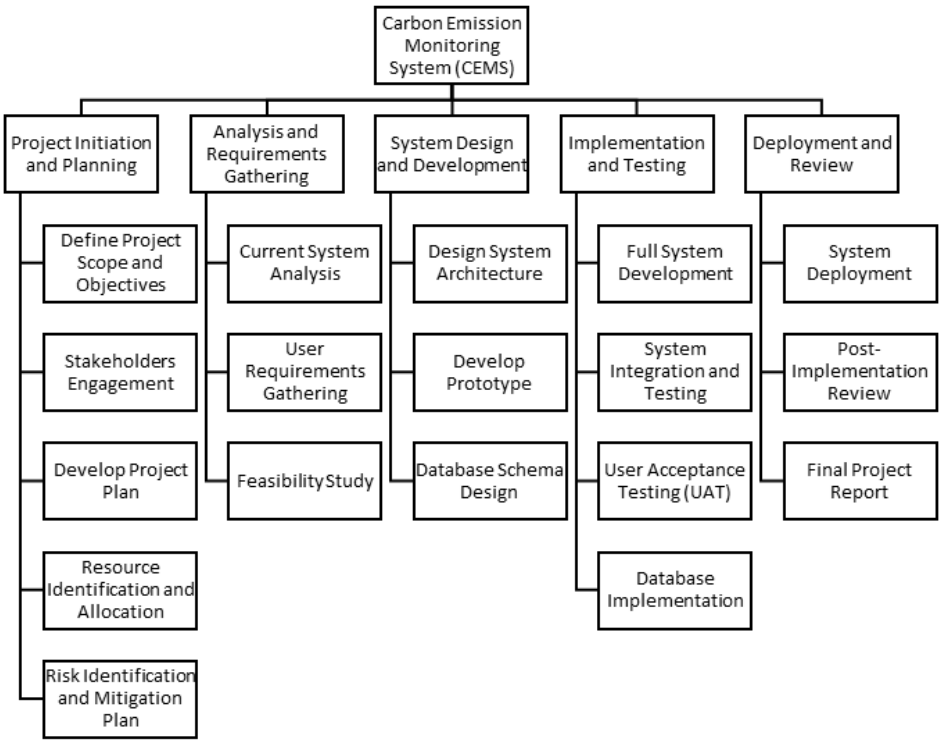
7.1 Human Resource

The project team comprises the following members who bring diverse expertise and skills essential for the successful execution of project tasks:

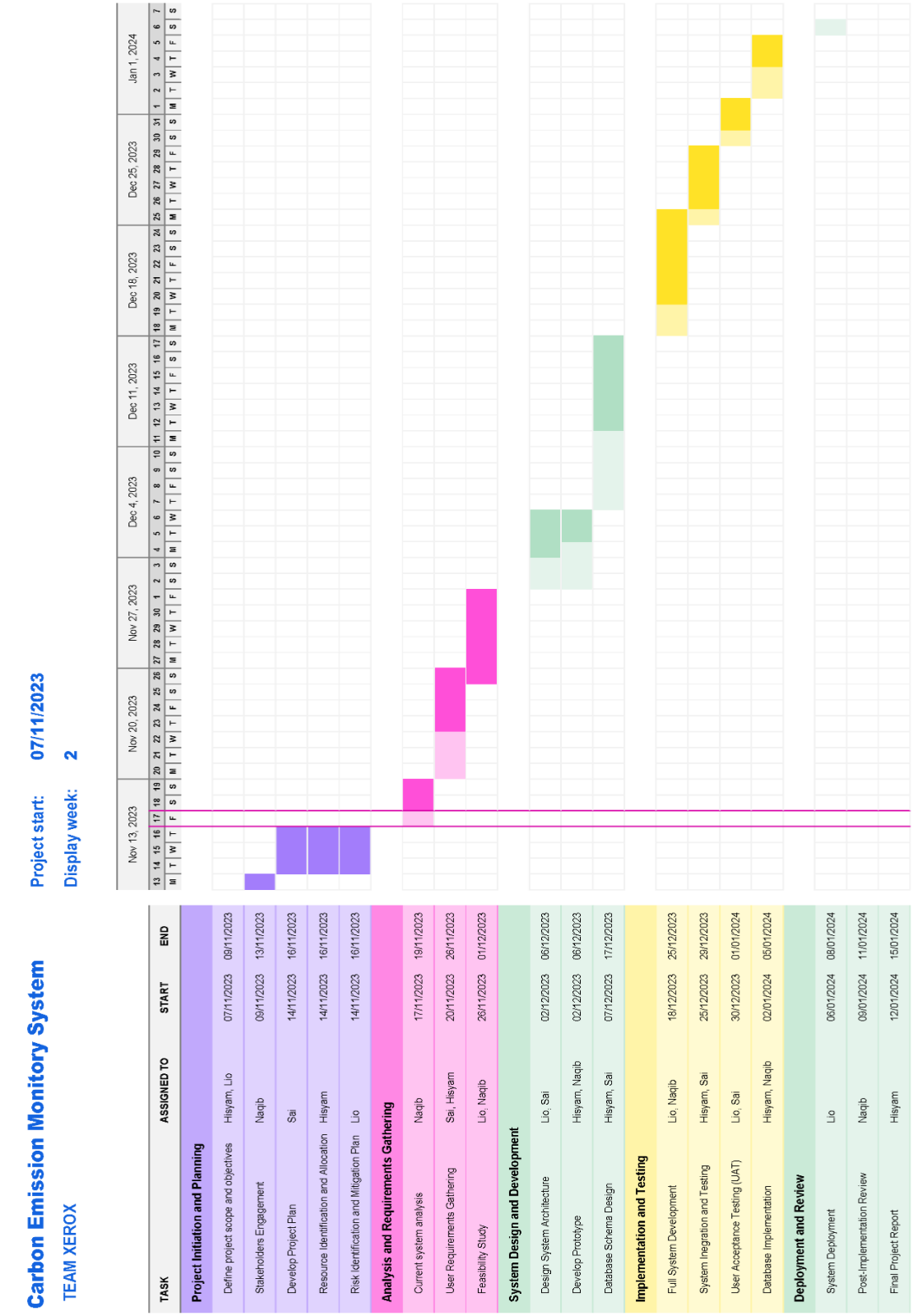
1. Lio Kock Hock
2. Ahmad Saifudin Bin Nardi Susanto
3. Hisyamuddin Firdaus Bin Hamzah
4. Naqib Azim Bin Shaun

Each team member's role, expertise, and contributions have been carefully considered to ensure a comprehensive coverage of the necessary skills and knowledge required to accomplish the project objectives.

7.2 Work Breakdown Structure (WBS)



7.3 Gantt Chart



8.0 Requirement Analysis

- **User Requirements**

  In the context of the database, the user shall be able to store, retrieve and manage information in the Carbon Emission Monitoring System (CEMS). The user can store personal information in the database system in order to access the remaining services offered by the system. Other than that, the user is required to enter information about their waste management, electricity bills and water bills to use the system services.

  The user should be able to retrieve useful information from the database system such as the carbon emission in the vicinity of the Iskandar Puteri area and analysis made by the experts to mitigate the effect of climate change.

  The user should also be able to manage their personal information such as their name, email, password and profile. This manageable information can be updated by the user and it will be stored in the database system.

- **Functional Requirements**

  As for the functional requirements, the database system is expected to perform operations and transactions of data in accordance with the functions set by the stakeholders. The database system functions as a storage and medium of data transactions between the user and the system.

  The database system shall be able to store users' personal information, users' bills, users' waste management data, carbon emission data, geographical data and other related data.

The database system shall be able to perform transactions of data between the user and the system that is whenever the data entered by the user shall be able to be stored in the database system.

- **Non-Functional Requirements**

The non-functional Requirements will primarily focus on the constraints aspects of the database system which are the performance, security and reliability. The database system is expected to perform the tasks with minimal errors and downtime.

The database system shall be able to maintain its optimal performance all the time during the system uptime. The database should be able to handle huge amounts of data with minimal throttling and crash.

Other than that, the database should be equipped with security to ensure that the data stored in the database is safe from any outside interventions and data leakage.

The database system shall also be reliable in performing its tasks such as storing data, exchanging data and maintaining a connection with the Carbon Emission Monitoring System (CEMS) all the time.

- **Data Requirements**

In data requirements, the definition of relations, data that will be stored in the relations and its datatypes will be scrutinized further for the ease of implementing the system in the future and provide guidelines for the readers about the database system and its data.

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The database will contain 4 relations each of which will store its corresponding data which are the residents, the system administrator, the environmental status and the carbon emissions.

For the resident's relations, it will store data regarding the personal information of the residents such as names, e-mail and passwords and also data about their bills and waste management.

For the system administrator's relations, it will store data about the login credentials of the system administrator such as usernames and passwords
and roles.

As for the environmental status relations, its primary job is to store the status of the environment within a certain area of the Iskandar Puteri and the expert's analysis of the environment status.

Last but not least, the carbon emissions relations will store data that are used in the calculation and estimating the carbon emissions within the vicinity of the Iskandar Puteri which are the residents' electricity bills, water bills and waste management.

8.1 Current Business Process

1. **Data Collection**

   The data collection is primarily performed by the database system. The database system shall be able to receive input from the user such as the personal information of the user, water bills and electricity bills and automatically store the data into its designated relations in the database.

2. **Data Transaction**

   The database system shall be able to perform data transactions between various system applications that are integrated into the database system. Some of the data such as the electricity bills, water bills and waste management are crucial for certain integrated applications to process and function as intended, therefore, the database must be able to perform the data transaction flawlessly.

3. **Presentation of the data**

   The database system should be able to present the data in an organized manner which follows the data requirements specifications. The data must be stored according to their assigned relations such as names and passwords must be stored in the users' relations.

4. **Backup and Recovery**

   Redundancy for the database is a crucial part of a business process in order to mitigate the effect of any catastrophic failures that happen during the use of the database system as well as recovery. The system administrator is responsible for doing a backup for the database regularly and storing the backup data in safe storage.

5. **Data Security**

   The system administrator is also responsible for providing sufficient security to the database system to safeguard the data stored in the database.

9.0 Transaction Requirements

1. **Data Collection Transactions**
    a. **Electricity Usage Records**

    Users need to be able to enter information about their monthly electricity usage, including readings from metres or electricity bills. Details such as the total units consumed, the billing period, and the tariff rates should all be recorded by the system.

    b. **Water Usage Records**

    Being able to enter information about monthly water usage, such as billing statements or water meter readings. Consider information such as water tariff rates, billing cycle, and total cubic metres used.

    c. **Waste Management Records**

    It is recommended that users maintain a record of all waste management activities, including the types, quantities, and disposal methods (recycling, landfill, organic waste, and recyclables).

    d. **Cooking Oil Consumption Records**

    Collect data on how much cooking oil is used and disposed of, as well as the amounts that are recycled, the disposal techniques used, and any important programmes that support oil recycling.

2. **Data Validation and Authentication Transactions**
    a. **Data Verification**

    Being able to verify data entry accuracy to ensure accurate inputs and prevent false or misleading data. It can check for logical integrity and consistency of the data to avoid inconsistencies.

    b. **Data Authentication**

Ability to authenticate user submissions or entries in order to verify the accuracy and legitimacy of the data that has been provided. Utilize administrator validation or user authentication methods.

3. **Calculation and Reporting Transactions**
    a. **Carbon Emission Calculation**

    Based on data entered for waste, water, electricity, and cooking oil consumption, the system should calculate carbon emissions. It will determine the reduction metrics using environmentally friendly methods or programmes.

    b. **Annual Performance Reporting**

    Create yearly performance reports that include a summary of the carbon footprint, reduction goals attained, and a comparison with goals or standards. Provide reports that are appropriate for stakeholder presentations and user comprehension.

4. **User Engagement Transactions**
    a. **User Feedback and Interaction**

    Allow users to comment on how was their experience using the system, what problems they encountered, and what could be improved. Create a channel of communication for user questions and help requests.

5. **Data Archival and Retention Transactions**
    a. **Data Retention Policies**

    Define data retention periods to ensure historical records availability for trend analysis, compliance, or future references. Implement archiving mechanisms for storing older data securely.

10.0 Benefit and Summary of Proposed Solution

- **Reduction in energy consumption**

  Reduction in energy consumption within the Iskandar Puteri vicinity could be achieved through the implementation of the proposed system due to increasing awareness among the residents in the Iskandar Puteri area. The Carbon Emission Monitoring System regularly monitors, analyzes and presents the data in a simplified and easy-to-understand way as the residents in the Iskandar Puteri are also one of the target audiences for our system. Therefore, the residents could easily access the carbon emission data and with it, it could increase the awareness of the residents to save up energy in order to inhibit the production of carbon emission and at the same time, drastically reduce the energy consumption in the Iskandar Puteri area.

- **Reduction in waste management cost**

  Reduction in the waste management cost is also one of the significant benefits achieved through implementing the Carbon Emission Monitoring System (CEMS) by increasing residents' awareness of managing their waste to greatly reduce their carbon footprints. One of the key factors in calculating the carbon footprint released to the environment other than energy consumption is waste production. By managing their waste production, the MBIP could cut the cost of waste management by recycling some of the materials to raise potential revenue from the recycled materials and at the same time, benefit the environment by reducing the carbon emission in the Iskandar Puteri area.

- **Improved quality of life**

  One of the aims of reducing carbon emissions through the implementation of the Carbon Emission Monitoring System (CEMS) is to improve the quality of life in

the Iskandar Puteri area. The awareness of the importance of a sustainable environment and ecology could be spread through the presentation of the carbon emission data through the system. With it, MBIP could build a sustainable society with clean and healthy living environments, therefore, increasing the quality of life in the Iskandar Puteri area.

- **Benefits the environment**

  The implementation of the Carbon Emission Monitoring System (CEMS) could significantly benefit the environment in the long-term period. Reducing carbon emissions could lead to improved air quality, a cleaner environment, less greenhouse gas emitted and contribute to combating climate change by regularly reminding the residents to lead a sustainable life through the proposed system.

The construction of the Carbon Emissions Monitoring System (CEMS) and the integration of a database system serve as a solution proposed by the MBIP with an aim to reduce the carbon emissions in the surrounding of the Iskandar Puteri area. The system was used for the data collection and analysis to map the presence of the carbon emissions released into the atmosphere within the vicinity of the Iskandar Puteri.

With it, MBIP plans to increase awareness among the residents and people in the Iskandar Puteri area to be conservative by reducing their electricity and water usage and also managing their waste to reduce their daily carbon footprints. The MBIP believe that the actions of the people could have an immediate effect on the reduction of carbon emissions as well as leading to the emergence of a healthy environment within the Iskandar Puteri area.

11.0 Summary

The proposed solutions made by the MBIP to construct a platform for the data collecting and analysis of the carbon emissions in the vicinity of the Iskandar Puteri area will prove beneficial to the overall environment as well as to help combat the ongoing climate crisis.

The database system integrated into the Carbon Emissions Monitoring System (CEMS) is implemented primarily to assist the system in performing its functionalities by providing services to it.

The implementation of the Carbon Emissions Monitoring System (CEMS) could increase the awareness of the surrounding people to take care of our environment by reducing their daily carbon footprint by managing waste, reducing electricity and water usage and also being mindful of our actions as they could significantly affect the environment.

Therefore, without immediate actions from the surrounding residents and authorities, the Iskandar Puteri could not achieve a reduction in carbon emissions and the green status of the environment. Hence, to cause an action, one must open their eyes to the problems and with the system, we hope to achieve an immediate effect on the surroundings by spreading awareness to others that it is our responsibility to take care of our environment.

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