UTM
UNIVERSITI TEKNOLOGI MALAYSIA

School of Computing
Faculty of Engineering

SECD2523 – DATABASE

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PHASE 2 - DATABASE CONCEPTUAL DESIGN (ERD)

<Carbon Reduction and Sustainability Engagement System>

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1.0 INTRODUCTION

This project explores the sustainability efforts that Malaysia has made, mainly concentrating on the Low Carbon Blueprint for Iskandar Malaysia 2025 and the Low Carbon Cities Framework (LCCF). By 2025, the target is to reduce carbon intensity by 58 percent from the baseline of 2005 levels. To raise awareness and promote the adoption of low carbon emission practices, the Malaysian government, more specifically in the Johor state has launched a number of initiatives. These include the Iskandar Malaysia Ecolife Challenge (IMELC) programme, the Johor Education Department's (JPNJ) e-Lestari system, and the Iskandar Puteri City Council's (MBIP) Iskandar Puteri Low Carbon (IPRK) initiative.

One of the main initiatives supporting the Low Carbon Society (LCS) in the Iskandar region is MBIP's IPRK initiative, which gathers information about community energy-saving activities. Among the projects included in this programme is the Iskandar Puteri Low Carbon Calendar Competition. However, there are issues with the existing data gathering approach, including a laborious entry process, a need for comprehensive participant information, and manual carbon reduction calculations.

The development of an automated data gathering and analysis system akin to the successful e-Lestari system executed by the Johor Education Department (JPNJ) is the most optimal solution that emerges to meet the current quandaries. This method is meant to cover a variety of community groupings, such as individuals who reside in multistory homes or landed property, institutions, MBIP divisions, and MBIP employees. This suggested data gathering and analysis system's main feature is a trustworthy computation process that determines carbon reductions for the usage of water, electricity, garbage, and repurposed frying oil. The ability to detect regions with significant carbon dioxide emissions—which includes a dashboard that allows users to self-monitor their carbon emissions—is another crucial component of the suggested system. Implementing the system in Bahasa Melayu, the national language, will ensure that all local users understand it.

The document highlights the potential for these solutions to enhance the Iskandar Puteri Low Carbon Calendar Competition in addition to providing a thorough outline of them. A self-monitoring dashboard for users is among the new dashboards that offer real-time insights into participants' carbon contributions. The Iskandar Puteri City Council (MBIP) is the client in this instance. They anticipate accurate cost estimates, technical viability, and clarity on suggested solutions. In addition, customers want a clearly defined schedule with quantifiable benchmarks and results, including improved data quality and higher engagement. This document functions as a thorough and complete plan to meet these goals and improve the Iskandar Puteri Low Carbon Calendar Competition's efficacy.

2.0 DFD (TO-BE)

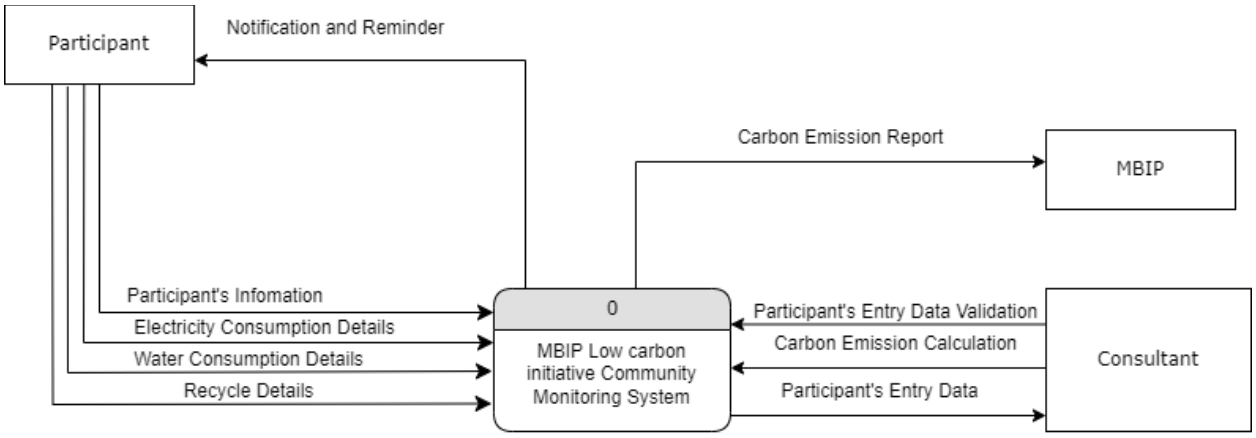


Figure 4.4.1 : Context Diagram of MBIP Low Carbon Initiative Monitoring System

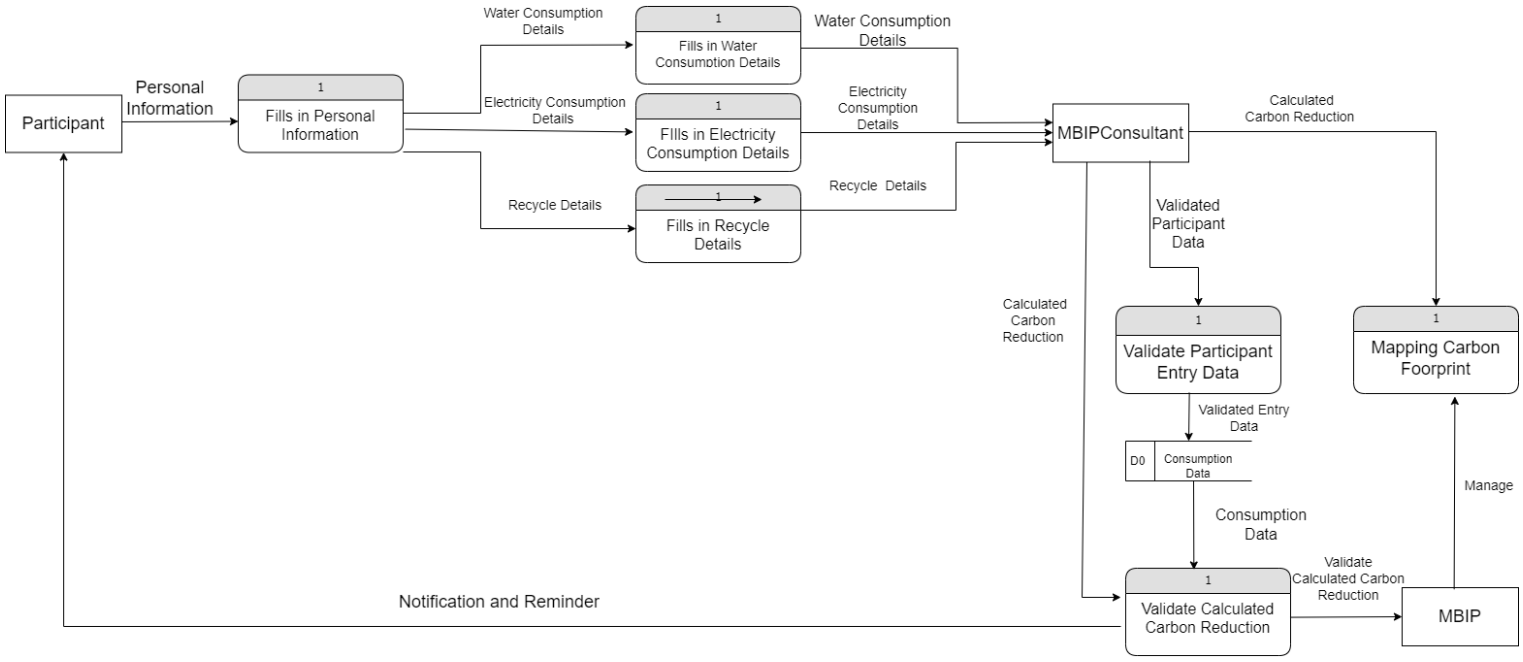


Figure 4.4.2 : Level 0 Diagram of MBIP Low Carbon Initiative Monitoring System

3.0 DATA & TRANSACTION REQUIREMENT

1. **User-unfriendly data entry process**
   When the Iskandar Puteri Low Carbon Calendar Competition was introduced, Majlis Bandaraya Iskandar Putri (MBIP), the stakeholder, found that the data entering process was laborious a

3.1 PROPOSE BUSINESS RULE

The business rule for the Carbon Reduction and Sustainability Engagement System :

1. One participant provides at least one consumption data
2. At least one consumption data are provided at least one participant
3. Each participant receive result of carbon footprint data at least one
4. Each carbon footprint data are receive result of by at least one participant
5. Each consumption data can be converted to one carbon footprint data
6. Each carbon footprint data converted to one consumption data
7. One MBIP town dept manage one CFM mapping
8. Each CFM mapping can be manage by more than one MBIP town dept
9. One MBIP town dept manage one carbon footprint data
10. Each carbon footprint data can be manage more than one by MBIP town dept
11. Each MBIPConsultant can validates one carbon reduction to be used in CFootprintMapping
12. Each CarbonReduction can be validate at least one MBIPConsultant that can be used in CFootprintMapping
13. Each CFootprint that have been validates by at least on MBIPConsultant have at least one CarbonReduction data.

3.2 PROPOSED DATA & TRANSACTIONAL REQUIREMENT

3.2.1 PROPOSED DATA

Participant

The information of participants are participant number, name, telephone number, and address are stored as data.

Electrical Consumption

When a participant fills in their electrical consumption data, the information is stored. The data has a bill reference number, total electrical consumption and price.

Water Consumption

When a participant fills in their water consumption data, the information is stored. The data has a bill reference number, total water consumption and price.

Recycling Collection

When a participant fills in their recycling collection data, the information is stored. The data has a recycling report, recycle details and weight.

Carbon Reduction Result

Carbon reduction result is the calculated carbon emission of a participant. The data of carbon reduction results are total carbon emission and emission rate.

Carbon Reduction Report

Carbon reduction report is the summarized data from the participants' carbon reduction result. The data of the carbon reduction report are total reduction index and emission level.

Winner

After the carbon reduction report is analyzed, the winner is decided. Winner data includes name, reduction index, emission level and rank.

3.2.2 TRANSACTIONAL REQUIREMENT

Data Entry

- Enter the details for participants
- Enter the details for electrical consumption
- Enter the details for water consumption

- Enter the details for recycling collection

Data Update/Deletion

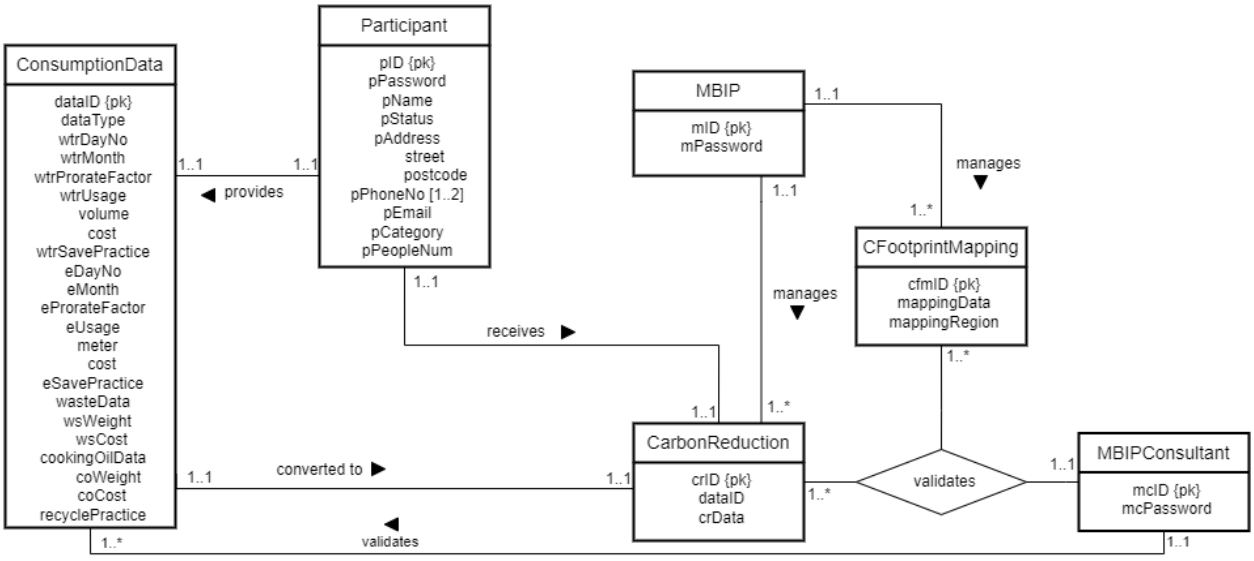
- Update/deletion the details of participants
- Update/deletion the details of electrical consumption
- Update/deletion the water consumption
- Update/deletion the recycling collection
- Update/deletion the winner of competition

Data Queries

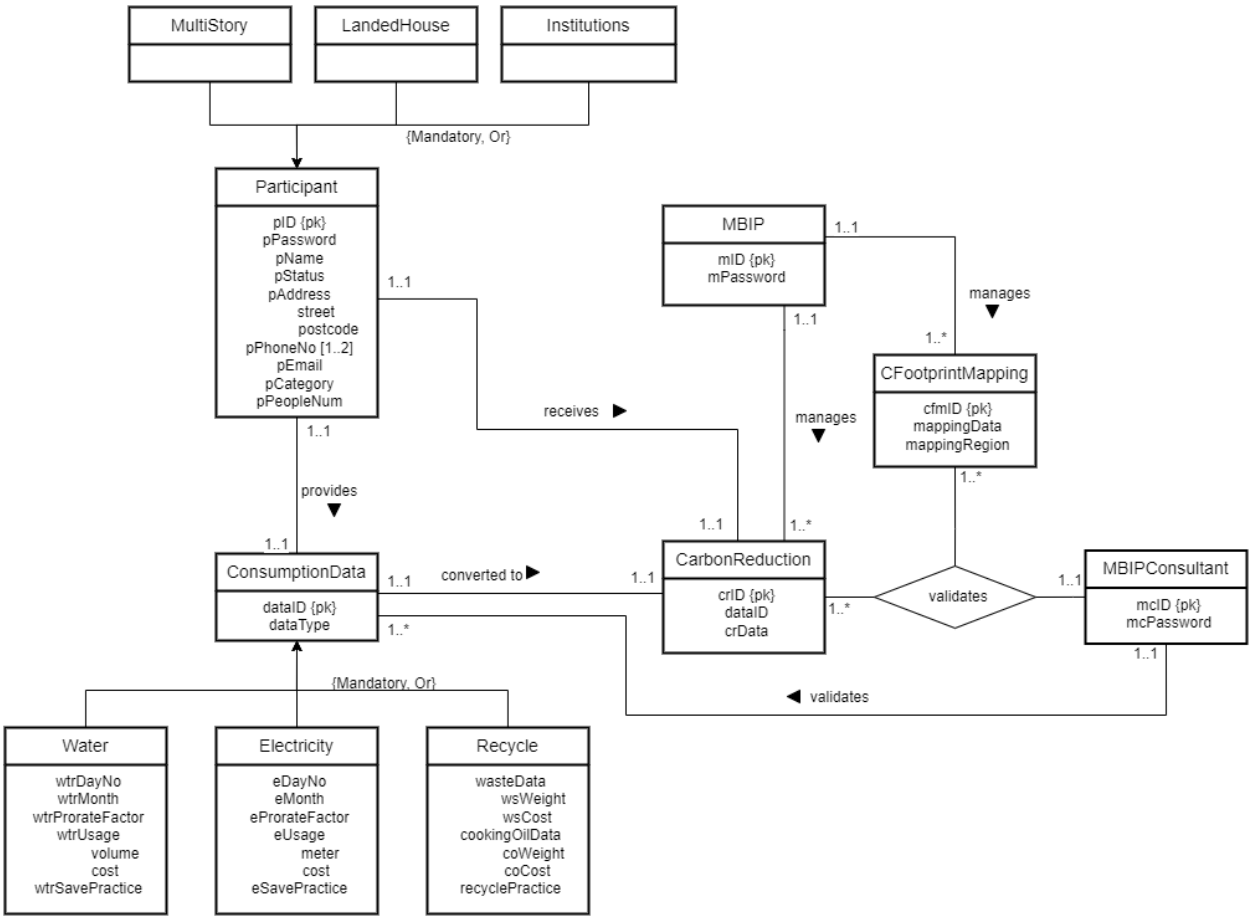
- List details of electrical participant
- List details of electrical consumption
- List details of water consumption
- List details of recycling collection
- Identify the winner of competition
- List details of winner
- Identify the carbon reduction result of a participant
- Identify the carbon reduction report of a participant
- Display the carbon reduction result of a participant
- Display the carbon reduction report of a participant

4.0 DATABASE CONCEPTUAL DESIGN

4.1 CONCEPTUAL ERD



4.2 ENHANCE ERD (EERD)


MultiStory
LandedHouse
Institutions
{Mandatory, Or}
Participant
pID {pk}
pPassword
pName
pStatus
pAddress
street
postcode
pPhoneNo [1..2]
pEmail
pCategory
pPeopleNum
MBIP
mID {pk}
mPassword
manages
CFootprintMapping
cfmID {pk}
mappingData
mappingRegion
receives
provides
ConsumptionData
dataID {pk}
dataType
converted to
CarbonReduction
crID {pk}
dataID
crData
validates
MBIPConsultant
mcID {pk}
mcPassword
{Mandatory, Or}
Water
wtrDayNo
wtrMonth
wtrProrateFactor
wtrUsage
volume
cost
wtrSavePractice
Electricity
eDayNo
eMonth
eProrateFactor
eUsage
meter
cost
eSavePractice
Recycle
wasteData
wsWeight
wsCost
cookingOilData
coWeight
coCost
recyclePractice

5.0 DATA DICTIONARY

The primary goal of this suggested solution is to provide a platform for data gathering and analysis that is akin to

Entity	Description	Aliases	Occurrence
MultiStory	Participants live a multistorey house	Multi-Storey house	Each multistorey house are live by one participants
LandedHouse	Participants live in a landed house	Land house	Each landed house are live by one participants
Institutions	Participants live in institution	College	Each institution are live by at least one participants
Participant	Holds participant information	Consumer	Participants receive carbon reduction data.Participants provides consumption data
ConsumptionData	Hold consumption data	Data Consumption	Every consumption data are converted to one carbon reduction data
Water	Hold participant water consumption	Water	Every water consumption data from each participants must store at consumption data
Electricity	Holds participant electricity consumption	Electricity	Every electricity consumption data from each participants must store at consumption data
Recycle	Holds participant	Recycle	Every recycle

	recycle consumption		consumption data from each participants must store at consumption data
CarbonReduction	Calculate carbon reduction from the consumption data	Carbon Reduction	Consumption data,participant and MBIP town department are been collected at carbon reduction
MBIP	MBIP manages carbon reduction data and CFootprintMapping	MBIP	MBIP manages carbon reduction data and CFootprint Mapping
CFootprintMapping	CFootprintMapping validates by MBIPConsultant	Carbon Footprint Map	CFootprint Mapping are been validates by carbon reduction data and MBIP consultant
MBIPConsultant	Process on validate the information	MBIP Consultant	MBIP consultant validates Carbon reduction and CFootprint Mapping

Entity Relationship

Entity 1	**Multiplicity**	**Relationship**	**Entity 2**	**Multiplicity**
Participant	1..1	provides	ConsumptionData	1..1
	1..1	receives	CFootprintMapping	1..1
ConsumptionData	1..1	converted to	CarbonReduction	1..1
MBIPConsultant	1..1	validates	ConsumptionData	1..*
	1..1	validates	CarbonReduction	1..*
			CFootprintMapping	1..*
MBIP	1..1	manages	CarbonReduction	1..*

	1..1	manages	CFootprintMapping	1..*

Entity Attributes

Entity	Attribute	Description	Data Type & Length	Constraint
Participant	pID	Participant’s ID	VARCHAR2(15)	PRIMARY KEY
	pPassword	Participant’s password	VARCHAR2(20)	NOT NULL
	pName	Participant's full name	VARCHAR2(25)	NOT NULL
	pStatus	Participant’s employment status	VARCHAR2(15)	NOT NULL
	pAddress	Participant’s address		
	street	Participant’s street name for pAddress	VARCHAR2(30)	NOT NULL
	postcode	Participant’s postcode for pAddress	VARCHAR2(5)	NOT NULL
	pPhoneNo [1..2]	Participant’s phone number(s)	NUMBER(11)	NOT NULL
	pEmail	Particpant’s e-mail address	VARCHAR2(20)	NOT NULL
	pCategory	Participant’s community category	VARCHAR(20)	NOT NULL
	pPeopleNum	Participant’s number of people in the household/building	NUMBER(5)	NOT NULL

Consumption Data	dataID	Consumption data's ID	VARCHAR(15)	PRIMARY KEY
	dataType	Consumption data's type/category	VARCHAR(20)	NOT NULL
Water	wtrDayNo	Water bill's days for the month	NUMBER(2)	NOT NULL
	wtrMonth	Water bill's month	NUMBER(2)	NOT NULL
	wtrProrateFactor	Water bill's prorate factor	NUMBER(4)	NOT NULL
	wtrUsage	Water usage for the month		
	volume	Water usage for the month in volume	NUMBER(5)	NOT NULL
	cost	Water usage for the month in cost	NUMBER(5)	NOT NULL
	wtrSavePractice	Participant's practice to save water usage	VARCHAR2(100)	NOT NULL
Electricity	eDayNo	Electric bill's days for the month	DATE	NOT NULL
	eMonth	Electric bill's month	DATE	NOT NULL
	eProrateFactor	Electric prorate factor	DATE	NOT NULL
	eUsage	Electric usage for the month	DATE	NOT NULL
	meter	Electric number for the month in meter	DATE	NOT NULL
	cost	Electric usage for the month in cost	DATE	NOT NULL
	eSavePractice	Participant's practice to save electricity usage	DATE	NOT NULL

Recycle	wasteData	Recycled waste data		
	wsWeight	Recycled waste weight	NUMBER(4)	NOT NULL
	wsCost	Recycled waste profit from collected weight	NUMBER(4)	NOT NULL
	cookingOilData	Recycled cooking oil data		
	coWeight	Recycled cooking oil weight	NUMBER(4)	NOT NULL
	coCost	Recycled cooking oil profit from collected weight	NUMBER(4)	NOT NULL
	recyclePractice	Participant's recycle practice	VARCHAR2(100)	NOT NULL
MBIPConsultant	mcID	MBIP Consultant ID	NUMBER(4)	NOT NULL
	mcPassword	MBIP Consultant login password	VARCHAR(6)	NOT NULL
CarbonReduction	crID	Carbon reduction data ID	VARCHAR2(15)	PRIMARY KEY
	dataID	Consumption data's ID	VARCHAR(15)	FOREIGN KEY, NOT NULL
	crData	Carbon reduction calculated data	VARCHAR2(100)	NOT NULL
CFootprintMapping	cfmID	Carbon footprint mapping ID	NUMBER(4)	NOT NULL
	mappingData	Mapping Data	VARCHAR(15)	NOT NULL
	mappingRegion	Mapping region data	VARCHAR(15)	NOT NULL

MBIP	mID	MBIP ID	NUMBER(4)	NOT NULL
	mPassword	MBIP login password	VARCHAR(6)	NOT NULL

6.0 SUMMARY

System

- **User Registration and Authentication:** Enable users to register and log in to individual accounts including personnel, residents, institutions, and MBIP divisions, ensuring secure access to the site.

- **Mapping Carbon Footprint:** Establish features that allow for the visual representation of carbon emissions across several community types when mapping the carbon footprint within the MBIP region.

- **Carbon Reduction Calculation:** To provide insights into sustainable practices, enable the system to calculate and analyze carbon reductions for waste, water, electricity, and recycled cooking oil use.

- **Self-Monitoring Dashboard:** Create an intuitive self-monitoring dashboard that will help workers, residents, MBIP divisions, and institutions keep track of and comprehend their individual and group carbon emissions by providing real-time data.

- **Localisation support:** Design the platform to operate primarily in Bahasa Melayu, ensuring accessibility and inclusivity for the local community.

Users

- **Residents:**
    - Permit citizens to see and comprehend their carbon footprint.
    - Permit locals to submit data on their use of recycled cooking oil, water, electricity, and garbage.
    - Give residents a way to voice their concerns and efforts related to sustainability through a feedback mechanism.

- **MBIP staff:**
    - Permit access to extensive data on sustainability initiatives for MBIP staff members.
    - Give employees tools to organise and interact with citizens, organisations, and other stakeholders.
    - Assist MBIP personnel in making evidence-based decisions by facilitating data analysis

8.0 REQUIREMENT ANALYSIS

Stakeholders:

1. Iskandar Puteri City Council (MBIP):

- Responsible for implementing the IPRK initiative and monitoring the entire process.
- Requires efficient data collection, analysis, and reporting to measure the success of the initiative.
- Needs a good system to get as many participants as possible.

2. Residents:

- The contributors of data on energy-saving efforts.
- Need a user-friendly and easy-to-use platform for data submission.

3. Institutions:

- Participants in the initiative, contributing data on energy-saving practices.
- Require a platform that integrates seamlessly with their operational processes.

4. Factories:

- Contribute to energy-saving efforts and may have specific data related to their industrial processes.
- Require a platform that allows them to efficiently report their contributions to the low carbon initiative.

Functional Requirements:

1. User Registration:

- Residents, institutions, MBIP staff and factories should be able to register easily for the IPRK initiative platform.

2. Data Submission:

- Participants should have a good and user-friendly interface for submitting data required for the initiative.

3. Automated Calculations:

- The system should calculate carbon emission based on the data submitted by participants automatically rather than manual labor.

4. Real-time Reporting:

- Generate real-time reports on carbon footprints and energy-saving efforts.
- Provide MBIP with visualizations of the data gathered.

5. Dashboard:

- Implement a self-monitoring dashboard for MBIP to track progress and receive insights.

7. Compatibility:

- Ensure the platform is compatible with various devices and browsers for accessibility.

8. Security:

- Ensure security measures to protect participant data and privacy from misuse.

Non-functional Requirements:

1. Performance:

- The platform should perform efficiently, providing quick responses to user interactions.

2. Scalability:

- The system should be scalable to handle a growing number of participants and increasing data over time.

3. Reliability:

- The platform should be reliable, minimizing downtime and ensuring data integrity.

4. Usability:

- The user interface should be intuitive and easy to navigate, catering to users with varying technical proficiencies.

Constraints:

1. Budget Constraints:

- Develop the platform within an expected budget to ensure cost-effectiveness.

2. Timeline Constraints:

- Complete the development and implementation of the system according to a planned dateline.

Assumptions:

1. Participant Engagement:

- Assume that participants will engage with the platform willingly sharing their personal data.

2. Data Accuracy:

- Assume that the data entered by participants is accurate and legit based on their consumption.

3. User-friendly Interface:

- Assume that participants will be able to submit their data with easy

8.1 CURRENT BUSINESS PROCESS

The current business process of MBIP is promoting the Low Carbon Society (LCS) as well as managing the energy saving electricity and energy consumption.

1.Data Collection

The database system must have the capability to execute data transactions among different system applications that are integrated into the database system. Certain integrated applications rely on important data, such as electricity bills, water bills, and waste management, in order to operate effectively. As a result, it is essential for the database to flawlessly carry out the data transactions.

2. Data Transaction

Currently, the gathering of data is done through a Google Form in a manual manner. Individuals are required to provide in-depth information about their energy-saving practices, including details about their energy consumption. The act of manually inputting this data can be tiresome and may pose challenges for participants, especially because of the extensive amount of information that is being asked for.

3.Carbon Reduction Calculations

MBIP conducts manual calculations by analyzing the data provided by participants to evaluate their accomplishments in reducing carbon emissions. These calculations encompass a thorough examination of various factors such as electricity usage, water consumption, waste management, and the utilization of recycled cooking oil. Through this meticulous evaluation, MBIP can estimate the amount of carbon emissions that correspond to these activities.

4.Data Presentation

In order for the database system to be effective, it is necessary for it to possess the ability to present data in a manner that is both well-organized and structured. This entails ensuring that the data is stored in a way that aligns with its designated relations, such as storing user-related information in the appropriate users' relation. By upholding proper organization and adhering to the specified data requirements, the database system can efficiently manage and retrieve information in a manner that is both meaningful and efficient.

5.Data Backup and Recovery

Having redundancy in your database is essential for keeping your business running smoothly. It's mainly because it helps protect you from major system issues that could cause problems with your database. It also makes it easier to get your data back if something goes wrong. It's up to your system admin to make sure you're doing regular backups of your database and keeping the backup info safe.

6.Reporting and Analysis

MBIP uses data from participants and calculates how much they've saved to create detailed reports. These reports give us an idea of how much the whole community has saved. We can use these reports to see how well our programs are doing and what needs to be improved. These reports are really important because they help us measure how successful our energy-saving efforts are and set us up for success in the future.

7.Security Data

It's really important to keep your data safe and secure if you want to keep your business running smoothly. You need to make sure your system has strong security measures in place, like authentication, controls on who can access it, and encryption. This will make sure that only the right people can see and change the data, and show that your company is serious about protecting it and following the law.

9.0 TRANSACTION REQUIREMENT

9.1 Data Entry

- **Enter the information for user's registration:**
  Users register their account authorization (technical admin, community, MBIP)
- **Enter the type/category of user:**
  Users choose their community category (residents, institution, MBIP divisions/staff)
- **Enter the user's information:**
  Users input their required information
- **Enter the type of data to be provided:**
  Users choose the type of data to provide for the system (consumption of electricity, water, waste, recycle cooking oil consumption)
- **Enter the detailed information for carbon-related domestic consumption:**
  Users provide relevant records/documents data related to carbon emissions based on their choice of data type, such as energy usage, consumption habits, and other related activities

- **Enter the detailed information for CO2 emissions:**
  Users enter the detailed data related to CO2 emissions, to support their provided data

9.2 Data Update/Delete

- **Update/delete the details of user profile:**
  Enable all categories of users to modify the informations of their respective account profile, and allow admin to manage the information of all users' profile
- **Update/delete the details of MBIP region's carbon footprint mapping:**
  Allow admin/MBIP staff to manage the carbon footprint data within the MBIP region
- **Update/delete the information previously provided by users:**
  Enable users to modify their data they provided within a certain duration and allow admin/MBIP staff to manage the data provided by the community
- **Update/delete the details of analyzed data provided by users:**
  Allow MBIP staff/A.I. to analyzed the data provided in certain manners to create statistics for regional carbon footprint mapping, dashboard and to determine communities with high CO2 consumption
- **Update/delete the information of calculated carbon reductions:**
  Allow A.I. to automatically calculated the carbon reductions based on data provided by the community to be included in the analyzed data
- **Update/delete the details of communities with high CO2 consumption:**
  Allow MBIP staff/A.I. to identify and determine the communities with high CO2 consumption based on the analyzed data, and promptly alert the users of that community regarding that matter
- **Update/delete the details on the user's carbon emissions dashboard:**
  Enable all users to manage their self-monitoring dashboard for carbon emissions among users

9.3 Data Queries

- **List detailed information of user profile:**
  Display to users the information of their respective account profile, and display to admin/MBIP staff the information of all users' profile
- **List detailed information of user's carbon footprint analysis:**
  Display to users the analyzed data of respected users' carbon footprint, and display to admin/MBIP staff all users analyzed data
- **List of detailed information of user's consumption history and trends:**
  Display to users their respective previous carbon usage that can be viewed by choosing desired timeframe, and display to MBIP staff all users' previous carbon usage

- **List of detailed information of user's overall carbon emissions data:**
  Provide to users their respective analyzed data of carbon emissions, and provide to MBIP staff the analyzed data of all users' carbon emissions and overall carbon emissions data based on community categories and regions
- **List detailed information of MBIP region's carbon footprint mapping:**
  Provide to admin/MBIP staff the regional mapping of the carbon footprint of the community within the MBIP region
- **List detailed information of user's carbon emission dashboard:**
  Provide to all users the detailed data and insights on the user's carbon emission dashboard

12.0 REFERENCE

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