UTEM CARBON EMISSION ESTIMATION SYSTEM (CEES)

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JUDUL: **UTEM CARBON EMISSION ESTIMATION SYSTEM (CEES)**

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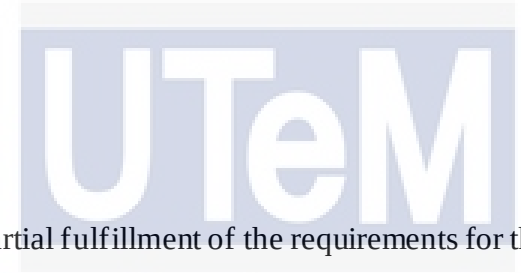

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DEDICATION

I would like to express my wholeheartedly dedication to my beloved parents, who gave me strength during this project development by contributing moral, spiritual, emotional and financial support. Next, I would like to dedicate my project supervisor and friends who have been the source of inspiration and gave me support during conducting this project.

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ABSTRACT

Carbon emission means the process of carbon especially carbon dioxide (CO2) that releases at the atmosphere. Due to the industrial revolution, the carbon emission level in our earth had increases from year to year. The high amount of carbon emission had led to many bad affects to earth such as global warming or greenhouse effect. To monitor energy consumption and carbon emission in UTeM from electricity usage, KPKA requires a system that can calculate energy consumption and estimate carbon emission of each building in UTeM. The process of calculating energy consumption and estimating carbon emission are large work and complicated. Human errors may occur by calculating in manual which will make the result inaccurate or has large different from actual estimation. Furthermore, KPKA needs to produce carbon emission summary report for each building and hand in to each energy monitoring department monthly. It is time consuming if the report is produced by manual and the contents may not be interesting. To overcome these problems, this project is a proposed solution for them. By developing UTeM Carbon Emission Estimation System (CEES), KPKA can use the system to calculate energy consumption and estimate carbon emission for each building by just importing the energy meter reading datafile from EMIS. The system will alert users if building has low effective of electricity usage that leads to high amount of carbon emission. Management department can make right decision to reduce carbon emission level. Lastly, KPKA not need to spend more time and energy for generating carbon emission summary report which has attractive contents such as chart and graph because it can be done automatically by this system with few finger-clicking.

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ABSTRAK

Pelepasan karbon bermaksud proses pembebasan karbon terutamanya karbon dioksida ke atmosfera. Oleh kerana revolusi industri, tahap pelepasan karbon di bumi kita meningkat dari tahun ke tahun. Jumlah pelepasan karbon yang tinggi telah menyebabkan banyak kesan buruk kepada bumi seperti pemanasan global atau kesan rumah hijau. Untuk memantau penggunaan tenaga dan pelepasan karbon di UTeM dari penggunaan elektrik, KPKA memerlukan sistem yang dapat mengira penggunaan tenaga dan menganggarkan pelepasan karbon dari setiap bangunan di UTeM. Proses mengira penggunaan tenaga dan menganggarkan pelepasan karbon adalah kerja besar dan rumit. Kesalahan manusia mungkin berlaku jika mengira secara manual lalu akan menjadikan hasilnya tidak tepat atau mempunyai perbezaan yang besar dari anggaran sebenar. Selanjutnya, KPKA perlu membuat laporan ringkasan pelepasan karbon untuk setiap bangunan dan menyerahkan laporan kepada setiap jabatan pemantauan tenaga pada setiap bulan. Banyak masa perlu digunakan jika laporan dibuat secara manual dan kandungannya mungkin tidak menarik. Untuk mengatasi masalah ini, projek ini adalah cadangan dan penyelesaian untuk mereka. Dengan membangunkan UTeM Carbon Emission Estimation System (CEES), KPKA dapat menggunakan sistem tersebut untuk mengira penggunaan tenaga dan menganggarkan pelepasan karbon untuk setiap bangunan dengan hanya mengimport data bacaan meter tenaga dari EMIS. Sistem ini akan memberi amaran kepada pengguna jika bangunan mempunyai keberkesanan penggunaan elektrik yang rendah dan menyebabkan jumlah pelepasan karbon tinggi. Jabatan pengurusan dapat membuat keputusan yang tepat untuk mengurangkan tahap pelepasan karbon. Terakhir, KPKA tidak perlu menggunakan banyak masa dan tenaga untuk menghasilkan laporan ringkasan pelepasan karbon yang mempunyai kandungan menarik seperti carta dan grafik kerana ia dapat dilakukan secara automatik oleh sistem ini dengan sedikit klik jari.

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CHAPTER 1: INTRODUCTION

1.1 Project Background

Since the industrial revolution, human source of carbon emission has been growing from year to year. Human activities such as burning fossil oils and natural gas for electricity consumption are the primary cause of increase carbon intensity in the atmosphere. Nowadays, carbon emission issue has been receiving a lot of attention from global. This is because high amount of carbon emission can lead to some bad affects to our earth such as climate change, global warming, rising sea level and so on. In UTeM, there is a department called KPKA (Pejabat Keselamatan Pekerjaan Dan Kelestarian Alam Sekitar). One of the objectives of KPKA is to promote environmental conservation for designing a sustainable campus development. To reach this objective, KPKA needs to know the amount of carbon emission from electricity usage in UTeM so that they can take actions on the buildings to reduce the pollution by reducing carbon emission. Recently, KPKA has an energy monitoring system called EMIS which is used to collect electricity data from each building in UTeM by sensors such as energy meter reading, voltage, current and power. But the current system did not have modules to calculate energy consumption and estimate carbon emission from the electricity data. In every month, KPKA have to import the energy meter reading datafile from EMIS for calculating energy consumption and estimate carbon emission of each building by using Microsoft Excel. It is time consuming for carry out the processes and human error may lead to inaccurate result. Therefore, the purpose of this project is to develop a system that can calculate energy consumption (kWh) by importing the energy meter reading datafile from EMIS. Later, the system will estimate the daily carbon emission for each building with carbon intensity and energy consumption. Users also can input dynamic daily

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carbon intensity value so that the carbon emission estimation result can be more accurate. If users did not input carbon intensity value for a day, the system will generate carbon intensity value for that day. After carbon emission estimation process is completed, the system will rank the carbon emission level for each building after estimating total carbon emission. If the carbon emission of a building had reached a certain level, the system can alert users at the system dashboard for discovering the factors of having high carbon emission level. By developing this system, the process of calculating energy consumption and estimating carbon emission can be done more efficient and systematic.

1.2 Problem Statement

There are some problems that have been identified for current process:

1. **Human errors may occur in calculating energy consumption and estimating carbon emission.**
   Calculating energy consumption and estimating carbon emission of each building in UTeM are large work, human error may occur by manual process and will lead to inaccurate or large different from actual carbon emission estimation.

2. **Low efficiency and secure data management by Microsoft Excel.**
   High security level cannot be implemented into Excel documents and the documents can be accessed or retrieved by unauthorized users easily. Time consuming in searching and retrieving required data from many Excel documents.

3. **High skills needed to produce accurate and attractive summary report.**
   Making accurate and attractive summary report by using Microsoft Excel needs high skills and more time. Users who not familiar to Excel operation are hard to make report by using Excel. Users may need to retrieve data from many Excel documents to produce the summary report.

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1.3 Objective

This project embarks on the following objectives:

1. To improve efficiency and reduce human errors in calculating energy consumption and estimating carbon emission, provides an accurate estimation of carbon emission.
2. To provide an efficient, reliable, and secure data management to ease authorized users in searching and retrieving data.
3. To generate accurate and interesting report that summaries carbon emission based on energy consumption and other analytical information.

1.4 Scope

1.4.1 Target User

i. UTeM KPKA department (Pejabat Keselamatan Pekerjaan Dan Kelestarian Alam Sekitar)
ii. UTeM energy monitoring department
iii. UTeM IoT and PPTe committee
iv. Public users who have interest to use the system

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1.4.2 Modules

i. User Authorization Module

System users need to login to system by username and password. Each user can view or modify their own user profile such as image, name, email, password and so on. Each user level has different type of functions that can be used in the system. Admin can change user type for particular user to give he/she more function to be accessed in the system.

ii. Building and Sensor Module

Authorized users can view and manage the data of building and sensor in the system. They can add new building and its sensor if there is new building in UTeM that needed to be monitored. They can also update or delete particular building and sensor.

iii. Energy Consumption Calculation Module

The system provides import datafile function for authorized users to import datafile from EMIS which consists of timestamp and meter reading data. During importing, the system will recognize the timestamp format and covert each of them into the default timestamp format in database. Furthermore, energy used of each timestamp will be derived from energy meter reading data.

iv. Carbon Emission Estimation Module

Each time authorized users imported data file from EMIS, the system will calculate and estimate the daily carbon emission of the building by processing the energy used data and carbon intensity data. If there is no carbon intensity data for that day, the system will generate carbon intensity value for that day by averaging carbon intensity value of that month. After calculating and estimating the daily carbon emission, the system will rank the carbon emission level based on the total carbon emission of that day.

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v. Export Data Module

Users can export system data in the form of CSV file from the system such as energy meter reading, carbon intensity, carbon emission and energy used data. The data exported from system can be used as research or analyzation in other related system in the future.

vi. Summary Report Generation Module

The system can generate carbon emission summary report of each building for authorized users by retrieving data from system database. Detail information will

be generated into the report such as total energy consumption, carbon emission, average carbon intensity and so on. Besides that, the report will show the change of value by comparing the last month/year value so that users can know whether this month/year value is increased or decreased. Some of the information will be displayed in the form of chart and graph for making the report more interesting and attractive.

1.5 Project Significance

UTeM Carbon Emission Estimation System (CEES) is developed to manage the energy consumption calculation and carbon emission estimation process. This system enables KPKA to calculate the energy consumption for each building automatically by just importing CSV file from EMIS. The problem of different format in timestamp data can be resolved by system easily and automatically. Besides that, this system provides dynamic daily carbon intensity value for KPKA to insert for estimating a more accurate daily carbon emission of each building rather than using fixed value. Each time KPKA had imported the energy meter reading datafile, the daily carbon emission estimation process will run automatically and KPKA can get the result just few seconds. Besides that, KPKA not need to spend time on writing or making carbon emission summary report of each building as this system can generate the summary report with detail information and interesting charts by few finger-clicking. By developing this system, the process of calculating energy consumption and estimating carbon emission can be done more effective and systematic. Since all data of the system are stored in system database, therefore the data can be managed securely and reliably.

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1.6 Expected Outcomes

UTeM Carbon Emission Estimation System (CEES) is a web based and stands alone system that developed for managing the energy consumption calculation and carbon emission estimation process of each building in UTeM. The system enables users to import energy meter reading data file that is exported from EMIS to UTeM CEES. During importing, UTeM CEES will check the timestamp format in the datafile and convert the timestamp format into default timestamp format in MySQL database. Then, UTeM CEES will derive the energy consumption for each timestamp from energy meter reading data automatically. Users can insert specific carbon intensity value for particular day to have a more accurate result in carbon emission estimation process. Each time users had imported datafile, the system will estimate daily carbon emission of that building automatically with the energy consumption and carbon intensity. Later, system will rank the carbon emission level of that building based on the total carbon emission. System will alert users on the dashboard if the carbon emission level had reached certain level. Lastly, interesting report can be generated to users so that users can make right decision in reducing carbon emission level. By developing this system, the process of calculating energy consumption and estimating carbon emission can be done more effective and systematic.

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1.7 Conclusion

In this chapter is about the basic description of UTeM Carbon Emission Estimation System (CEES). UTeM CEES is very useful and convenient for calculating energy consumption and estimating carbon emission of each building in UTeM. Users can directly know the energy consumption and carbon emission by importing the energy meter reading datafile from EMIS to UTeM CEES. Since all data of this system are kept into database, therefore the data can be managed securely and reliably. The process of calculating energy consumption and estimating carbon emission of each building can be done more efficient with the development of UTeM CEES.