Research Journal of Recent Sciences _____ ISSN 2277-2502
Vol. **4(11),** 52-62, November **(2015)** *Res.J.Recent Sci.*

Investigating the Implementation of Low Carbon Construction Activities in Order to Optimize Electricity on Construction Site

Reza Esmaeilifar, Milad Samari and Mohd Wira Mohd Shafiei
School of Housing, Planning and Building, University Sains Malaysia, MALAYSIA

Available online at: www.isca.in, www.isca.me
Received 2nd April 2014, revised 6th October 2014, accepted 8th May 2015

Abstract

Over the recent years, the number of construction project of law carbon has increased excessively across Malaysia. In fact, we do not doubt the importance of progress in law carbon construction and its significance for the society, particularly for the construction companies. To make influential inroads into the construction practices of low carbon, the industry has to develop the energy usage and natural sources that is consumed in all activities of its construction site. In this paper, the findings of the second section of a countrywide research project administered in Malaysia, was set up to investigate and evaluate the sources of CO_2 emission with respect to electricity usage in construction projects; secondly, to identify effective optimization methods as for electricity usage in construction activities; and finally, to provide an action plan to minimize CO_2 emissions during construction activities. SPSS version 20 was employed to analyse the collected data. Three hundred questionnaires were distributed to the construction companies in Malaysia. The findings showed that, in spite of the importance of low carbon construction, not many companies are serious enough to cut down their natural resource consumption. In fact, myriad of contractors and construction firms in Malaysia have not yet paid attention binding themselves to carbon construction and green building's constitution in general by contrast to common construction activity. Time night working for electricity is the main way for the law carbon construction and has been highlighted as the main reason of ignorance of the current situation within the construction sectors. Indeed, introducing optimization methods is vital for contractors and supervisors of the sites to be motivated considering the inequality on usage of electricity during construction project which lead to production of carbon dioxide. In addition, to optimization electricity finding an appropriate place for the lighting is the paramount one.

Keywords: CO_2 emission, construction site, electricity, natural resources, Malaysia.

Introduction

There are a great number of researches focusing on climate change as a critical and important issue[1]. In 1997 based on The Protocol of Kyoto, many researchers tried to solve the change in the climate which is the result of greenhouse gas created by manufacturers, factories, construction, and transport sections[2,3]. Industrial revolution has revolutionized the human life[4]. This importance of human resource in the organization requires organization to develop their employees up to the required standards where they are valued by organizations[5]. The discussed change was boosting rapidly in the previous century. Developing and thriving in the industries have produced novel technologies which in turn have equipped human with a more comfortable life[6]. Training is one of the effective factors for achieving this goal[7,8]. Losing the natural environment would be the payment for this change. paucity of natural resources, Global warming, air pollution, water shortage, and the critical climate change are a few number of negative outcomes of using modern technologies and employing excessive energy without considering their detrimental threats for environment, planet, and more saliently future life[9]. The basic rational explanation for a rise in degree of greenhouse gases in the atmosphere can be figured out in the unlogical use of fossil resources that is the fundamental resource in constructions, sectors in transportation, and cities. This sort of increase in fuel use also leads in global warming. Since 1880 the temperature of world examined by the NASA's Goddard Institute for Space Studies Average has increased to 1.4 degrees Fahrenheit (equal to 0.8 degree Celsius), a great amount of such an increase has occurred in recent decades. The Intergovernmental Panel on Climate Change (IPCC) of United Nations has announced that the last two decades in the previous century should be considered as the hottest period in the last 400 years or more probably in the several millennia. “El Niño of the century” has declared that from 1975, the hottest year was spotted in 1998[10]. All the measures are making an attempt to display that an approaching crisis is endangering the earth. So, all nations controlled by United Nation have tried to harness greenhouse gases, more specifically the emission of CO_2 to decrease the temperature rising and ultimately to remove its influence on the life of human.

Construction has a significant role in reducing energy use and positively, in result, backbones the issue of change in the climate; construction has a crucial role in producing CO_2 into

the atmosphere in the modern town[11]. Building has become one of the society parts that need a great deal of energy; only in the EU, near 40 % of energy consumption is related to the construction, use, and buildings deconstruction[12]. Despite remarkable improvement to elevate the energy efficiency with respect to energy consumption in building (e.g. the EU Energy Performance of Buildings Directive), the standard of building process and the complex attainment of construction have encountered some difficulties in promoting the instruments and implementation[13]. Nowadays we have confronted new problems. Lately climate change has turned into a controversial issue because it has influential impact on the lives. This change has climbed to its acme and has become a controversial issue. It has been worsened by an increase in population which means influence of human on the planet. This population growth certainly has dangerous results if it is not examined meticulously. Construction sector is also evaluated as one of the dominant element which leads to the environmental damage. Due to this effect, carbon construction law was passed to decline this harmful effect by means of sustainability and carbon construction law[9].

The degree of atmosphere gases has reached an astonishing level, intensifying the influence of greenhouse. The effect of greenhouse is a type of process by that CO_2, natural occurrence in the atmosphere, absorbs earth radiation on the surface generating warmth in the atmosphere and finally makes this planet a better setting for living. The great degree of greenhouse gases amplifies this impact though. Shaped in the atmosphere it builds a cover around the earth. This slowly heats the earth which in turn causes climate change and global warming[14]. It is thought that developed countries should take the responsibility of the highest level of carbon emissions per person. The US, the United Arab Emirates, and Australia are regarded as the top for the emissions of carbon. Nations that are in path of developing have transformed this design. China has been considered as the top carbon producer; India is in third level whereas USA has the second rank[9]. The sections involved in residential and industrial projects and responsible for transporting and producing electricity play an important role in generating CO_2 in Malaysia. Based on a complete modeling instrument, in the current study, long-range energy alternatives planning system (LEAP) was selected to search the emissions of CO_2 from 2000 to 2020 regarding individual part. It was inferred that regardless of mitigation, in 2020, 285.73 million tons of carbon dioxide were estimated to be emitted. In proportion to the amount of CO_2 in 2000, there was a 68.86% increase in emission of CO_2. Regarding Mohd Safaai et al.[15] electricity sector seems to be the biggest sector of all other parts responsible for CO_2 emission.

Literature review: CO_2 in Construction: Before examining the notion of implementing the law carbon in the industry of construction, it seems important to say what the CO_2 spread is meant in this sector. A comprehensible and exhaustive definition of this idea accelerates the methods for the project to accomplish its goals [9]. It also sounds vital to render an overall and vivid view of purpose of greenhouse presence in construction so as to shed more light on these parts. The realization of objectives and goals of greenhouse appears very influential and helpful. As it is clear, CO_2 is viewed as a component of the gases; even though greenhouse encompasses some other gases too. In this study, we have focus on CO_2 since it is the major gas produced during construction. The environment plays a critical role in reducing the energy consumption and is completely useful in the issue of change in the climate. The sector of construction is looked as the powerful producer of CO_2 in the modern countries[11]. Construction uses noticeable amount of energy. Just in the EU, about 40% of energy use was estimated in building usage, deconstruction, and construction[12].

Electricity: As the mains electricity are close to the site, it is assumed that the mains can meet many energy requirements for the construction procedure[16]. While fossil fuels are used in the units of stationary combustion or other types of resources including wind, natural gas, nuclear are exploited, electricity will be generated. Technologies that make a great use of gas, coal, and oil (fossil fuels) generate a large amount of carbon because they burn these resources in the process. In contrast, technologies that feed on non-fossil resources including solar, nuclear, wave, wind, tidal, biomass are entitled carbon neutral for in operation they generate no CO_2. However, it does not mean that they are exempt from producing carbon; in fact, it should be said that in other states such as decommissioning, extraction, maintenance, and construction, they yield CO_2 (figure-1).

The foot print of carbon is defined according to the total emission of CO_2 or other types of GHGs in the process or product life cycle. CO_2 grams equal to per kilowatt hour is expressed as g CO2 eq/kWh. The different global warming effects are realized through this amount of the GHG emission. This deals with life cycle of CO_2 emission rooting in electricity process [17].

Fossil Fuelled Technologies: The process of construction and building is the main reason for emitting GHG by using fossil fuels. The energy released in the chemical reactions happening in the tasks (e.g. CO_2 produced in Poland Cement, mixing chemicals) is not related to GHG emission intensities. In operational activities of buildings, only the emission produced through electricity and natural gas is regarded as the main reasons for CO_2 emission whereas other sources have very small amount of contribution[16]. CO_2 Emission of the operation prevails the power plants function drawing on fossil fuel. The peripheral emission in the steps such as the extraction of raw materials and the construction of plant is relatively low[17].

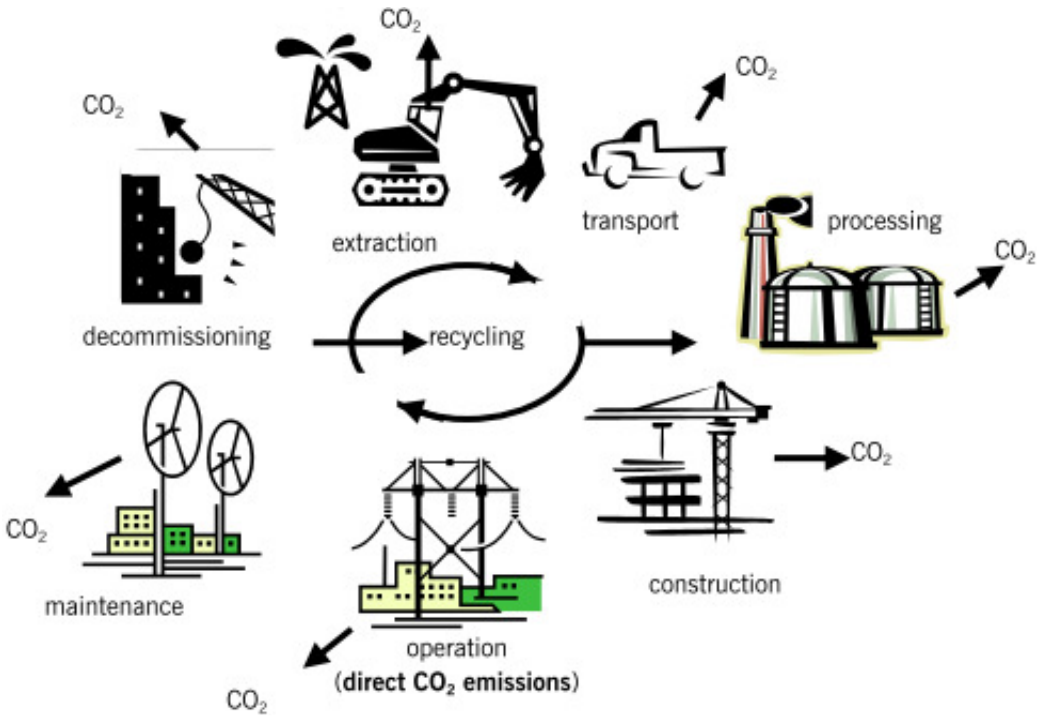

Figure-1
Life Cycle CO_2 Emissions for Electricity Generation Technologies[17]

Practice Energy Management on Site: A complete business sense is the expected result of decreasing energy use[8]. This attitude can result in financial support, high reputation of collaboration, and facilitation in climate change. The Carbon Trust gives different organizations the efficient useful help to cut down on CO_2 emission; the easiest way is to use resources efficiently. Energy management makes a systematic use of technology and management techniques to make sure that organizations use energy efficiently. It is vital to employ the energy procurement and efficient renewable energy. A successful management is subject to theoretically effective strategies as well as practical considerations. Ko[18] enumerated the performance that should be taken to guarantee energy efficiency in the construction sites:

Directing generators to fulfill the electricity needs, Thwarting use of the site at nights and accommodations of the lighting. Using efficient lighting tools such as fluorescent and LED. Good management of computers' server. Insulating the accommodation of the site. Effective use of plant. Metering, communication, reporting, and data collection.

Considering the Construction Industry Research and Information Association (CIRIA), the following list consists of environmentally efficient performance in the construction site[18].

Responsibility Assignment: In every construction site, the advisor of energy is supposed to monitor and report the energy enactment.

Particularity of energy advisors' assignment: the contract documentation should include the appointment of energy advisor which should be clarified so as to observe and report the energy actions.

Determine an effective performance toolkit: consult researchers to suggest an efficient toolkit. Consider training course.

Effective practice: follow the guidance provided in toolkit for an efficient energy management.

Details of Assumptions: Site Accommodation: Cabins Producers of energy efficiency announced that compared to the standard cabin, they have already saved 50%. The investigation of two sites revealed that saving in practice could be increased to 85%. As saving is closely related to the site cabin, promoting cabin use could be beneficial regarding both finance and carbon. Comparing manufacturers' claim with actual figures received from the projects reveals the possibility of saving 50% of carbon. In the current study, it was very difficult to provide a clear vision of data that differentiate the amount of carbon produced by cabins and what is generated by the other energy uses such as small power and lighting. The cabin consumption of 70% of the electricity is the main basis for estimating the emission of carbon. It sounds important to update this amount according to the current data. In that sense, cabins produce 35% of carbon emission through site activities. As effective cabins are beneficial and available in the markets, this performance seems essential to give 15% target. The hypothesis would be that 65% the constructions of the building can be changed to the

effective cabins. The given benefit seems high due to this type of change[18].

Construction Plant: According to carbon Subgroup's reports, the plants are not functioning efficiently. The engines work for a long and a little attention is given to how to reduce fuel consumption. Some reports are also revealed regarding the use of oversized plants. 15% carbon have been saved in training of operating. Since Carbon Subgroup declared around 20% of the part, the coverage was supposed 20%. A fine large size of data can lead to the separation of accommodation and generators from construction plant. It is highly debated that the activities of the site is responsible for 50% of carbon emission in the construction sites using electricity and fuels[18].

Electrical Curing for Concrete: Regarding concrete curing, there are several ways for electrical curing consisting of a variety of techniques: i. concrete as electrical conductor, ii. making use of reinforcing steel which functions like a heating component, iii. using steel which are electrically heated (as the most well-known relevant method), iv. special wire is used as a heating element, and v. electric blankets. In the cold weather electrical heating can help concreting. Hot oil moves through steel so as to heat the concrete. If infrared method is used to cure concrete, a covering should be used or enclosed steel will be utilized. Electrical, oil, infrared curing techniques are highly used in the precast concrete industry[19].

Location of Site: Construction activities are assumed to consume small but important degree of the energy in the construction site. This has a range of 15 to 35% of the entire embodied energy. Transporting, leveling, digging, lifting, compacting, and mixing in construction sites are responsible for a great use of energy; whereas builders exploit the second noticeable degree of energy either temporarily or permanently in the construction site. The third great consumer of energy is considered to be those materials that use concrete formwork and scaffolding. The construction efficiency can also impact the amount of embodied energy in the site to some extent since site inefficient management could result in magnificent materials wastage. It is said, for example, that cement in the sites of developing countries used 25% more than needed with respect to the development of quality control. However, in some cases the degree of utilized materials is more than what has been preplanned in the design which was supposed to decrease the time and labor cost. In addition, the location of site plays a very important role in electricity use, delivery, climate condition, logistics, labor cost, local rules, and availability of materials and equipments. For instance, the demand of electricity increases in line with an increase in the site temperature. An increase of 8 to 10°F is considered to elevate the demand of electricity per year to 20% [20].

Methodology

Introduction: The global tendency is oriented toward building a better and cleaner environment for the future life. The issue of preventing global emissions has forced many to provide new ways to stop the gas emissions. So many nations have outlined some aims concerning the pollutants that are supposed to be achieved by 2050. The impact of the construction activities on the environment obligates measuring the pollutants used in certain ways in the activities of construction[21].

Why focus on Malaysia?: In the previous two decades, the Asian construction industry has grown fast, and is assumed to continue[22-24]. Malaysia is located in south-east of Asia encompassing an area of 329,847 km. Regarding the report released by Department of Statistics Malaysia, in 2010, Malaysia with a population of around 29 million has 2% rate of population growth which is followed with urbanization (71%). The Malaysian government has embarked on developing programms to be fully recognized as a developed nation in near future. The plans have given Malaysia a remarkable speed of industrialization and development. The fast urbanization rate has compel the country to encounter critical environmental issues including air and water pollution in towns such as, Kuala Lumpur, Penang and Johor Bahru. Cutting down trees and decreasing the areas of the forests with the aim of expanding and urbanizing industrial areas have brought up new dangers to the Malaysian natural areas. It implies that the faster population growth, the more activities in the society. The only dangerous outcome of rise in the activities and population is the environmental problems mentioned above[26]. In Malaysia the industry of construction originates in wealthy generation with the improved economic, building, and social infrastructure. Therefore, construction industries along its given sectors are concerned with and focus on the profitable projects of building. In construction parts are working 800, 000 workers who comprised 8% of entire number of employees al over the world. The industry of construction is regarded as one effective parts with continuous relation with economy[27]. The experts stress that this discussed industry has highly influenced the ecosystem and people because it encompasses a large number of activities. The related symptoms from previous studies showed that the rate of construction growth was around 5.3%, thus, contributing 2.1% of entire Gross Domestic Product (GDP) in Malaysia[27].

According to Abdullah et al.[27], 4.5% of GDP in Malaysian construction has been supposed to have a remarkable impact on the environment. It sounds astounding that commercial offices spend 20% more than enough. According to GBI BEI (Building Energy Index), the present official offices consume electricity at 250 KWhr/m2 annually in Malaysia while 150 KWhr/m2 per year is the exact standard according to The BEI standard. The residential and commercial sites consume approximately 40% of electricity. As for this undesirable situation, promoting green construction was never considered so important than these days because the rise in greenhouse gases emission is in the non-stop process of altering the climate patterns. The Malaysian government passed the Green Building Index in 1990 to get closer to the development of green construction and to support

the natural ecosystem. Home-owners in Malaysia, who intend to possess GBI certificates, and customers, who like to buy houses with such a certificate, are exempted from tax breaks and stamp duty. It has been backboned by government to develop green construction everywhere and they are very provoking for people.

Why Electricity-Related Construction Activities in focus?: As long as the demand of electricity rises up, the investment on the potential of producing electricity from renewable and non-renewable resources can consider the possible consequences of change in the global climate either at the power plants' operational stage or at the effects of construction [28]. This tool intends to measure the indirect generation of CO_2 emission which has to do with the purchased electricity. Steam, electricity, and heat are produced using fossil fuels in the stationary combustion. They are also produced through other resources like hydro, wind, solar, nuclear. The emissions of GHG (CH_4, CO_2, and N_2O) has a firm root in generating steam, electricity, and heat by burning fossil fuels in the parts of stationary combustion.

Target respondents and sample selection: Since the study focused on CO_2 emission with respect to electricity use in Malaysia in building period, employing the interview as a data collection method was impossible due to financial resources, manpower, time shortage, as well as large scope. Thus, questionnaire had been selected as an influential way to collect data for this study. Questionnaires were more appropriate for the present study than interview since questionnaires make it quicker to enter the data. Moreover, that they are well-built and do not take long time is a merit for the current research. The noticeable pitfall of surveys is that a small number of them are brought back. Considering this difficulty, they all were handed over respondents and it was attempted to get them back immediately. Even through this collection method, only 31% of them were collected back. Using this sort of instrument in this study will sensitize contractors of the effect of their actions on the ecosystem by displaying the dominant parameters leading to emission of CO_2. The present results would be a great help in making them sensitive to which part of their performances is more serious and demands more attention to decrease the emission and finally produce greener activity or construction. A sum of 385 questionnaires was given to the study participants. To make study more comprehensive, they were distributed in main areas of Malaysia and Construction Company. 31 (8%) questionnaires were returned and considered. The analysis of frequency was employed as initial examination. This will depict the percentage and the frequency. The results were generated using the Statistical Packages for Social Science (SPSS) version 20.

Contractors Registered by Grade: According to CIDB Malaysia's report on 31st December 2010, in 2009a total number of 64,924 contractors were registered. More than 52,709 or 80% of them had registration under G1, G2, and G3 grades; while the remaining was registered as foreign contractors and under G4-G7 grades[15]. In fact, the G7 of the registered contractors could be used in this research for their big range of influence on construction.

As table shows, in order to achieve reliable and valid data, 385 questionnaires were handed over for the adaptation with the standard size of sample.

Design of the questionnaire: Hence, exploring the acceptable and affordable object for the activity of construction can be useful for optimal electricity use in construction site. The collected data in the section A and B are useful for this purpose and give the correct estimation for employing this electricity factors which emitting carbon on the construction site. The main characteristic of the study is to measure the origins of the emission with respect to electricity consumption in building era and to optimize such a factor. This factor focused on engineers, the managers of project, and architects, whose function is on construction sites. It is vital to consider this issue from their view point.

Table-1
Number of Contractors by Grade

Grade	Bidding Limit	2006	2007	2008	2009
G1	Not exceeding RM200,000	36,141	34,581	34,060	33,633
G2	Not exceeding RM500,000	6,937	7,300	7,516	8,095
G3	Not exceeding RM1,000,000	10,043	10,572	10,963	10.981
G4	Not exceeding RM3,000,000	2,140	2,340	2,420	2,613
G5	Not exceeding RM5,000,000	2,816	3,078	3,363	3,673
G6	Not exceeding RM10,000,000	1,003	1,065	1,206	1,437
G7	Unlimited	3,736	4,191	4,285	4,326
Foreign	Unlimited	163	163	164	166
Total		62,979	63,290	63,977	64,924

Source: CIDB Malaysia

Summary of Questionnaires: Section A: In this section, the basic questions were asked, which provided clear picture of respondents' background. This section also includes items as follow: 1. Gender 2. Age 3. Job experience in projects of the development of construction 4. The level of education-5. position of job

Construction project Involvement: Section B: The questionnaires were divided into two main parts. Firstly, 7 questions were asked from respondents. The main purpose of this section is to investigate the amount of electricity usage in construction site. It is essential to know the primary parts with electricity use in the site, since they have an impact on more emission of carbon dioxide.

Table-2
Section B part 1 of Questionnaire Electricity-Related Construction Activities

1	The Location of Site
2	Spraying Concrete
3	Cleaning the equipments
4	The Cleanup of the Site
5	Equipment Use
6	Insulating the Accommodation of the Site
7	Working time in the Night

In the second part of section B in the questionnaire the question about optimizing electricity came out. Optimizing the use of electricity seems to be a crucial factor in the activities of the site. The personnel and contractors can provide helpful recommendation and suggestion on the construction site in order to make efficient usage of electricity. Their help has a great role in decreasing the emission of carbon dioxide.

In part 2 of section B, CO_2 emissions will be estimated in the process of operation of the project. This certainly helps contractors, regulators, and decision makers select an appropriate construction method to maximize the financial, social, and time benefits.

ANOVA: ANOVA (Analysis of Variation) is a statistical technique used to estimate the differences between more than three groups of response or a test to identify differences in means[29]. A One-Way ANOVA is used to analyse the variance of a dependent variable by a single independent one. One-way ANOVA procedure was used to compare means between different factors of electricity use to identify whether there are differences in the strand scores. For instance, we used ANOVA to clarify if the impact of site location and the other relevant elements in the consumption of electricity (the dependent variable) differs significantly from the location. We preferred ANOVA to t-tests since the independent variables of the study were more than two groups.

Table-3
Section B part 2 of Questionnaire

1	The control of generators to fulfill the present electricity needs
2	Preventing unnecessary working at night and lighting
3	Setting up task lighting like LED and fluorescent and energy effective security
4	Effectively managing computer server
5	Insulating accommodation on the site
6	Effective plant use
7	The collection of data, metering, reporting and communicating
8	Responsibility Assignment
9	Energy Advisor
10	Developing a toolkit for good performance
11	Having efficient performance
12	Taking advantage of daylight if possible
13	Installing the lighting meticulously in the needed place
14	Utilizing lamp shades which are light-colored and non-opaque

Data analysis and Findings: An overview was gained through calculating the median, mean, and mode values in tables-2 and 3. These units of dispersion were to measure the heterogeneous or homogenous nature of the obtained data[29]. The data analysis displayed approximately close measures of medians, modes, and means, with low values of standard deviation and variance. This verified the acceptable homogeneity and quality of the collected data. It also confirms a reasonable low amount of dispersion which leads in reliable findings[30].

The Level of Electricity Consumptions: In this part, the site supervisor and respondents' views about electricity use were investigated through questions. It was important to show the levels of electricity consumption to accomplish the law of carbon construction. According to these findings related to the prominent techniques of electricity use on building site, we could modify this use pattern and finally to decrease the emission of carbon on construction site. In addition, spotting these barriers will help decrease greenhouse gasses (GHG) emission through sensitizing contractors or other people concerned with the construction activities to this pattern of

electricity use and their impact on carbon emission. It is also linked with the research question one of the present study that measures the origins of the emission regarding the electricity during the activities of construction. In general, this section consisted of two different sub-parts. The first has to do with the electricity use in the construction activity. This section made an attempt to answer the question which has a root in the previous studies and had the most influential role in the use of electricity such as the one that inserts an effect on producing CO_2 and eventually greenhouse gasses (GHG).

Ranking Factors for electricity-Related to Activities in Construction: According to table-4, the mean of working time in the Night was 3.67 which is the most prominent component in the electricity usage during the activities of the construction with respect to a respondent's viewpoint. The site location with a mean (3.38) was the second element. Equipment use was regarded as the third effective factor (mean: 3.25). Insulating the Accommodation of the Site, The Clean-Up of the Site, Equipment cleaning and spraying concrete were found to be at lower level.

Anova Test among Electricity-Related Construction Activities: The table-7 displays the outcome of the Anova in a growth pattern for Electricity- related to the Activities of the Construction. The F ratio is seen to be 4.312 and the level of significance is 0.000 ($p < 0.001$). This is lower than 0.05; therefore, implying that the electricity mean length during the activities of the construction is not same. Post hoc analysis displays that equipment cleaning ($p<0.01$), the spraying concrete ($p<0.01$), and the clean-up of the site differ meaningfully from Working time in the Night. Working at night was found to be an effective variable with mean of 3.67. It highly differs from other given variables.

Results and Discussion

Time working in the Night: Working in the night seems to have an important contribution in the amount of electricity usage. According to data analysis, 32.3% of respondents believe that working in the night could be an average element while 29.0% of them find that an important factor. 25.8% of respondents hold that it is an influential factor only in case of consuming electricity.

The Location of Site: Around 41.9% of subjects found the site location as the average parameter in sites with an impact on the degree of electricity consumption. 29.0% of them look at this factor as prominent factor and only 16.1% said that they look at that a low effective parameter in the site.

Use of Equipment: Among different activities in the construction site, using equipment demands electricity consumption. Thus, supervisor should be wary of the type and amount of electricity consumption in site. This section regards equipment use as a parameter for electricity usage in the construction sites. 45.2% of respondents expressed that this factor has a high impact on the electricity usage. On the other hand, 38.7% of them hold this idea that this parameter has an average impact on the consumption of electricity during the site activities.

Electricity Usage on Site: In general, in this part the study intends to figure out the methods of optimizing electricity consumption in the activities of the construction from the respondent's views. It also tries to realize the ways that are the effective methods for reducing the use of electricity. According to the information of literature review, the electricity usage optimization can be categorized in certain efferent ways which are asked from respondents via questionnaire. Considering the respondents ideas, this study makes an attempt to clarify the possible ways of reducing the electricity usage. Based on the received information, this part could be divided to 14 questions. It seems better to state that the usage of electricity has been categorized in 14 forms.

Table-4
Rank of Factors for Electricity-Related to Construction Activities

	Mean	Std. Deviation	Mode	Minimum	Maximum	Sum	Rank
The location of site	3.3871	.91933	3.00	2.00	5.00	105.00	2
Spraying concrete	2.7241	. 1.06558	3.00	1.00	5.00	79.00	7
Equipment cleaning	2.7742	. 95602	2.00[a]	1.00	5.00	86.00	6
The Clean-Up of the Site	2.8710	.71842	3.00	1.00	4.00	89.00	5
Equipment Use	3.2581	.81518	4.00	1.00	4.00	101.00	3
Insulating the Accommodation of the Site	3.2258	.95602	3.00	1.00	5.00	100.00	4
Working time in the Night	3.6774	1.10716	3.00	1.00	5.00	114.00	1

Effective Factors in Electricity Usage optimization on Site: According to their preferences and effective and influential ways for optimizing use of electricity and for encouraging sites' contractors and supervisors to decrease the electricity consumption, table-5 displays the rank of all methods selected by respondents. Of course, the final result would be carbon dioxide reduction, cleaner site activities, and finally well-developed construction industry. Generally speaking, in this category the means have fallen in the range of 3.9 to 3.4, thus, showing that the subjects of the study agree with that all given factors play key role in electricity usage optimization. Regarding the variance between them which is not very high, it could be concluded that they could also be employed as optimizing parameters.

Anova Test among Electricity Consumption on Site: Based on the data, it was found that the in this section the variable is not meaningful which means that variable does not numerically differ very much. In other words, according to respondents' opinions, this parameter is not the identical range for reducing electricity usage in site activities.

Assigning Responsibility: It was revealed that, 38.7% of respondents accept the efficiency of Responsibility Assignment as an important factor in electricity consumption optimization in construction parts. Additionally, 35.5% of them agreed with that. Those respondents who had a strong agreement with this factor form 25.8% of total. According to respondents' opinions, the high Mean (3.90) and Sum (121 from155) of Responsibility Assignment was considered as high effect element.

Table-5
Rank of Factors for Optimizing Electricity Usage on Site

Practice energy management on site	Mean	Std. Deviation	Mode	Minimum	Maximum	Sum	Rank
-Controlling generators to meet only current electricity needs	3.6774	1.04521	3.00	1.00	5.00	114.00	4
-Avoiding unnecessary night time site and accommodation lighting	3.4839	1.26151	4.00	1.00	5.00	108.00	7
-Installing energy efficient security and task lighting such as fluorescent, LED and metal halide lamps	3.7419	.85509	3.00	2.00	5.00	116.00	3
-Effective server management for computers	3.4194	.76482	3.00	2.00	5.00	106.00	8
-Well insulated site accommodation	3.4194	.80723	3.00	2.00	5.00	106.00	8
-Efficient use of plant	3.6129	.61522	4.00	2.00	5.00	112.00	5
-Metering, data collection, communication and reporting	3.7419	.72882	3.00	3.00	5.00	116.00	3
-Assigning responsibility	3.9032	.78972	4.00	3.00	5.00	121.00	1
-Energy Advisor	3.6774	.79108	3.00	3.00	5.00	114.00	4
-Develop good practice toolkit (training course)	3.5161	.92632	3.00	2.00	5.00	109.00	6
-Adopt good practice	3.8065	.70329	4.00	2.00	5.00	118.00	2
-Use daylight whenever possible	3.8065	.90992	4.00	1.00	5.00	118.00	2
-Place your lighting carefully where you need it	3.9032	.70023	4.00	3.00	5.00	121.00	1
-Use non-opaque, light-colored lamp shades	3.3548	.87744	3.00	1,00	5.00	104.00	9

Careful Lighting Placement where needed: According to outcomes of the analysis, 51.6% of respondents declared that Careful Lighting Placement where needed was considered as an effective element electricity optimization. Further, 29.0% of them agree to some extent with the given element which was chosen as a prominent parameter for electricity optimization and solving the related problems. 19.4% of respondent said that Careful Lighting Placement where needed was in a perfect agreement with their opinions and they agree with that strongly. The sum (121 from 155) and mean (3.90) illustrate the high satisfaction of respondents with respect to Careful Lighting Placement where needed in order to electricity consumption optimization.

Good Performance Adoption: It was demonstrated that 71.0% of respondents agree or strongly agree with Good Performance Adoption as an effective factor for the optimal usage of electricity. Nearly 29.0% of subjects agreed to some extent or dissent from the given factor. The mean of 3.80 and sum in a range of 118 from 155 show Good Performance Adoption as one of strong parameters for electricity optimization in the current activities of the site.

Daylight Usage Whenever feasible: It was evidenced that 51.6% of respondents concur with Daylight Usage Whenever feasible for electricity consumption optimization and 19.4% of them pointed out that they are strongly in agreement with this element to reduce the electricity usage in the related activities. While around 22.6% of respondents stated that they have a somewhat agreement with the given factor as influential one in reducing the electricity consumption. Eventually, only 6.5% of respondents disagree or strongly disagree with the given optimizing parameter. According to the displayed data, sum (118 from 155) and mean (3.80) evidence that this factor could be an effective one in optimizing electricity consumption.

Conclusion

To analyse reliable data for the present study, a great number of participants were asked to answer the questionnaires. This study covered different aspects such as education level, job position, ages, and work experience in the projects of construction development. As this study placed its focus on law of carbon construction, involvement in the project of construction as well as having good outcomes as the respondents' experiences were important to be determined. The sample could represent the building site (as well as its usefulness for supervisors and contractors in their performances) where the results would be practical. The primary objective of the present attempt was, to examine the original factors resulting in CO_2 emission in a sense of exploiting electricity at construction time. This present part is about evaluating sources of CO_2 emission that came out of electricity consumption during construction activity.

Regarding this part, it was found that the subjects have the opinion that "Time working in the night" could be the main contributors with respect to using electricity in the activities of the site. The second factor for electricity consumption pertains "Location of the site". As follows these elements, "Use of equipment" and "Insulated site accommodation", are arranged in this category.

(Use of equipment) Causal factors related to insufficient maintenance, as well as the unsuitability and inappropriate use of equipment employed on-site are included in the Equipment factors category. In this case, 'equipment' refers to construction vehicles, machinery and tools located on-site [31].

The main objective of this study is to identify effective usage to optimize electricity usage in the activities of building to lower carbon dioxide and possess low construction. The optimization is directly related to Energy Efficiency (EE) and using Renewable resources, as continuing using and working with this to factor optimizing will be achieved. As I mentioned in above, the optimum level of consuming electricity could be classified in 14 sections.

The subjects highly insisted that "Place the lighting carefully where it need" and "Assigning responsibility" are promising ways. The second areas are "Adopt good practice" and "Use daylight whenever possible". "Metering, data collection" and "Communication and reporting and Installing energy efficient security and task lighting" are in the third part of optimizing.

Table-6
The Suitable Methods of Construction to Reduce the CO_2 Emission

The 5 first factors for optimizing electricity Usage on Site	The careful placing of lightings
	Use daylight whenever possible
	Adopt good practice
	Measuring, collecting data, interactions and giving reports
	Setting security for efficient use of energy and lighting such as LED

Table-7
Electricity-Related Construction Activities

ANOVA					
Electricity-Related Construction Activities					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	22.908	6	3.818	4.312	.000
Within Groups	184.180	208	.885		
Total	207.088	214			

Table-8
Electricity Usage on Site

ANOVA					
Electricity Usage on Site					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	13.514	13	1.040	1.420	.147
Within Groups	307.548	420	.732		
Total	321.062	433			

Acknowledgment

This work was supported in part by the fellowship scheme of Universiti Sains Malaysia.

References

1. Houghton J.T., Ding Y., Griggs D.J., Noguer M., Van der Linnden P.J., Dai X., Maskell K. and Johnson C.A., Climate change 2001: the scientific basis, Cambridge University Press Cambridge, **(2001)**

2. Dunn W., Infant/Toddler Sensory Profile manual, New York: Psychological Corporation, **(2002)**

3. Climate Change Secretariat, *A Guide to the Climate Change Convention and Its Kyoto Protocol*, United Nations Framework Convention on Climate Change (UNFCCC), http://unfccc.int/resource/guideconvkp-p.pdf., **(2002)**

4. Masomi E., Asl D.M., Eghdami A., Ashore S. and Ghanimat P., The Study of Corporate Entrepreneurship and its Relationship with job satisfaction: The Case Study: Sepah Bank, branches of Golestan Province, *Research Journal of Recent Sciences,* **3(3),** 104-111 **(2014)**

5. Wahab A.R.S., Hussain A., Zadeh A.A., Shah A.F. and Hussain J., Employees' Perception and Motivation towards Training and Development Programmes in Health Sector of Pakistan: A Case Study of Khyber Pakhtunkhwa, *Research Journal of Recent Sciences,* **3(2),** 1-7 **(2014)**

6. Charandabi S.E. and Bohlooli N, Investigation and Prioritizing the Key Factors of Success in Small and Medium Size Enterprises, *Research Journal of Recent Sciences,* **3(2),** 31-34 **(2014)**

7. Zaferani Z.A. and Aliakbari H.N., Investigation the relationship of Staff's training courses with their Performance, *Research Journal of Recent Sciences,* **3(4),** 1-6 **(2014)**

8. Masomi E., Asl D.M., Eghdami A., Ghanimat P. and Ashore S., Survey on the Role of Knowledge Management on the Quality of working Life, Case Study: Islamic Azad University, Iran, Pars Abad Branch, *Research Journal of Recent Sciences,* **3(2),** 100-108 **(2014)**

9. Moxon S., Sustainability in Interior Design, published in 2012 by Laurence king publishing Ltd, **(2012)**

10. Christy J and Spencer R, Global Temperature Report 1978-2003, Earth System Science Center, The University of Alabama, US, **(2003)**

11. Roaf S., Crichton D. and Nicol F., Adapting Buildings and Cities for Climate Change, Architectural Press, Oxford, **(2004)**

12. Runci P.J., Energy Research and Development in the European Union, PNNL-12218, Battelle Memorial Institute, Pacific Northwest National Laboratory Technical Report, Richland, Wash, May, **(1999)**

13. Casals X.G., Analysis of building energy regulation and certification in Europe: their role, limitations and differences, *Energy and Buildings*, **38(5),** 381-92 **(2006)**

14. Wee-Kean F., Hiroshi M., Chin-Siong H. and Yu-Fat L., Energy Consumption and Carbon Dioxide Emission Considerations in the Urban Planning Process in Malaysia, **(2009)**

15. Shaffii N., Malaysia Country Report, Construction Industry Development Board Malaysia, **(2010)**

16. Brockman M.D., Land and Environment Court Proceedings, Environmental Defender's Office Ltd., **(2007)**

17. Parliamentary Office of Science and Technology, Carbon footprint of electricity generation, postnote October 2006 Number 268, **(2006)**

18. Ko J., Carbon: Reducing the footprint of the construction process, **(2010)**

19. Burg, R.G., The Influence of Casting and Curing Temperature on the Properties of Fresh and Hardened Concrete, Research and Development Bulletin RD113, Portland Cement Association, **(1996)**

20. United Nations Centre for Human Settlements (Habitat) Nairobi, Energy for Building: Improving Energy Efficiency in Construction and in the Production of Building Materials in Developing Countries, HS/250/91 E ISBN, 92−1−131 174−8 **(1991)**

21. Shaik S.S. and Samuel T.A., Methodology for estimating emissions in underground utility construction operations, *Journal of Engineering, Design and Technology,* **7(1),** 37-64 **(2009)**

22. Bon R. and Crosthwaite D., The Future of International Construction, Thomas Telford Limited, London, **(2000)**

23. Raftery J., Anson M., Chiang Y.H. and Sharma S., Regional overview. In: Chiang, Y.H., et al. (Eds.), The Construction Sector in Asian Economics, Spon Press, London, **(2004)**

24. Chan E.H., Qian Q.K. and Lam P.T., The market for green building in developed Asian cities—the perspectives of building designers, *Energy Policy*, **37(8),** 3061-3070 **(2009)**

25. Houghton H, Global warming (3rd Edition), New York: Cambridge University Press, **(2004)**

26. Fong W.K., Matsumoto H., Ho Ch S. and Lun Y.F., Energy consumption and carbon dioxide emission considerations in the urban planning process in Malaysia, **(2007)**

27. Abdulllah F.M, Chiet V.C., Anuar K and Shen T.T., An Overview On The Growth and Development Of The Malaysian Construction Industry, Workshop on Construction Contract Management, Universiti Teknologi Malaysia **(2004)**

28. Pacca S. and Horvath A., Greenhouse Gas Emissions from Building and Operating Electric Power Plants in the Upper Colorado River Basin, *Environ. Sci. and Technol.,* **36,** 3194–3200 **(2002)**

29. Bernard H.R., Social Research Methods: Qualitative and Quantitative Approaches, Sage Publishing Ltd., London **(2000)**

30. Trochim W.K., The research methods knowledge base, Cincinnati, OH: Atomic Dog Publishing, **(2001)**

31. Fuertes Casals A., Casals Casanova M., Gangolells Solanellas M., Forcada Matheu N., Macarulla Martí M., and Roca Ramon X., An environmental impact causal model for improving the environmental performance of construction processes, **(2013)**