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THE IMPACT OF MALAYSIAN INDUSTRIAL ENERGY USE ON CARBON DIOXIDE EMISSIONS

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Abstract

This study attempts to identify the impact of Malaysia economy on CO_2 emission by analyzing the energy intensity and CO_2 emission intensity. Environment issues such as global warming and climate change give the negative effects to the Mother Nature such as floods, landslides, erosion and extremely heat. Otherwise, there is positive effect to the economy subsequent to disaster through the substitution of capital. Moreover, the government policy seen recently in the 10^{th} Malaysian Plan will highly promote to energy efficiency and focus on high value added sector that produce less CO_2 emission. This study found that Transportation sector has produced the highest value added with the highest CO_2 emission. The finding of this study will facilitate energy policy makers to investigate the sector contributed high CO_2 emission, and encouraged the high value added (productivity) sectors that produce less CO_2 emission. Moreover, it is very important because recently the government, economist and policy makers have discussed the best strategies to protect the environment particularly in regarding to reduce the CO_2 emission. From the finding, in order to reduce CO_2 emission, the energy intensive sectors will also have to reduce energy consumption by applying the energy efficiency technology less CO_2 technique in the future.

Field of Research: *energy intensity, CO_2 emission intensity, IPCC revised 1996, value added, energy efficiency*

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1. Introduction

Rising in production of goods and services will consume lots of energy such as electricity; gas, petroleum product, coal and crude oil that will effects the environment. Energy is one of the main source of country's economic and development as well as social progress. Energy has changed the level of value added through the production activities as well as changes the lifestyle of households all over the world. Energy also gives an awful impact to environment through the direct and indirect energy consumption, with direct and indirect impact on CO_2 emission.

The consequences of energy consumption in Malaysia to the CO_2 emissions are not the new issues to discuss but this issue have been growing for the last two decades. Due to these conditions, government has promoted the strategy to reduce the amount of energy consumption as well as to reduce CO_2 emission through energy efficiency in order to protect environmental issues as stated in the 10^{th} Malaysia Plan. Therefore, Malaysia has agreed to reduce the carbon dioxide by up to 40 percent by year 2020 in comparison to 2005 level even though Malaysia is non-annex 1 in the Kyoto Protocol but it is encourage in reducing the CO_2 emission.

It is very important to save the environment through the efficiency of energy management and consumption from the point of view of environmental preservation because there is no point if economy grew at positive rate but quality of environment become worsens. In order to combat this environment problem particularly on CO_2 emission, the sectors that contributed the highest CO_2 emission must be taken into consideration.

The environmental problems are the biggest issues faced by Malaysia. Malaysia has experienced one of the least environmental problems in Asia. However, with the enormous of Malaysian structural change of recent years through the industrialization, agriculture, tourism, and export activities indicated the positive economic growth of Malaysia over the years. Due to this growth has caused pollution for instance air pollution from industrial activities and motor vehicles emissions as well as water pollution from raw sewage. The continuous rising of pollutions could have many other damaging effects. One of the damaging effects had occurred was the global warming due to rising in generation of CO_2 emission. The impact of CO_2 emission to the environment is it might harm plants and animals living in the sea or land due to extremely heat. It also could change the world patterns, causing floods, drought and an increase in damaging storms.

In terms of well-being and health, human disease could spread such as malaria and dengue, and crop yields could decline. Longer-lasting and more intense heat waves

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could cause more deaths and illnesses as well as increase hunger and malnutrition. All of these disasters are mainly caused by human activities and it will continue growing if there is no appropriate control. The disasters such as floods, landslides, erosion and extremely heat often occur in Malaysia and it can destroy many things like houses, cars, home appliances and infrastructure.

Most floods that occur are natural disaster of cyclical monsoons during the local tropical wet season that are characterized by heavy and regular rainfall from October to March. However, floods that occur in December 2006 to January 2007 in Southern Johor were believed due to recent global warming effect and unplanned development, for example inadequate drainage in many urban areas. Meanwhile, the disaster such as landslides that occur in many part of Malaysia was due to deforestation for the development activities at hill sites were abandoned for a long period, affecting the maintenance of the slopes could cause landslides.

Disaster have the negative effects on the economy through reconstruction such as repairing and replacing, for example demand on electrical appliances, cements, woods product, medicine, transportation and others. As a result, demand for those goods rapidly increase will resulted the production activities continues actively growing in order to fulfill economy equilibrium in the short and long run period as well as causes an increase the CO_2 emission. Therefore, an increase of CO_2 causing disasters also has an impact on the loss of natural resources because these resources are serving human needs well by providing foods, shelter, clothing and energy. However, disasters also have positive effects for the certain case but very little effects. Hallegatte and Dumas (2009) suggested that the disaster may have the positive economic effects, through the substitution of capital and it refers to productivity effects which investigated by using a model with embodied technical change.

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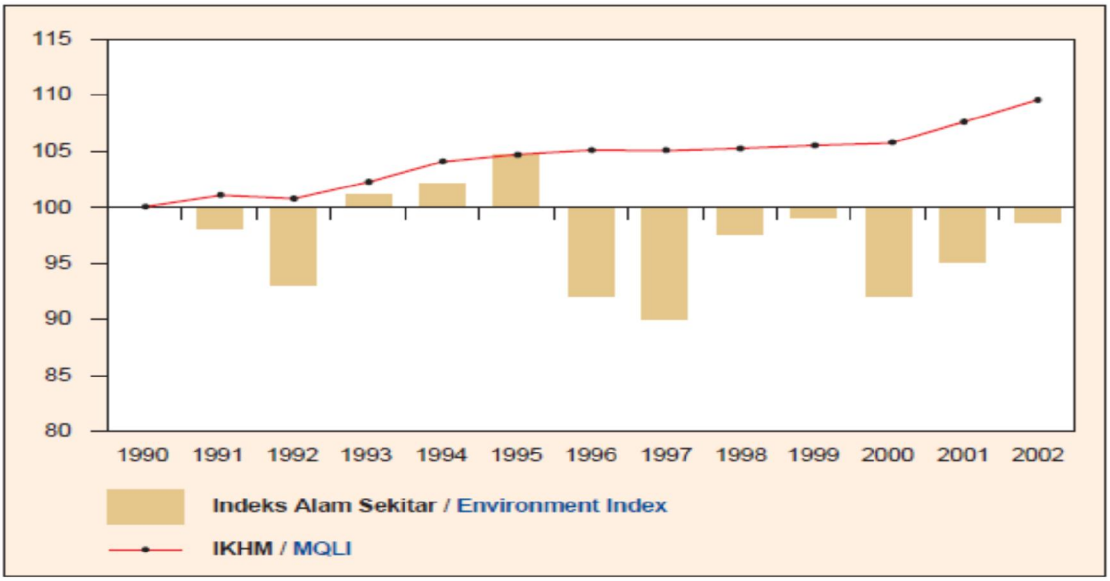

Source: Malaysia Quality of Life, 2004, Economic Planning Unit (EPU), Malaysia

Figure1: Malaysia quality of life index and environment, 1990-2000.

As shown in figure 1, the trend of Malaysian Quality of Life Index (MQLI) is rapidly increase means Malaysia economy grew at positive rate but environment index decrease from 1997 to 2002. Environment index dropped to 4.3 percent from 1990 to 2007 and this should be taken into consideration. As a result, more increase in economy, but less in environmental quality.

Empirically, the relationships between economic growth, energy consumption and environmental have been widely analyzed over the last two decades. The validity of economic growth and environment can be tested, by applying the environmental Kuznets curve (EKC) hypothesis. The empirical studies differ substantially and are not convincing to present policy recommendations that can be applied across countries. An evaluation of the empirical studies suggests that most studies focus either on the economic growth–energy consumption nexus or economic growth–environmental pollutants where little attempt has been made to test these two links under the same framework.

Literature on the relationships between economic growth, energy consumption and environmental degradation has been reviewed by Zhang and Chen, (2009) on three strands. The first strand focuses on the relationship between economic growth and environmental pollutants by applying the environmental Kuznets curve (EKC) hypothesis of Grossman and Krueger (1991). The second strand of the research is the relationship between economic output and energy consumption. This means that economic growth and output may be together determined, because economic growth

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is directly related to energy consumption as higher economic development needs more energy consumption (Haliciogl, 2009). The third strand is a combination of these two strands which examines the relationships between three variables: economic growth, energy consumption and environment degradation.

The approach of EKC assists examining the dynamic relationships between economic growth, consumption of energy and environment degradation. For example, Ang (2007) applied the vector error-correction and co-integration modelling technique to examine the dynamic causal relationship between growth, energy consumption and emission for France and used exactly the same ideas for Malaysia (Ang, 2008). Ang (2007) concluded that France is an independent economy in energy corresponding to its policy to achieve energy independence in the long term; however, Malaysia is an energy dependent economy due to its rapid industrialization that requires high and more efficient energy consumption and concluded that output growth of Granger causality test causes energy consumption in Malaysia. But, there is weak evidence of causality running from carbon emissions to income in the long run, but no feedback link is observed.

The rapidly economic development through urbanization, industrialization and other land-use activities since the 1980s later caused water, air and land pollutions, which have remained as serious environmental problems in Malaysia (Khalid, 2007). A number of authors maintain that fundamental solutions to many environmental problems should be considered in combination with current energy consumption patterns (e.g. Duchin and Lange, 1994; Duchin, 1996; 1997;1998).

This study use input output model (IO) because it helps to reduce the effect of price distortion on the results and makes analyses of the result easier. Most importantly, this model can determine to what extent each sector consumes energy and generates the CO2 emission. For example, Cruz (2002) suggested that such an approach provides a consistent and systematic tool to appraise impacts of measures regarding the achievement of both pollution control and sustainable development for Portugal, regarding the energy intensities and CO_2 emissions derived from fossil fuels use and CO_2 emissions are reported, Alcantara and Padilla (2006) presented an approach that allows the identification of the “key” productive sectors responsible for CO_2 emission.

Tunc et al. (2006) estimated the CO_2 emissions for the Turkish economy using an extended I-O model using 1996 data in order to identify the sources of CO_2 emissions. Lise (2006) stated that the emission growth in Turkey, over the period 1980-2003, was almost 80% as a result of the growing economy, 13% as a result of structural change towards more energy-intensive sectors and 13% as a result of an increase in the carbon intensity of energy, while decreasing energy intensity offset these increases by 7%.

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Mongelli et al. (2006) suggested that developing countries may become a shelter for the production of not environmental-friendly commodities using an extended I-O model. In this case, the so-called Pollution Haven Hypothesis, due to freer international trade the comparative advantage may change the economic structure and consequently the trade patterns of the countries linked by trade relationships, may occur. Chung et al. (2009) estimate the energy and GHG emission intensity in Korea and concluded that energy consumption and environment counter measure not to slow down the activity of economic as well as achieve GHG reduction using an extended I-O model.

By using an IO table constructed by DOS, this study is divided into energy sector that consists of 3 energy sector and 37 non energy sectors of Malaysian economy sector. Unfortunately, there has been little research done on the impact of production sectors on the environment in Malaysia, particularly by applying input-output analysis (IO). Therefore, the significant of this study is it covers the production sector in detail that has contributed the highest value added in GDP with the highest CO_2 emission generation. Jaafar et al. (2008) applied an input-output analysis in their study on electricity generation and its impact on the environment in Malaysia.

The main objective of this study is to identify the sectors that contributed high impact of economic growth on CO_2 emission. This study will start by presenting the step in measuring the CO_2 emission intensity by sector. Then, the results and findings regarding the CO_2 emission by sector will be presented. Lastly, conclusions and policy implication will be discussed.

2. Methodology

2.1 CO_2 emission intensity (M)

This study focus on CO_2 emission only because this emission is the most listed in the IPCC (revised in 1996) and most effect to climate changes. This study used the emission factor recommended in IPCC guidelines (Module 1) for the assessment of the amount of CO_2 emission caused by energy consumption. CO_2 emission factor were calculated based on models below:

$$f_i = C_i / e_i \qquad (1)$$

where f_i is the CO_2 emission factor of energy type 1 i.e. petroleum product. C_i is the CO_2 emission from energy type 1 and e_i is the energy consumption by sector type 1.
In order to estimate the CO_2 emission intensity, the models used as below:

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$$\boldsymbol{M = (m_i \# r_i)\, f\, (I\text{-}A)^{-1}} \qquad \textbf{(2)}$$

Equation (2) estimates the CO_2 emissions intensity (multiplier) in the Malaysia economy sector by using the extended input-output model introduced by Leontief and Ford (1972). ***M*** is denotes as CO_2 emission intensity (multiplier), **m** is a 11x40 matrix of fuel mix in the production sectors, i.e. demand for 11 energy types per unit of total demand for energy for all production sectors; **r** is a 1x40 vector of energy intensities, i.e. total energy consumption per unit of production in all 40 sectors; ***f*** is a 11x1 vector of CO_2 emissions per unit of consumption of each of the 5 energy types; $\mathbf{(I\text{-}A)^{-1}}$ is the 40 x 40 Leontief inverse matrix. Whereas f, m_i, r_i, $(I\text{-}A\text{-})^{-1}$ are factors of behavior of the sector in the economy, i.e. demand for inputs in the energy supply sector and other production sectors.

In order to estimate generation of CO_2 emission in Malaysia, the models used as below:

$$\mathbf{E_i = M.V} \qquad \textbf{(3)}$$

Where $\mathbf{E_i}$ is denotes a vector of total CO_2 emissions in the production sectors as a consequence of production of goods and services; **V** is denotes as value added in Equation (8).

This study used the 40 sector classification input-output tables for Malaysia for the years 2005 published by the Department of Statistic (DOS), in current prices. The 40 sectors consist of 37 non-energy sectors and 3 energy sectors which are petroleum products (motor petrol, gasoline, diesel, kerosene, LPG, refinery gas, non energy, aviation fuel and fuel oil), coal and natural gas and electricity. Energy consumption data for 2005 are taken from the National Energy Balance of Malaysia Energy Centre (PTM, 2006) and the Ministry of Energy, Water and Communications Malaysia. While the data concerning to CO_2 emission factor by calculating the energy consumption and CO_2 emission in Malaysia recommended by IPCC, Module 1 (revised in 1996)

3. Results and Findings

3.1 Comparison CO_2 emission intensity of Malaysia to the other countries.

Malaysia's CO_2 emission intensity is higher than world average as shown in figure 2. CO_2 emission intensity is measured in tones of CO_2 emitted from the use of energy to produce a unit of GDP (US$1,000). The CO_2 emission intensity of developed countries such as united State, Singapore, Japan and United Kingdom are lower because the main sector of these nations mostly come from service sector, which uses less energy to produce per unit of GDP compared to the developing countries such as Malaysia is

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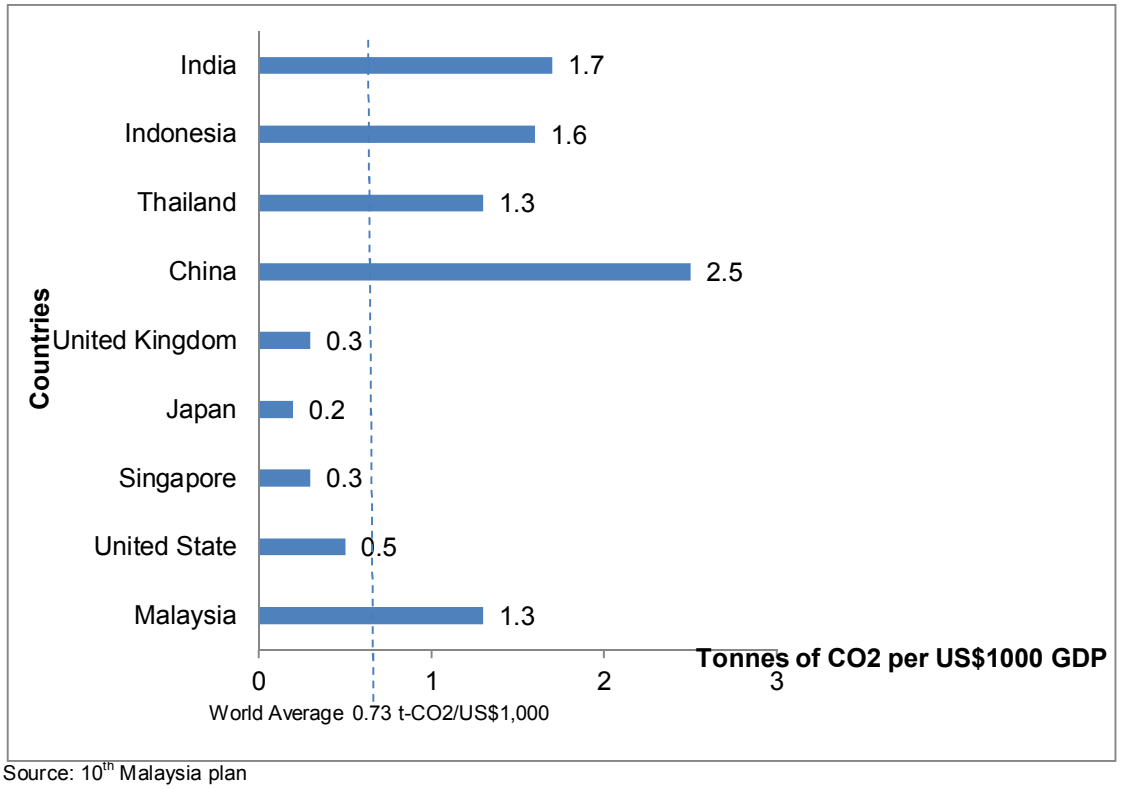
based on manufacturing goods, then intensity would be higher compared to a country which imports manufactured goods.



Source: 10th Malaysia plan

Figure 2: CO_2 emission intensity for selected countries, 2007 (in t- CO_2/US$1000GDP)

In order to measure CO_2 emission intensity of Malaysia whether it has employed clean or polluted technology in it production sectors is by comparing the CO_2 emission intensity of Malaysia and the developed countries because most of developed countries like U.S., UK, Japan and Singapore are already applied the clean technology in their production activities. Developed countries have dominated the boundaries of technology that have innovated and adopted new technologies the earliest (World Bank, 2008). Therefore, CO_2 emission intensity of developed country can be used as a measurement tools in order to measure the level of CO_2 emission intensity of Malaysia. In this case, Malaysia should reduce the CO_2 emission intensity so that it level is in par with CO_2 emission intensity of developed country.

In order to reduce energy intensity and CO_2 emission intensity, most of developed countries have applied a few strategies such as improve the energy efficiency in manufacturing sector and production. Some developed countries have moved from

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manufacturing sector towards services sector and import products that are energy intensive to produce and increase their GDP at a rate higher than CO_2 emission. The country such as United State and United Kingdom is outsourcing the production to the other developing country such as China as solution in reducing global energy use and global GHG emission but it is not the best solution because those developing countries will bear the highest CO_2 emission intensity. Therefore, Malaysia requires technology transfer, skills and knowledge in order to improve energy efficiency. Consequently, the producers and consumers should share the benefits and costs to obtain this solution.

3.2 CO_2 emission intensity (multiplier) in Malaysia.

Firstly, this study will estimate the CO_2 emission intensity in order to quantify the CO_2 emission by production sectors. CO_2 emission intensity is the ratio of CO_2 emissions produced to GDP or value added (1 unit of CO_2 per Ringgit Malaysia). This intensity is used to estimates of CO_2 emissions based on the amount of energy use by each sector and it may also be used to compare the environmental impact of different sectors. This study has divided the production sector into energy and non-energy group. Energy groups consists the primary energy (crude oil, coal and natural gas), petroleum product and electricity, while non-energy groups are consists the sector of agriculture, manufacturing, transportation and services.

In the whole production sector found that average value of the total energy intensity and CO_2 emissions intensity caused by energy consumption in Malaysia in 2005 was found to be 64.5 (toe/M-RM) and 0.272 (T- CO_2/M-RM), respectively. The sectors that are below both average values are considered that those sectors are improve energy efficiency and produced environmental friendly products because they use less energy and less intensive CO_2 technology in the production activities. However, the sectors that are above both average values are considered as those sectors use higher energy and produced the polluted products because from this analysis found that this sector use more energy and very intensive CO_2 technology. Therefore, those polluted sectors are encouraged to take an accurate action in order to reduce their CO_2 emission production voluntarily so that their CO_2 emission intensity shift to the below average value. This is very important to the production sectors to take part in reducing CO_2 emission.

The main sources that increase in CO_2 emission intensity is from energy consumed for every unit of Ringgit. From this analysis, we can trace the main sources that caused the increasing in CO_2 emission intensity through the energy consumption for every Ringgit Malaysia. Estimating for energy intensity and CO_2 emission intensity is becoming the crucial step in appropriate understanding the energy consumption structure and generation of CO_2 emission. As a result, Table 1 have categorized of energy intensity and CO_2 emission intensity into four; High-High, High-Low, Low-High and Low-Low. The

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sectors in the category of High-High are Electricity, Manufacture of yarns and cloths, Manufacture of other textiles, Other chemical industries, Other non-metallic manufacture, Manufacture of cement, Irons and steels industries and Transportation sector. The Electricity sector has the highest energy intensity at about 328toe/M-RM and generates at about 0.367 T- CO_2/M-RM. For example, in order to produce 1 million Ringgit of electricity was used about 328 toe of energy and will generate 0.367 T- CO_2 of CO_2 emission.

Table 1: Energy intensity and CO2 emission intensity by category

Category	High-High		High-Low		Low-High		Low-Low	
Sector	Energy intensity (toe/M-RM)	CO2 emission intensity (tCO2/M-RM)	Energy intensity (toe/M-RM)	CO2 emission intensity (tCO2/M-RM)	Energy intensity (toe/M-RM)	CO2 emission intensity (tCO2/M-RM)	Energy intensity (toe/M-RM)	CO2 emission intensity (tCO2/M-RM)
Crude petrol, natural gas and coal							27	0.063
Petroleum products			79	0.197				
Electricity	328	0.367						
Agriculture							25	0.101
Mining					64	0.316		
Manufacture of oils and fats							40	0.264
Manufacture of other foods							46	0.236
Manufacture of yarns and cloth	91	0.403						
Manufacture of other textiles	77	0.392						
Manufacture of wearing apparels							33	0.203
Manufacture of wood product							50	0.266
Manufacture of industries chemical			124	0.216				
Manufacture of paints and lacquers							43	0.174
Manufacture of drugs and medicines					61	0.33		
Manufacture of soap etc.							45	0.193
Other chemical industries	91	0.439						
Manufacture of others products					56	0.304		
Other non-metallic manufacture	86	0.515						
Manufacture of cement etc.	208	0.93						
Iron and steel industries	86	0.403						
Manufacture of non-ferrous metals							34	0.19
Structural metal industries					55	0.301		
Other metal industries					59	0.38		
Manufacture of industries machinery							41	0.222
Man. of household machinery							17	0.125
Manufacture of radio, television etc.							18	0.14
Man. of electric appliances etc.							16	0.114
Man. of other electric machinery							26	0.158
Manufacture of motor vehicle							47	0.269
Construction			49	0.309				
Wholesale and retail trade							46	0.154
Transportation	101	1.162						
Communication							38	0.145
Real estate							39	0.166
Business services							38	0.225
Education							32	0.108
Private non-profit institution							23	0.078
Recreation							48	0.122
Recycling							6	0.033
Others services							42	0.168

Source: Calculation from equation 2.

Comparing to Transportation sector, this sector uses about 101 toe of energy in order to produce 1 million Ringgit of Transportation, but it has produced the highest CO2 emission about 1.162 T-CO2/M-RM. It shows that the sector with the highest energy

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intensity is not necessarily generating the highest CO2 emission. However, those sectors are typically characterized by industries that are not employing the environmental-friendly processes or those sectors have carried out combustion process on a big scale. Consequently, those sectors in this category have to take into consideration in order to reduce their energy intensity and CO2 emission intensity.

Then proceed to the next category; High-Low. The sectors in this category are Petroleum product, Manufacture of industries chemical and Construction. The sectors with higher energy intensity but with lower CO2 emission intensity than the average are employ low CO2 emitting energy use or employ combustion technology but consume much more energy than the other sectors. These sectors are managed to reduce CO2 emission for every million Ringgit of output with high energy use that above than average value of both energy intensity but below than average value of CO2 emission intensity. Although those sectors have the higher energy intensity but it can reduce the CO2 emission intensity below than average value of CO2 emission intensity.

In the category Low-High, the sectors such as Manufacture of oils and Fats, Manufacture of drugs and medicine, Manufacture of others products, Structural metal industries, Others metal industries and manufacture of motor vehicles have low energy intensity but higher in CO2 emission intensity. This situation should be taken into account for their lowers energy consumption but generates high CO2. This means those sectors has been applied extremely CO2 emission intensive technology and typically characterized by industries that use processes that are not eco-friendly in terms of energy use or carry out combustion process on a large scale. These sectors are succeeded to reduce their energy use but produced high CO2 emission for every million Ringgit of output that below than average value of both energy intensity but above than average value of CO2 emission intensity.

However, most production sectors in Malaysia are in the category of Low-Low because most of them have used the process that are environmental friendly in terms of energy use and carry out combustion process on a small scale due to their lower energy intensity and CO2 emission intensity than average value as shown in Table 1. The sectors that are in this category are Primary energy products, Motor vehicles, Wood products, Mining, Foods, Chemical industries, Soap products, Non-Ferrous metal, Electric and electronic products, Machinery and Services sector. These sectors are succeeded to reduce their energy use and produced low CO2 emission for every million Ringgit of output that below than average value of both energy intensity and CO2 emission intensity.

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3.3 The relationship between value added and CO_2 emission.

By employing CO2 emission intensity, it can quantify the CO2 emission generated by value added of each sector. So the relationship between value added and CO2 emission for each sector was shown in figure 3. The regression lines are plotted and slopes indicate CO2 elasticity of value added which is smaller than unity. If the sector is above regression line, it actually CO2 emission factor will be larger than that predicted by the regression model and the measures to reduce CO2 emission must be taken. Further, the average value of value added and CO2 emission for all sectors in 2005 are used as the origins of the coordinate system shown in these figure. The value added of a sector that lies to the right of the ordinate axes is higher than the average value. On the other hand, the value added of a sector that lies to the left of the ordinates axes is lower than the average value.

From the figure 3 also shows the relationship between GDP by sector (value added) and CO_2 emission intensity in 2005. Firstly, this scatter plot has divided into 4 quadrant; quadrant I, II, III and IV. The sectors that lie in quadrant I indicates that they produce lower GDP with higher CO2 emission such as (16), (3) and (11), while the sectors that lie in quadrant II indicates they produces higher value added with higher CO2 emission such as Transportation(32), Business services (35), Wholesale and retail trade (31), Other products (17), Construction (30), other electric machinery (28), Real estate (34), Primary energy (1), Other services (40) and Agriculture (4). The sectors that lie in quadrant III indicates that they produce lower value added with higher CO2 emission such as Mining (5), Manufacture of oils and fats (6), Manufacture of other foods(7), Manufacture of yarns and cloths (8), Manufacture of other textiles (9), Manufacture of wearing apparels (10), Manufacture of industries chemical (12), Manufacture of paints and lacquers (13), Manufacture of drugs and medicines (14), Manufacture of soap (15), other non-metallic manufacture (18), Manufacture of cement (19), Irons and steels industries (20), Manufacture of non-ferrous metal (21), Structural metal industries (22), Other metal industries(23), Manufacture of industries machinery(24), Manufacture of household machinery (25), manufacture of radio, television (26), Manufacture of motor vehicles(29), Recreation (38) and Recycling (39), while quadrant IV indicates that the sector produces higher value added with lower CO2 emission such as Communication (33), Education (36) and Manufacture of electric appliances (27).

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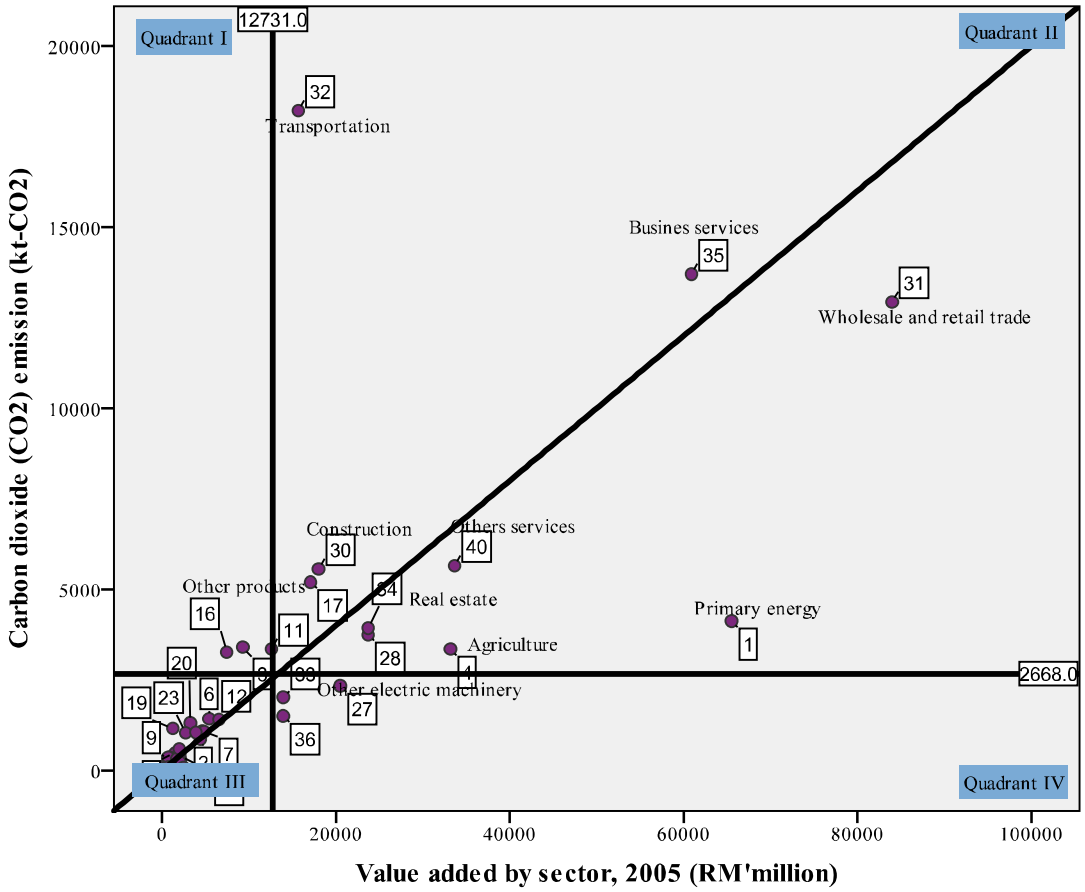

Figure 6: Distribution of CO2 emission for 40 sectors in 2005

Most of sector lays in quadrant II and III rather than quadrant I and IV. The sectors that lies in quadrant I and II should be taken into consideration due to their contribution on high CO2 emission above than average values of CO2 emission (2,668 kt-CO2) but below than average values of value added (RM12,731 million) for the sectors that lie in quadrant I. However, the sectors that lie in quadrant II should be taken into the most consideration due to their high contribution on value added and CO2 emission which above than average values of value added and CO2 emission such as Transportation (32), Construction (30) and Manufacture of other products (17) due to their higher in CO2 emission intensity but produce low in output compare to Wholesale and retail trade (31) and Business services (35) which produce the highest of value added and generates lower CO2 emission. However, Business services (35) and Wholesale and retail trade (31) should reduce their CO2 emission generation so that they can move down to quadrant IV which more better.

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The sectors that lie in quadrant III should not be a big problem because their value added and CO2 emission are relatively lower than average values. Therefore, those sectors should find the alternative in order to increase their value added and trying to maintain or reduce their CO2 emission so that they can move to the right to quadrant IV. The sectors that lie in quadrant IV are considered as clean sectors because they are succeeded to reduce CO2 emission below than average value and produce the environmental friendly products with less CO2 intensive technology compared to the sectors that lies in quadrant I and II. The sectors that lie in quadrant IV are Manufacture of electric appliances (27), Communication (33) and Education (36).

4. Conclusions and policy implications

This study has explained the structure of CO_2 emission intensity in each economy sector in Malaysia. In the energy sector, Electricity has contributed the highest CO_2 emission, while in non energy sector; Transportation has contributed the highest CO_2 emission in 2005. Malaysia's effort in protecting the environmental issue based on energy use is by not encouraging new energy intensive sector but will promote the energy efficiency and high production industries. Based on estimation of 40 sectors, stated in table 1, the sector with high CO_2 emission intensity must be taken into consideration particularly the sector located in quadrant II as plotted in figure 3. For example, the sector lies over average value of value added by sector and CO_2 emission have to reduce their CO_2 emission intensity and also should focus on primarily on energy conservation and efficiency improvement rather than environment friendly energy use. In contrast, the sectors lies on less than average value of GDP by sector and CO_2 emission should be supported as strategic industries since they have comparative advantage from the perspective of Malaysian energy and environment.

Analyzing in energy intensities and CO_2 emission intensities is becoming essential step in correct understanding the structure of energy use. Moreover, nowadays, global warming has become the issues of concern particularly those countries with high growth rate in energy consumption and CO2 emission such as Malaysia. Hence energy use and CO_2 emission structure should be taken into account for policy makers. Intensity for each sector should be clearly analyzed and understood so that policy of environment friendly can be recognized. In the future, energy consumption is increasing for the sectors which located in QI and QII. Therefore, the generation of CO2 emission will rise. Mean that, those sectors have not succeeded achieved in their voluntary target in reducing their CO2 emission even though demand of that sector continues growing.

Based on the result and findings, this study found some problems that have to solve for the future benefits. However, government is struggling to find the best strategic to address environment issues particularly generation of CO2 emission produced by

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Transportation sector. For example, government should forbid old vehicles especially lorries and buses from using the roads because old engine may cause incomplete combustion that generate more CO2 compared to new vehicles. The polluted sectors which located in QI and QII should be charged with higher carbon tax due to their higher CO2 emission (above average value). By imposing a carbon tax, producers will strive to reduce CO2 emission by improving energy efficiency.

Acknowledgment

This paper is the continuity of my PhD thesis.

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Appendix.

App: 1

Sector classification:

Crude petrol, natural gas and coal	1	Manufacture of non-ferrous metals	21
Petroleum products	2	Structural metal industries	22
Electricity	3	Other metal industries	23
Agriculture	4	Manufacture of industries machinery	24
Mining	5	Manufacture of household machinery	25
Manufacture of oils and fats	6	Manufacture of radio, television etc.	26
Manufacture of other foods	7	Manufacture of electric appliances etc.	27
Manufacture of yarns and cloth	8	Manufacture of other electric machinery	28
Manufacture of other textiles	9	Manufacture of motor vehicle	29
Manufacture of wearing apparels	10	Construction	30
Manufacture of wood product	11	Wholesale and retail trade	31
Manufacture of industries chemical	12	Transportation	32
Manufacture of paints and lacquers	13	Communication	33
Manufacture of drugs and medicines	14	Real estate	34
Manufacture of soap etc.	15	Business services	35
Other chemical industries	16	Education	36
Manufacture of others products	17	Private non-profit institution	37
Other non-metallic manufacture	18	Recreation	38
Manufacture of cement etc.	19	Recycling	39
Iron and steel industries	20	Others services	40