Impact of Carbon Dioxide Emission Growth by Energy Consumption in Malaysia

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Abstract

This paper attempts to investigate the impact of CO2 emissions and energy consumption on energy sector in Malaysia using ordinary least square (OLS) method for the period from year 1978 to 2015. The empirical evidence indicates significant positive impact of CO2 emissions on energy consumption for industrial sector and commercial sector. Transport sector has a positive relationship with carbon dioxide emission but insignificant impact on carbon dioxide emission. The coefficient of determination (R-squared) is signal that shows how many percent the independent variables explain the variation on dependent variables. Based on this study, found that that commercial sector and industrial sector is the most sector that give towards the increasing of carbon dioxide emission in Malaysia. the R- squared is 0.990219 @ 99.02% of independend variables of energy consumption explains the movements in carbon dioxide emission, only 0.98% is not explained by independent variables because maybe there is other variables more important than variables that already test.

Keywords *:* Carbon Dioxide Emission, Energy Consumption, Ordinary Least Square, Energy Sector

I. Introduction

Human activities influence the environment, and human actions, particularly those involving the burning of fossil fuels and biomass, create an impact on carbon dioxide emission. The emission of carbon dioxide is showing a rapid increase in the past few decades. Almost 30 billion tons of carbon dioxide enters the atmosphere every year as a result of human activities. Carbon dioxide emission is an important parameter for the indication of environmental impact in an industrial process. The chemical and petrochemical industries are the main contributors of industrial demand for energy not only in Malaysia but worldwide. Their demands amount to about 10% of final global energy consumption, in addition 7% of 'greenhouse gas' (GHG) emissions are associated with these industries (IEA,2013).

Human activities continue to impact the Earth's climate through the emission of greenhouses gases (Safaai, Noor, HaslendaHashim, Ujang, & Talib, 2010). A greenhouses gas (GHG) is a gas in an atmosphere that absorbs and emits radiation within the thermal infrared range. The energy sector is one of the main contributors to a country's economic development as well as social progress. Energy has added value to human existence by means of advancement in production activities, as well as changes in the lifestyle of households all over the world. Paradoxically, energy also causes a detrimental impact on the environment, either directly and indirect, through carbon dioxide emission (chik & rahim, 2012).

Daily life activities will be severely affected without energy. Energy is not only limited to the amount that appears on the monthly utility bill, but it is the foundation of everything we do. All of us use energy every day such as for transportation, cooking, heating and cooling rooms, manufacturing, lighting, and entertainment. The increase in the development of commercial buildings and residential areas has a positive impact on the national development, but it also increases the demand for energy**.** We rely on energy to make our lives comfortable, productive, and efficient. To sustain the current quality of life over a long period of time, it is imperative that we become more conscientious in our use energy resources. Energy efficiency is one of the factors that mitigate climate change (chik & rahim, 2012). As a human, it is difficult to halt climate change even if we stop the emission of greenhouse gasses (GHG) completely. A more workable solution would be to practice a low carbon lifestyle which could minimize carbon input into the environment and create a long-term strategy to mitigate climate change.

The environmental problems are one of the most significant issues faced by Malaysia. Malaysia had experienced one of the least environmental problems in Asia. However, the enormous structural change in recent years through intense industrial,

agricultural, tourism, and export activities indicated positive economic growth of Malaysia over the years. Regrettably, this growth has caused increased pollution for instance air pollution from the industrial activities and motor vehicles emissions as well as water pollution from raw sewage.

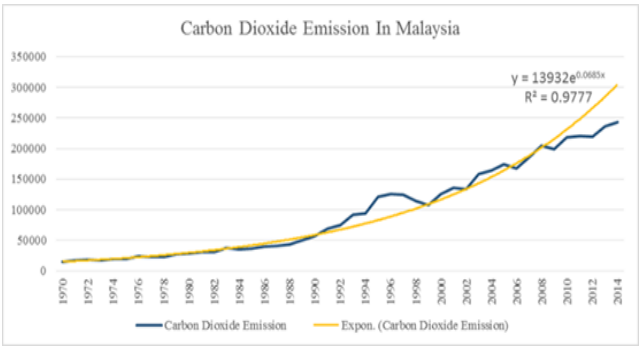

Fig. 1. Malaysia Carbon Dioxide emission per capita in Malaysia from year 1970-2012 Sources: World Bank

Figure 1 shows the continuous rise of carbon dioxide emission in Malaysia from the year 1970 until 2014. The average growth for carbon dioxide emission in Malaysia is 0.0685 from the year 1970 until 2014. The increasing numbers of carbon dioxide emission cause the pollutions that could give many other damaging effects. One of the damaging effects that had occurred was the global warming due to increasing carbon dioxide emission. The impact of carbon dioxide emission to the environment is it might harm plants and animals living in the sea or on land due to extreme heat. It also could change the world's climate patterns, causing floods, drought and an increase in damaging storms. The massive emissions of carbon dioxide from the burning of fossil fuels and give climatic impact. Electricity generation, transportation, industrial and residential are the main sector that identified to contribute to the emission of carbon dioxide in Malaysia. Carbon dioxide is important to prevent the Earth from becoming frozen ball in space but the increasing of carbon dioxide concentrations has resulted in global warming and caused disastrous environmental consequences like increased frequency of storms, floods and droughts (Goodall, 2007).

Carbon dioxide emission that causes the climate change also has apparent negative effects on key economic sectors such as agriculture, water resources, forestry and biodiversity, coastal and marine areas, energy and transport as well as public health. Some of these effects resulted in reduced crop yields (especially for economically important crops such as oil palm, rubber and paddy), water consumption and irrigation shortages, floods, land erosion, encroachment on sensitive habitats with resulting impacts on biodiversity, coral bleaching, damage to infrastructure, impacts on equipment efficiency, and increased transmission of diseases like dengue, malaria and cholera. All these effects of climate change may have a detrimental socio-economic transformation, including deterioration in the economic growth, livelihood opportunities, actual incomes, workforce capacity and human health.

II. Literature Survey

Energy plays an important role in deriving economic growth and hence paving the way for socio economic development and its growing demand is linked to population growth, industrialization and improving the quality of life. The demand for energy products is increasing to fulfill the needs of growing economies. However, increase in the utilization and consumption of energy resources creates pollution due to carbon dioxide emissions. An important strategic commodity and a thought to be life line of the economy is best recognized as energy (H.Sahir, Mukhtar, & H.Qureshi, 2007).

Energy is essential in almost all fields of economics, especially, to keep the environment clean. Previous researcher also found that the factors which could become the reason for reduction of carbon dioxide emissions by using the decomposition method. According to the analysis, there should be a decrease in carbon dioxide emissions with improved technology, energy efficiency and fuel substitution. They also find a huge effect of energy intensity on energy induced

carbon dioxide emissions but they find negligible effect of pollution and carbon dioxide emissions in agricultural sector (Paul & N.Bhattacharya, 2004)

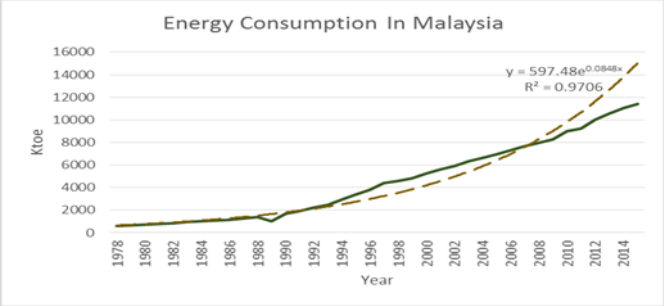

Fig. 2. Energy Consumption in Malaysia from year 1978-2015
Sources: Malaysia Energy Information Hub

Figure shows the continuous rising of energy consumption in Malaysia. The average growth for carbon dioxide emission in Malaysia is 0.0848 from year 1978 until 2015.

Previous researcher also found that the higher energy consumption could become possible because of the improvements in energy efficiency. Energy consumption is dependent on growth and standards of living while energy efficiency is driven primarily by economic reasons. However, conserving energy is much cheaper than to locate a new source of energy, and by conserving a unit of energy is the cheapest way to have an economic adage (Dincer, 1999). In the last decades, Rapid population and economic growth in the South Asia is believed to have primarily responsible for increased energy consumption (Vidyarthi, 2014). Reducing energy consumption may affects the economic prospects of these economies adversely as energy is considered to be direct input to production or complements the labor or capital in production process.

According to Lin, Lu and Lewis (2007), the economic growth and electricity usage are the main factors for the rapid increase in carbon dioxide emission in Taiwan and the growth rate of carbon dioxide emission was found to be higher than energy consumption. Despite the efforts that were made to promote energy conservation and efficiency, industries such as agriculture, forestry & fisheries, foods & products, printing & publishing, chemical products, electricity & power generation and water supply still witnessed a substantial increase in carbon dioxide emission and emission coefficients because of the rapid increase in the demand for electricity in recent years (Lin, Lu, & Lewis, 2007).

In order to fulfill human needs, chemistry provides a fundamental basis for the synthesis of the main, intermediate and finale product (Griffin, 2017). The end products are key to the global economy nowadays extending from agriculture, medicine, through fuels, plastics and synthetic textiles. All of these products will give impact to the emission of the greenhouse gas.

III. Research Methodology

There is many factors influence of increasing in carbon dioxide emissions, including socio-economic developments, like financial development, population and energy use . Based on previous study stated that seven major Asia-Pacific and North American countries selection of countries also reflects the differences in their economic development and energy use patterns together represent about half of the world's economy, population and energy use [9]. Some researcher on energy consumption included financial development, total population and labor force variables in their empirical models to study the impact of these variables on energy consumption. Thus, in this study proposed model, which seems to be consistent with the broader literature on the determinants of energy consumption cited above, takes the following from:

$$EC = f(\ RS, AG, CM, IN, TR)$$

This essentially states that total energy consumption per capita (EC) is a function of residential (RS), agriculture (AG), Commercial (CM), Industrial (IN), transportation (TR). Energy consumption is measured at the equivalent of kg of oil per capita.

The methodology of this study firstly check on normality test.Secondly, it is test on correlation matrix that will be used to identify the relation between the variables. The value of (-1) means that the relation between the variables ifs negative and the value (+1) means the variables is perfectly position relatinship. However the value of 0 will means there is no relationship between the variables.

The relationship between the variables :

$$CO^2 emission = f(\ RS, AG, CM, IN, TR)$$

Where

CO^2emissions is Carbon Dioxide emission in metric tonnes per capita residential (RS), agriculture (AG), Commercial (CM), Industrial (IN), transportation (TR)

The regression model is to test relationship of determinants of carbon dioxide emission and energy efficiency. To test hypothesis, which addresses the relationship between carbon dioxide emission and energy consumption, this study employs the following regression models [10].

$$Y_{it} = \alpha_i + \sum_{j=1}^{5} \beta_j X_{it}^j + \varepsilon_{it}$$

$$(i = 1, \ldots .5 \ and \ t = 1,2, \ldots . .37)$$

(Model 1)

Where Y_{it} , the dependent variables (carbon dioxide emission); α_i constant; X the explanatory variables (dependent variables); ε_{it} the error term. $\sum_{i=1}^{5} \beta_j X_{it}^j$ refer to 5 independent variables.

To consider the alternative measure of the energy effieciency, equation 3.1 is detailed as follows:

$$CO_{it}^{2} = \alpha_{it} + \beta_1 RS_{it} + \beta_2 AG_{it} + \beta_3 CM_{it} + \beta_4 IN_{it} + \beta_5 TR_{it} + \varepsilon_{it}$$

(Model 2)

Where :

i = Sector 1 to 5
t = From year 1978 – 2016
$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ = Coefficient of Independent Variable
CO^2 = Carbon Dioxide Emission (Dependent Variables)
RS = Residential
AG = Agriculture
CM = Commercial
IN = Industrial
TR = Transportation
α = Constant Coefficient
ε = Residual Term

IV. Results and Discussion

Table 1. Descriptive Analysis

	CO2_EMISSION	AGRICULTURE	INDUSTRIAL	COMMERCIAL	RESIDENTIAL	TRANSPORT
Mean	116544.0	10.23684	2199.789	1565.632	1157.632	5.526316
Median	117659.4	5.000000	2220.000	1350.000	770.0000	1.000000
Maximum	242821.4	40.00000	5218.000	3659.000	2435.000	23.00000
Minimum	23237.78	5.000000	323.0000	281.0000	770.0000	1.000000
Std. Dev.	72917.11	10.23094	1574.698	1038.645	538.9850	7.251232
Skewness	0.284446	1.687102	0.287663	0.592071	1.112126	1.454047
Kurtosis	1.741932	4.413360	1.750024	2.186463	2.824925	3.500336

The descriptive statistics mean, standard deviation (Std. Dev.) and the coefficient of variation (CV) of these variables are recorded in Table 1. CO2 emission is measured in metric tons per capita. Energy consumption is measured at the equivalent of kg of oil per capita. Carbon dioxide emission indicates the higher value achieved is 242821.4, with mean value of 116544.0. The mean growth rate of Industrial sector is the highest with 2199.789 value compared with agriculture sector, commercial sector, residential sector and transportation sector.

Table 2. Correlation Result Analysis

	CO2_EMISSION	AGRICULTURE	COMMERCIAL	INDUSTRIAL	RESIDENTIAL	TRANSPORT
CO2_EMISSION	1					
AGRICULTURE	0.7803	1				
COMMERCIAL	0.9824	0.8528	1			
INDUSTRIAL	0.9875	0.7651	0.9657	1		
RESIDENTIAL	0.9101	0.9296	0.9469	0.9071	1	
TRANSPORT	0.8480	0.9637	0.9007	0.8383	0.9609	1

Table 2 demonstrates the Pearson correlation analysis between independent variables for checking multicollinearity problem before regressing the data analyses. From this analysis, data regressions do not pose serious multicollinearity problems between all independent variables. The variable is positively correlated. Therefore, it is not large enough to cause any concern in the regression model. Hence, the data regressions can be used to interpret the factors that impact on carbon dioxide emissions.

Table 3. Regression result analysis

Dependent Variable: CO2_EMISSION
Method: Least Squares
Date: 01/27/18 Time: 14:52
Sample: 1978 2015
Included observations: 38

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	15136.89	7618.203	1.986937	0.0555
AGRICULTUR	-573.5178	537.6520	-1.066708	0.2941
COMMERCIAL	43.67760	6.535558	6.683071	0.0000
INDUSTRIAL	23.54535	3.719241	6.330686	0.0000
TRANSPORT	281.5286	882.1852	0.319126	0.7517
RESIDENTIAL	-12.48714	12.46152	-1.002056	0.3238

R-squared	0.990219	Mean dependent var	116544.0
F-statistic	647.9068	Durbin-Watson stat	1.883855
Prob(F-statistic)	0.000000		

Table 3 shows the result of energy consumption on carbon dioxide emission that specific to agriculture sector, commercial sector, industrial sector, transportation sector and residential sector. Multiple linear regression analysis used to evaluate 38 sample of data to identify the impact and relationship of independent variables on dependent variables.

The coefficient of determination (R-squared) is signal that shows how many percent the independent variables explain the variation on dependent variables. Based

on this study, the R- squared is 0.990219 @ 99.02% of independend variables of energy consumption explains the movements in carbon dioxide emission, only 0.98% is not explained by independent variables because maybe there is other variables more important than variables that already test.

Durbin-watson statistic is a number that test to detect any autocorrelation in the regression analysis. Based on the table above, the durbin-watson statistic value is 1.883855 which based on 38 samples and also five independent variables. The durbin-watson value is close to two,shows there is no auto-correlation problem in the regression model.

Based on the result only commercial sector and industrial sector have significant impact towards carbon dioxide emission with positive relationship towards the dependent variables. Another three sector which is agriculture sector, transportation sector and residential sector shows no significant impact and negative relationship for agriculture and residential sector. Meanwhile, transportation sector give positive impact towards the carbon dioxide emission eventhough it is not significant towards the dependent variables.This result shows that commercial sector and industrial sector is the most sector that give towards the increasing of carbon dioxide emission in Malaysia. Thus, this two sector is closely related to the economic growth of Malaysia.

V. Conclusions and Recommendation

This study has explained the structure of CO2 emission towards the energy consumption in five sector in Malaysia that listed in Malaysia information hub. In the energy sector, this study found that commercial and industrial sector that give high impact towards the increasing of carbon dioxide emission in Malaysia. It was also found that there is a relationship between the variables and the fact that the relationship also was strong relationship as the value of R square is 99%, only 1% effected by others factor.

Presently, there is no specific policy related to energy sector that controlling of CO2 emissions in government plans like National Physical Plan (NPP) or Government Transformaton Program (GTP) to directly deals with energy and CO2 issues. As evidenced by the current study, Malaysia, being one of the most rapidly growing countries in Asia, with the persistent consumption of energy for the purpose of economic growth especially from commercial and industrial sector would significantly contribute to air pollution in this country. The Malaysian government should establish a comprehensive policy to support and monitor environmental protection to encourage preservation of natural resources for sustainable economic development and taking into account the growing energy consumption and domestic energy supply constraints.

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