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**Article**

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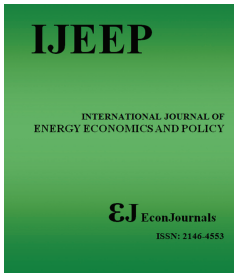

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# Renewable Energy Use and Its Effects on Environment and Economic Growth: Evidence from Malaysia

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**ABSTRACT**

The purpose of this study was to analyse the impact of renewable energy use in Malaysia on the environment and economic growth and directing study findings to stimulate developing economies in Arab region to evaluate its economic returns from renewable energy uses. In this study, a set of time series data has been used which is ranging from the year 1989 to 2018. Moreover, the stationary of the data was tested through Augmented-Dickey Fuller (ADF) test. The normality test of the data distribution was also conducted with the help of Jarque Bera test. In addition to the methods, due to the existence of unit roots, an ARDL technique was also incorporated which tested the influence of renewable energy use on the growth and environment of Malaysia. The findings of the study imply that the renewable sources usage in Malaysia was found to have a positive and significant relation on the $CO_2$ emissions in the case of Malaysia. Furthermore, the findings of the study also suggested that there is no significant relation between renewable energy use and GDP. Also, it was identified that there was no long-run influence in the variables and hence a short-run influences were recognised.

**Keywords:** Renewable Source, $CO_2$ Emission, GDP, Malaysia
**JEL Classifications:** Q20, F63

## 1. INTRODUCTION

Over the years, several countries around the world have achieved fast economic growth by leveraging industrialisation. In this regard, the economic activities in both emerging and developed countries have expanded to great extent. As a result of this, two major concerns have emerged; firstly, rapid reduction of non-renewable energy sources including diesel, petrol, coal and gas with their significant increase in consumptions, and secondly, the global warming that is affected by the emission of greenhouse gases like methane and carbon dioxide ($CO_2$). Therefore, the challenges pertaining to energy has shifted the focus of different countries towards renewable energies. Due to the adverse environmental impact of conventional energy forms of usage and production, and the limited availability of conventional sources of energy have increased the urgency of using renewable energy sources (Ntanos et al., 2018). According to Bhattacharya et al. (2016), with the advent of different challenges related to energy consumption, the different nations around the world have gradually started to realise that economic growth from the expansion of industrialisation will not last longer if proper measures are not taken to reduce greenhouse gas emissions from fossil fuels, and air pollution.

As per the study of Mathai and Narayan (2017), after the negotiation of Kyoto Protocol in 1997, all the industrialised nations were held liable to restrict their Greenhouse Gas emissions. Following that, the strong focus on replacing the fossil fuels for renewable energy sources have been observed around the world. The significance of renewable energy for positively influencing the environment and economic growth of any country has been well recognised in the existing body of literature. With reference to

the study of Ahmed and Shimada (2019), economic growth of any country is closely linked with their pattern of energy consumption. In accordance with the same study, most of the economies from Latin America, Africa, and Asia have converted their status from low income to middle income nations.

This rapid shift in the development patterns has brought significant demand for energy consumption along with the challenges associated with the conventional sources of energy. In this context, the use of renewable energy is regarded as highly crucial for countries to sustain their economic growth. Similarly, the study carried out by Soava et al. (2018) provides empirical evidence from European Union countries, where positive impact of renewable energy consumption has been found on countries economic growth. The same study holds the view that effective energy policy is highly important for the economic growth of any country, as patterns of energy consumption is inherently linked to GDP, therefore energy policies significantly influences the economic performance of European countries.

Apart from favourable economic impact, the consumption of renewable energy also holds huge importance for making a positive influence on environment. As mentioned in the study of Inglesi-Lotz (2016), the use of renewable energy is one of the most effective and efficient way to prevent environmental pollution, and to ensure sustainable energy development. Similarly, a study conducted by Ali et al. (2017) identifies the positive impact of renewable energy consumption on environment as it plays a key role in reducing greenhouse gases and other air emissions. The same study recognises the huge importance of renewable energy consumption for AEAN countries, and particularly for Malaysia, as 95% of the country's electricity production in 2009 was based on conventional vestige energies.

However, since then country has made some serious efforts in improving the consumption patterns of energy by emphasising on renewable energy usage. According to Abdullah et al. (2019), the government of Malaysia has set an encouraging target to accomplish the high penetration of renewable energy in the overall energy mix of Malaysia. As per the same study, in 2019, the energy coming from renewable energy sources was around 2% as compared to total energy mix; however, the government of Malaysia is planning to achieve 20% penetration of renewable energy by 2025.

The main rationale of this study is to examine the impact of renewable energy consumption on environment and economic growth of Malaysia. There are several studies have already been conducted to investigate the impact of renewable energy consumption on environment economic growth of the country (Kahia et al., 2016; Jónsson, 2019); however, in the context of Malaysia the study lacks proofs pertaining to what is the current status of renewable energy consumption in Malaysia, and what implications it possess with regards to the country's environment sustainability and economic growth. Therefore, another main aim of conducting this study is to fill a research gap and to make a valuable addition in the existing literature.

Based on the key aim of this research, the following research question is developed:

*What is the impact of renewable energy usage on environment and economic growth of Malaysia?*

## 2. LITERATURE REVIEW

The consumption of energy has become a hot topic nowadays since the population is growing day by day whereas the resources are becoming scarce. As per the study conducted by Inglesi-Lotz (2016), this globe is changing into a village as the growing population is demanding for more requirement of energy that is leading towards the usage of fossil fuels such as coal, gas, and oil in fulfilling the requirement of energy. This is creating unsustainable circumstances and many difficulties such as the reduction of fossil fuels, conflicts with regards to the environment and geography, greenhouse effect, global warming, and fluctuating prices of the fuel.

It is also due to the fact that the powerful class of economy has the potential to purchase more resources which leaves the poor class deprived. According to the study conducted by Bhattacharya et al. (2016), it is important that there should be proper accountability of the state so that there should be equal distribution of the resources. In this way, the economy will also prosper if the energy is given to all the sectors whether it is residential, commercial or industrial.

It is the prediction of International Energy Agency, mentioned in a research conducted by Begum et al. (2015), that the consumption of energy might rise up to 53% in 2030 all across the globe where 70% ratio of the world's energy consumption would be approximately used by the developing countries that also includes Malaysia. The economic activities are more specifically based on the production as well as consumption which requires a large amount of energy. With the help of this primary resource, the economic growth is stimulated that helps in increased industrialization. As per the study conducted by Alper and Oguz (2016), the energy sector is influential in the vitality as well as the sustainability of the whole economy, from the creation of jobs to the efficiency of the resource and sustaining the environment.

Renewable energy is a significant source for the generation of power in the upcoming future as these resources can be used for producing useful energy multiple times. The resources of the energy are usually categorized as fossil resources, renewable, as well as the resources of nuclear energy. As per the study conducted by Popp et al. (2011), there are different resources of the renewable energy, such as hydropower, wind, solar, biomass, ocean energy, biofuel, geothermal, etc., that tends to provide about 15-20% of the entire global energy.

Because of the environment-friendly and less emission of harmful gases from renewable energy, it is known to be a sustainable energy source. All over the world, there are around 1.6 billion people who do not have access to the electricity, while on the other hand, approximately 1.1 billion people are living with the deprived supply of water. The resources of renewable

energy have the capacity in completing the demand of energy in the world along with protection of environment and provision of energy security. Apart from these advantages of the renewable resources, there are some limitations also that exist such as the difference of output on the basis of seasonal change. It is the most common thing for the power plant that runs by wind and hydroelectricity.

The distribution concerning the technologies of the renewable energy has seen a substantial growth in the past years which is supported by the policies and the sharp decline in the cost of the energy. As per the study conducted by IRENA (2016), the motivations for the increased use of renewable energy included an improved security of energy, less adverse impacts of the climate change and comprehensive access to the energy.

As the economies struggle for regaining the momentum, the policymakers are gradually concerned about the potential benefits for the deployment of the renewable energy on the economic growth as well as job creation. The benefits of the renewable energy consequently have a major role in the formation of the policy decisions and tipping the balance in favour of low-carbon investments. As per the studies conducted by IRENA (2015, 2016 and 2018), inspite of the high reliance on fossil fuels in many Arab countries most developing economies in Arab region have set targets of renewable energy and sustainable energy as part of their national strategies, be these medium-term (2020s) or long-term (2030s) targets. Such targets demonstrate a political commitment to the transition towards renewables. IRENA Studies also pointed that Egypt the most populous country in the Arab region faced rapid increase in energy demand, putting a strain on the country's domestic energy resources even amid substantial recent natural gas finds. Therefore, Egypt government committed to the widespread deployment of renewable energy technologies.

As per the report 2017 on World Energy Markets Observatory, the usage of energy in Malaysia is predicted to rise by 4.8% in the year 2030 (Klingberg, 2019). According to an industry consultant, Capgemini SE, the usage of energy for the purpose of transportation is projected to increase in the upcoming 25 years with a yearly growth rate of about 5.3%. According to the study conducted by Klingberg (2019), the 19$^{th}$ edition of the World Energy Markets Observatory report specified that the overall energy requirements in the country are expected to get triple in the year 2030, as per the observation made with regards to the present level of consumption. As per the total population of Malaysia that is 31.7 million, the consumption of the country was 99.5Mtoe which is a million tonnes of oil equivalent. As per the Department of Statistics (2020), the total electricity utilization in Malaysia is almost 80% of the consumption for the projections in Malaysia, which has risen 9.85% from 135.8 TWh (terawatt hour) in the year 2015 up to 149.2TWh in the year 2016.

As per the study conducted by Bakirtas and Akpolat (2018), the average growth rate on a yearly basis with regards to the consumption of energy in Malaysia is rising year by year. That refers to the key sources where the consumption of energy is high including the consumption of natural gas that has increased up to 9.2% while the consumption of electricity that has raised up to 7.9%. Moreover, the consumption of coal has raised up to 5.1% and the products of petroleum and oil to 4.4%.

The industrial consultant has mentioned in the report that the county is in a difficult battle in contradiction to the climate change, with the increasing demand for energy that outperforms the intensification in the sustainable energy. South-East Asian countries, especially Malaysia is facing a trilemma of energy that refers to a struggle between the striking balance in the energy security, the sustainability of the ecology and competitiveness in the economy. Thus, it is now intending to shift towards clean energy.

Regardless of the increasing shares of the power supply through the renewable source, the consumption in Malaysia was merely about 4.6%, whereas the other is extensively generated from the fuels of fossil that include coal, natural gas, and oil. The cost of coal is inexpensive as compared to the natural gas. As per this finding, the use of coal for generating electricity is predicted to rise for most of the countries in South-East Asia, which also includes Malaysia.

Malaysia has emitted 264 Mt $CO_2$, which names it as the second biggest contributor of carbon dioxide ($CO_2$) in the South Asian region, after Taiwan that emits 276 Mt. The power generators along with the emissions from the automobile are amongst the major contributors in polluting the country that has impacted the ozone layer. The rise of the greenhouse effect has a major influence on the meteorological conditions and also on the rise and fall of the oceans. It can even bring a storm that might tend to result in floods. Malaysia has aimed at slashing $CO_2$ from the current 8 Mt per capita to 6 Mt per capita in the year 2030, which is included in its Green Technology Master Plan 2017-2030. In a nutshell, Malaysia is trying to develop its economy through the usage of a renewable energy resource so that its economy can sustain as well as survive for a long period of time while also conserving the environment through green initiatives.

## 3. THEORETICAL FRAMEWORK AND CONCEPTUAL FRAMEWORK

With regards to the economic growth in a country, following are the theories that have been proposed so that a clear consensus can be made with regards to the topic, providing evident information.

### 3.1. New Economic Growth Theories (Endogenous Growth)

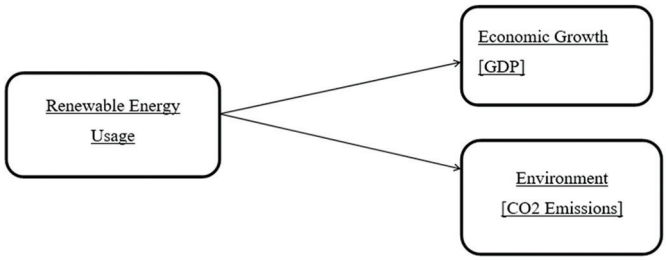
Endogenous growth models are made by Paul Romer and Robert Lucas who have put a great stress on the notion of human capital. Their focus was that how the workers can help in increasing the economic growth in a country. According to the study conducted by Johansson et al. (2011), the new Economic Growth Theory that is Endogenous growth has emphasized on growing both the capital as well as labour productivity. It also states that the diminishing returns cannot be achieved by the increase in the

labour productivity, but, the increasing returns can be achieved. Diminishing returns are dependent on the kind of capital investment.

### 3.2. Harrod-Domar Theory

Harrod-Domar's theory is known as the extensive work on the short-term analysis by Keynes with regards to the employment as well as income theory. The Harrod-Domar growth model is developed on the basis of a long-term theory based on the output. As per the study conducted by Van (2013), the emphasis on the economic growth was paid by the economists when there was a Great Depression in the year the 1930s and economic devastation caused due to World War II. Harrod and Domar have given a model that emphasizes on the needs that are compulsory for having a steady economic growth (Boianovsky, 2018). As per their research, the accumulation of the capital is a key aspect to achieve growth and development in the economy.

The model presented below relates to the concepts of the study and highlights the dependent and independent variable of the study.




## 4. RESEARCH METHODOLOGY

### 4.1. Data

In this study, researcher has aimed to provide more concrete and factual information about the research topic by following the quantitative research approach. The complete understanding of this research study requires the extensive review of existing literature present in different secondary sources. Researcher in this study has emphasised on collecting comprehensive data about the different indicators including renewable energy consumption, GDP, and $CO_2$ emission. Therefore, on the basis of research requirements and the nature of this study, the researcher has opted for collecting secondary quantitative data. The two main secondary sources that have been used in this study for data collection are the official websites of OECD and World Bank. Moreover, researcher has collected the 30 years of times series data from the period of 1989 to 2018.

### 4.2. Data Analysis Method

The appropriateness and preciseness of research findings are highly subjected to the type of approaches and methods that are undertaken to analyse collected data, as any element of biasness in the process of data analysis can make the research findings invalid. In preceding section, the approach of collecting time series data for this study has been highlighted; however, this section presents the methods that researcher has followed to interpret the collected data. In this study, researcher has undertaken particular assumptions to examine how variables within the model are influenced by other models. In this regard, the researcher while conducting regression has taken certain assumption testing considering multicollinearity, normality, unit-root stationarity testing.

For the purpose of testing the stationarity of data, researcher has carried out unit-root testing, which was supported with augmented Dickey-Fuller test (ADF), and executed on each variables of this study. The result of ADF test reveals that time series data that is incorporated in this study has a unit root. This implies that the research data which has been collected for this study was non-stationary. Moreover, researcher was also concerned with determining the normality for the collected data.

For that purpose, researcher has applied Jarque-Bera test, the results of which reveals that all the gathered data was normal. Hence, researcher after confirming that time series data entails unit roots, the normality of collected data has also been validated. Based on this, the Autoregressive Distributed Lag (ARDL) has been identified as more appropriate technique to conduct regression. According to Yang and Wen (2018), ADRL by using the concept of lag helps the researcher to predict the future data while referring to the historical data. This technique is recognised as highly crucial because the data entails no cointegration relationship. Therefore, researcher in this study has followed this technique to create different regression model reflecting the main research question of this study.

$$EcoGrow_t = \alpha + \beta_1 RS_t + + \beta_2 EcoGrow_{t-1} + \beta_3 RS_{t-1} + \ldots \varepsilon$$

$$Envt = \alpha + \beta_1 RS_t + + \beta_2 EnvCons_{t-1} + \beta_3 RS_{t-1} + \ldots \varepsilon$$

Here,
RS: Renewable Sources
EcoGrow: Economic Growth
EnvCons: Environment
t: Present time
t−1: Lagged time
ε: Error.

## 5. RESULTS AND ANALYSIS

### 5.1. Descriptive Statistics

The descriptive statistics of the study which has taken into consideration the dependent and independent variable is discussed in Table 1. Moreover, the mean along with standard

**Table 1: Descriptive statistics**

| | Renewable sources % | GDP (USD) | $CO_2$ emission (metric tons per capita) |
|---|---|---|---|
| Mean | 93.50 | $ 167,918,519,687 | 6.22 |
| Standard deviation | 2.33 | $ 107,731,902,361 | 1.59 |
| Minimum | 88.02 | $ 38,848,567,631 | 2.85 |
| Maximum | 96.18 | $ 359,581,943,446 | 8.53 |
| Jarque-Bera | 1.78 | 3.43 | 4.46 |
| Probability | 0.41 | 0.17 | 0.11 |

deviation with the minimum and maximum values are essential for consideration under each variable. From the Table 1 below, it can be assessed that the renewable sources have been estimated at 93.5% while for the GDP is USD is estimated at 167 billion. In addition, the mean value for the $CO_2$ emission has been estimated as 6.22. In addition, in terms of the standard deviation, the renewable sources are estimated at 2.33%. Moreover, the GDP is estimated at 107 billion USD, whereas, the $CO_2$ emissions are estimated at 1.59. A higher value of the standard deviation has been obtained for the $CO_2$ emissions which are mainly due to increased differences in the minimum and maximum values. As far as the nature of the data is concerned, the values of JarqueBera and probability are also necessary for incorporating because it determines whether the data is normal. The value JarqueBera for the renewable sources is estimated at 1.78 (P = 0.41). Furthermore, the values for the $CO_2$ emissions and GDP has been obtained at 3.43 (P = 0.18), and 4.46 (P = 0.11) respectively. This explains that the data for the variables has not been approximately normally distributed.

## 5.2. Unit Root Testing-ADF

In this part of the research, the unit root testing has been discussed which explains the stationarity or non-stationarity state of the data selected for this study. It has been highlighted that the Augmented Dickey-Fuller (ADF) is applied when it is necessary to assess the stationarity of the data and further assess whether the unit root is present within the time series data. In addition, it is necessary to discuss the assumption associated with the null hypothesis for the state of unit root where the data is based on time series nature. Considering the unit root rest for dependent variables, the t-statistics for the carbon emissions is estimated at 1.946 (P = 0.3074). From the P-value, it can be asserted that it appears greater than the standard significance level of 0.05 which implies that the unit root exists in the time series data. The same can be observed in the case of GDP where the t-statistics is estimated at 0.64 reflecting an existence of unit root.

| ADF test | t-statistic | Prob.* |
|---|---|---|
| $CO_2$ | −1.946 | 0.307 |
| GDP | −1.228 | 0.648 |

It can be asserted from the Table 2 presented below, that the P-value which is estimated at 0.714 appears to be insignificant as it is greater than the standard value of the significance. Hence, the independent variable is also non-stationarity.

**Table 2: Unit root testing for independent variables**

| ADF test | t-statistic | Prob.* |
|---|---|---|
| Renewable sources | −1.067 | 0.714 |

**Table 3: 1st level difference unit root**

| Series | Prob. | Lag | Max. Lag | Obs |
|---|---|---|---|---|
| $CO_2$_EMISSION__METRIC_TONS_PER_CAPITA_ | 0.2514 | 1 | 10 | 28 |
| LGDP | 0.6482 | 0 | 10 | 29 |
| RENEWABLE_SOURCES__ | 0.7147 | 0 | 10 | 29 |

The Table 3 presented above explains the unit root testing for the first level different and it can be assessed that the $CO_2$ emission probability is estimated at 0;25 and GDP is estimated at 0.64 the renewable sources are at 0.714. Hence there is no stationarity in the data.

## 5.3. Autoregressive Distributed Lag (ARDL)

The following section of the research paper discusses the ARDL (autoregressive distributed lag) to examine the causality between the variables. In this research, the ARDL has been used to examine the comprehensive relation between the variables which cannot be carried out with the Johansen cointegration. Since it has been confirmed that the time series data which has been selected for this study includes unit-roots, therefore, it is necessary that there should be an integration of the concepts related to auto-correlation which helps in estimating or predicting the values which are based on either the history or the future. In addition to the above statement, it is also necessary that the researchers should discuss the lag techniques of the time series as it assists in evaluating larger data based on time series and then predicting the values. The study which is under discussion here is based on the assessment of renewable energy usage with its implications and effects on the environment and economic growth. Here, the environment has been measured through $CO_2$ emissions and economic growth has been measured through GDP of Malaysia. Moreover, in this study, since the time series data incorporates unit root, as a result, for the checking the causality amid the variables, the ARDL technique has been used. According to Luqman et al. (2019), the ARDL model is based on the development of the prediction of future values which are based on the maximisation of marginal log observations. In this purpose, it is necessary for the economists and researchers to highlight that the model was developed for the purpose of running the regression on the time series data which includes the issues of multicollinearity.

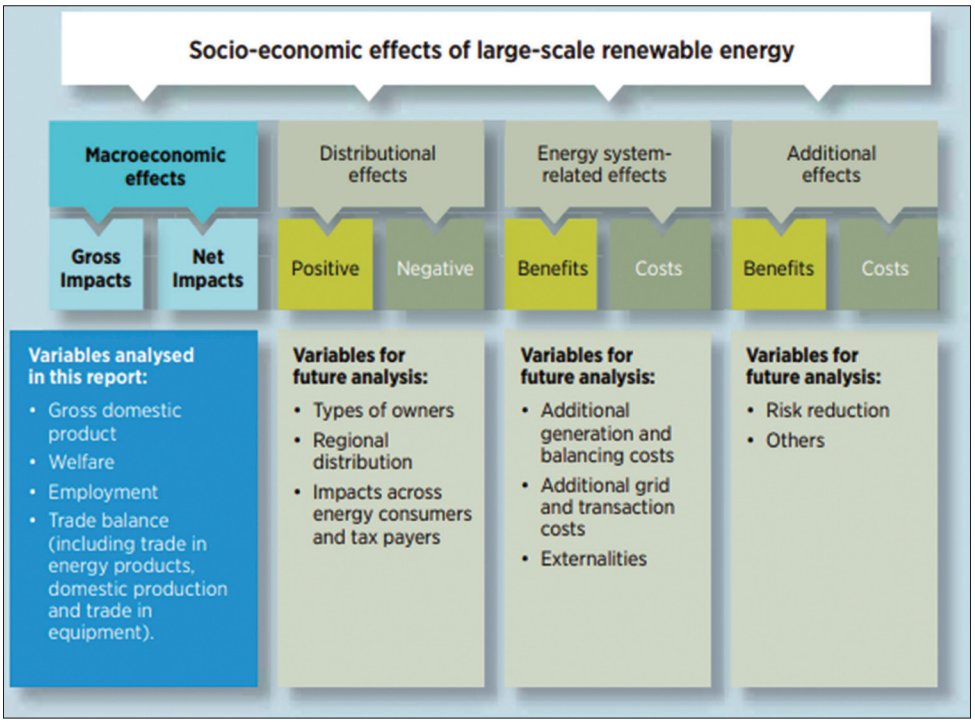
The Table 4 presented below is the first model which has been developed for assessing the relation between renewable sources and carbon emissions with the support of ARDL. From the findings presented in the Table 4, it can be observed that $CO_2$ emissions are dependent on their first lag as it can be computed on the threshold value of 1% significance. However, in the case of the independent variable which is renewable source, it can be observed that is significant at 5% on its third lag as the probability value on the third lag is estimated at (P = 0.0267). Moreover, it is not found significant on the first and second level lags implying that there is non-existence of long-run association between the variables. In this context, the model which has been developed highlights that the R-square is estimated at 94% which suggests that the renewable source predicts 94% for the carbon emissions. In addition, the probability value of 0.02 also reflects the renewable sources mainly influence the $CO_2$ emissions when considering the third lag.

In the following model, the assessment between the renewable sources with the GDP has been assessed. It can be examined from the Table 5 that none of the renewable lags other than the first lag is influencing the GDP which is the dependent variable

**Figure 1:** Energy resources

| Energy resource | Energy conversion and usage option |
|---|---|
| Hydropower | Power generation |
| Biomass | Heat and power generation, pyrolysis, gasification, digestion |
| Geothermal | Urban heating, power generation, hydrothermal, hot rock |
| Solar | Solar home system, solar dryers, solar cookers |
| Direct solar | Photovoltaic, thermal power generation, water heaters |
| Wind | Power generation, wind generators, windmills |
| Wave | Numerous designs |
| Tidal | Barrage, tidal stream |

**Figure 2:** Socio-economic effects of large-scale renewable energy




Source: IRENA (2016)

**Table 4: ARDL in the relation between renewable sources and $CO_2$ emissions**

| Variable | Coefficient | Std. error | t-statistic | Prob.* |
|---|---|---|---|---|
| $CO_2$_EMISSION__METRIC_TONS_PER_CAPITA_(−1) | 0.553479*** | 0.183763 | 3.01192 | 0.0083 |
| $CO_2$_EMISSION__METRIC_TONS_PER_CAPITA_(−2) | 0.444684** | 0.219625 | 2.024744 | 0.0599 |
| $CO_2$_EMISSION__METRIC_TONS_PER_CAPITA_(−3) | −0.05788 | 0.259932 | −0.222664 | 0.8266 |
| $CO_2$_EMISSION__METRIC_TONS_PER_CAPITA_(−4) | −0.39268 | 0.209497 | −1.874385 | 0.0793 |
| RENEWABLE_SOURCES__ | 0.000169 | 0.249201 | 0.000679 | 0.9995 |
| RENEWABLE_SOURCES__(−1) | −0.01009 | 0.372643 | −0.027066 | 0.9787 |
| RENEWABLE_SOURCES__(−2) | −0.67568 | 0.365186 | −1.850226 | 0.0828 |
| RENEWABLE_SOURCES__(−3) | 0.697823 | 0.286085 | 2.439217 | 0.0267 |
| RENEWABLE_SOURCES__(−4) | 0.124049 | 0.10958 | 1.132041 | 0.2743 |
| C | −9.61182 | 7.470521 | −1.286633 | 0.2165 |
| R-squared | 94% | F-statistic | 27.92 | |
| Adjusted R-squared | 90% | Prob(F-statistic) | 0 | |

Significant at 10%; **Significant at 5%; ***Significant at 1%

of the study. However, the model is completely fit because the adjusted R-square is estimated at 96%. Therefore, from the Table 5 presented, it can be asserted that there is no significant association between renewable sources and the GDP in the case of Malaysia.

**Table 5: ARDL in relation between renewable sources and GDP**

| Variable | Coefficient | Std. error | t-statistic | Prob.* |
|---|---|---|---|---|
| LGDP(−1) | 0.908485 | 0.072369 | 12.5535 | 0.000 |
| RENEWABLE_ SOURCES__ | 0.038408 | 0.025937 | 1.480841 | 0.1535 |
| RENEWABLE_ SOURCES__(−1) | −0.04459 | 0.038945 | −1.14481 | 0.2652 |
| RENEWABLE_ SOURCES__(−2) | −0.00519 | 0.028433 | −0.18248 | 0.857 |
| RENEWABLE_ SOURCES__(−3) | 0.021835 | 0.013199 | 1.654334 | 0.1129 |
| C | 0.069794 | 0.554255 | 0.125923 | 0.901 |
| R-squared | 97% | F-statistic | 148.37 | |
| Adjusted R-squared | 96% | Prob (F-statistic) | 0 | |

Significant at 10%; **Significant at 5%; ***Significant at 1%

**Table 6: Table of hypotheses assessment summary**

| S. no. | Hypothesis | Status |
|---|---|---|
| $H_1$ | There is a significant impact of renewable source usage on the economic growth of Malaysia. | Rejected |
| $H_3$ | There is a significant impact of renewable source consumption on the environment of Malaysia | Accepted |

### 5.4. Hypothesis Assessment

In Table 6, the summary of the hypothesis statement has been presented below which is determined with the help of ARDL testing.

## 6. CONCLUSION AND RECOMMENDATIONS

The main objective of this study has been to determine the impact of renewable energy usage on environment and economic growth of Malaysia and directing study findings to stimulate developing economies in Middle East such as Egypt, Morocco, Tunisia, Jordan etc. to evaluate its economic returns from renewable energy uses. For the purpose of achieving this objective, researcher has conducted quantitative secondary study where the 30 years of prior data pertaining to the environment ($CO_2$ emission), economic growth (GDP), and renewable energy consumption has been gathered. The overall findings of this study are based on the 30 years of data, which has been collected from the period of 1989 to 2018 in the context of Malaysia. In order to analyse the collected data, researcher has followed ARDL model which helps in examining the association between the different variables of this study. The findings of this study reveal the significant impact of renewable source consumption on the environment of Malaysia. However, there is no significant impact of renewable source usage on the economic growth of Malaysia has been found.

According to research findings the in Arab region developing economies (Egypt, Morocco, Tunisia, Jordan etc.) that implement sectorial renewable energy policies close to Malaysian sectorial policies expected to show no significant and weak impacts from renewable energy uses on real economic growth.

As per the research findings with regards to the research topic, some recommendations can be proposed so that Malaysia could have better usage of renewable energy that will help it in uplifting the economy. The government of Malaysia should look into this matter and pay serious concerns on the utilization of the renewable energy. It should suggest some policies with regards to the equal distribution of the energy so that no one remains deprived of it. For this, the distribution should be made while catering to both the sectors that are residential and commercial. The state should have a piece of complete information about the population and their needs so that the scale of energy could be set as per the purchasing power and unit consumption. The details of energy resources and Socio-economic effects of large-scale renewable energy is explained in the Figures 1 and 2.

The government should also spend more on the betterment of the industrial sector through efficient utilization of the renewable energy that will help in increasing the rate of GDP in the country. Different public or private organisations along with the government should take a collective initiative so that the scarcity of the energy resources could be levelled through the alternative source that is renewable energy. Not only this but on the state level, awareness should be spread among the public that they should abide by not wasting the resources so that everyone can take advantage of it.

Renewable energy bodies in in Arab region developing economies, that implement similar policies to Malaysian policies, should empowering renewable energy policies in industrial sector towards sustainable economic and environmental returns that lead to high rates of real GDP growth.

While conducting this research which is related to the correlation between the use and effect of renewable energy and the economic growth in the country, Malaysia, basic limitation of the research was shortage of sample size that was very confined and short. Hence, the sample was taken within a limited time frame of only 30 years in this research. Furthermore, the study specifically supports the connection of economic growth with the renewable energy usage that is based on the data of historic-series and just a few pointers were taken under accountability. Moreover, the study was conducted in specific sectors of Malaysia from where gathering data in detail was troublesome.

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