INTERNATIONAL JOURNAL OF ECONOMICS AND FINANCE STUDIES
Vol: 13 **No:** 2 **Year:** 2021 **ISSN**: 1309-8055 (Online) (**pp.** 1-21) **Doi:** 10.34109/ijefs.20212001
Received: 21.02.2021 | **Accepted:** 12.08.2021 | **Published Online:** 01.010.2021

-RESEARCH ARTICLE-

LINKAGE BETWEEN ENERGY CONSUMPTION, NATURAL ENVIRONMENT POLLUTION, AND PUBLIC HEALTH DYNAMICS IN ASEAN

Kittisak Jermsittiparsert

College of Innovative Business and Accountancy,
Dhurakij Pundit University, Thailand
E-mails: kittisak.jer@dpu.ac.th
https://orcid.org/0000-0002-4236-0472

─Abstract─

Energy consumptions, either from renewable sources or traditional sources, ultimately have an impact on the natural environment along with the community. This paper aims to investigate the influence of renewable and fossil fuel energy consumption on the natural environment and public health expenditures of four ASEAN economies; Indonesia, Malaysian, Thailand, and the Philippines. To analysis, data is collected from World Development Indicators (WDI) for the period 1985-2015 on an annual basis. Panel regression estimation is applied to examine whether the trends in the natural environment and public health expenditures are determined by energy consumption sources. The findings of the study confirm that renewable energy sources have a negative impact on carbon emissions, while fossil fuel energy has a direct impact, respectively. However, in terms of public health expenditures, renewable energy consumption (RE) shows a negative influence, whereas fossil fuel energy consumption shows a positive impact. The findings under the present study can be of great practical value for public health organizations, environmental departments, and experts in the energy sector. REC offers a viable solution in terms of lowering the harmful impact on the natural environment as well as reducing the amount of public health expenditure. Furthermore, researchers in the field of environmental science, energy economies, and public health can also utilize the present study, both from a theoretical and empirical perspective. It is pertinent to note however that this study is limited in terms of non-consideration of all ASEAN economies, missing some robust and advanced panel modelling and can potentially benefit from the addition of additional explanatory variables.

Citation (APA): Jermsittiparsert, K. (2021). Linkage Between Energy Consumption, Natural Environment Pollution, and Public Health Dynamics In Asean. *International Journal of Economics and Finance Studies, 13* (2), 1-21. doi:10.34111/ijefs.20212001

Vol: 13 **No:** 2 **Year:** 2021 **ISSN**: 1309-8055 (Online) (**pp.** 1-21) **Doi:** 10.34111/ijefs.20212001

Keywords: Energy consumption, natural environment, panel regression. ASEAN

JEL Classifications: Q01, K32, O13

1. INTRODUCTION

Over the years, the concern for sustainable development has grown significantly globe-over (Silvestre et al., 2019). This attributable to the fact that the environment is increasingly being affected by the economic and financial activities in most economies around the world. It is believed that with the increasing threat to the natural environment, there is a growing concern for the well-being of human populations. The resulting inequality or disturbance in the natural environment affects ecological life as well as the use and availability of natural resources. The conference of the party's agenda to lower down the carbon emission drastically to cap rise to the level of 1.5 degrees over the next century reflects the seriousness of the global warming issue (Owen et al., 2019).

On the other side, it is not only the developed economies, but also emerging as well as poor economies who are facing the severity of the issue of environmental sustainability in the current era (Klinger, 2018). Specifically, in the ASEAN economies, over the past three decades, there has been rapid urbanization along with industrialization, which is translated in terms of economic growth along with higher consumption and demand for energy (Mustapa et al., 2020). This increasing demand among the ASAN members is normally derived from some of the traditional energy sources like fossil fuels, coal, and natural gas, as well as oil. Another trend that is observed in the ASEAN economies is that the share of coal in the energy mix of ASAEN has been on the rise and is projected to increase in the coming years (Mustapa et al., 2020). The current outlook by the international energy agency has confirmed the fact that in ASEAN economies, there is an increase in the demand for fuel, which has now surpassed the regional production capacity and the amount of fuel currently import from outside countries. Although the increasing level of energy demand reflects that there is a growing trend in industrial and other economic activities, at the same time, this growing trend is causing more carbon dioxide emissions in the natural environment (Mason et al., 2018). Figure 1 below reports the relationship between increasing economic activities due to energy consumption along with carbon dioxide emissions as well.

Various researchers have made theoretical and empirical contributions to exploring the association between energy consumption from fossil fuel, renewable sources, and emission of carbon dioxide in the natural environment- (Ladha-Sabur et al., 2019; Remiro-Buenamañana et al., 2019; Doğan et al., 2021). These studies have applied different modelling techniques to explore the dynamic association between energy consumption from different sources and carbon emissions as well. For example, in the ASEAN region, Heidari et al. (2015) and Zhu et al. (2016) have applied the quantile regression methods to investigate into the impact of foreign investment, energy consumption, economic growth and CO_2 emissions. For this purpose, they have focused

on economies likes the Philippines, Malaysia, Indonesia, and Singapore. The study findings confirm the fact that factors like energy consumption along with other macroeconomic dynamics have a significant and heterogeneous effect on the value of carbon emission.

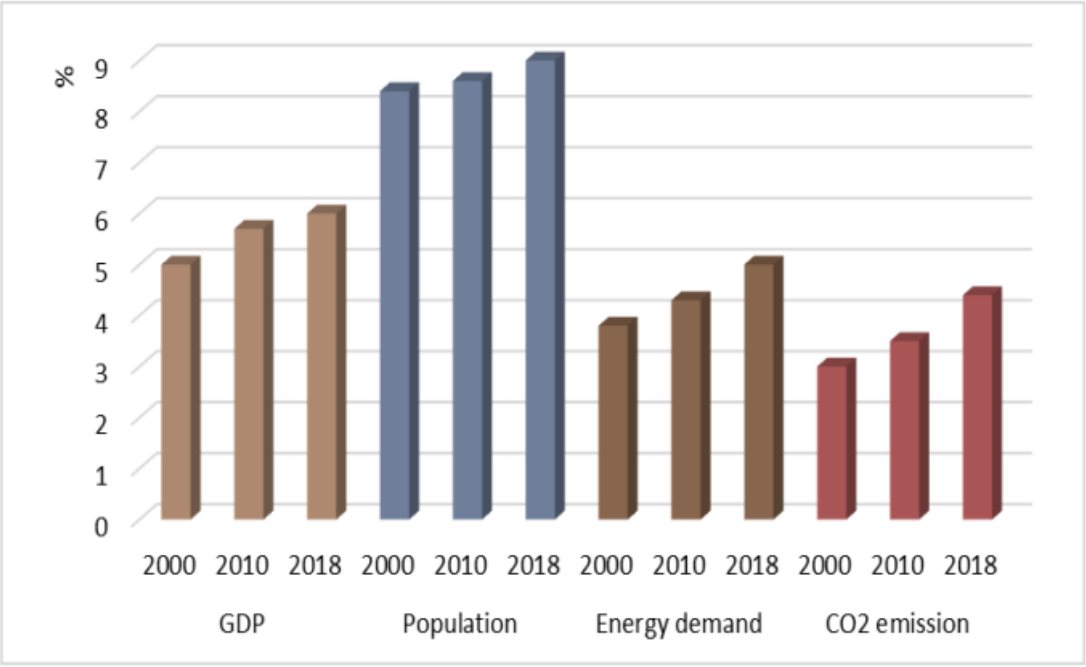

Figure 1. Share of Southeast Asian economies in the gross domestic product, energy consumption and CO_2 emissions, and population of the world economy
Source: Mustapa et al. (2020)

In addition, there are some other authors like Paramati et al. (2021), Pata (2021), and Rehman et al. (2021), who have tried to explore the dynamic linkage between energy consumption patterns and carbon emissions through autoregressive integrated moving average, autoregressive distributive lagged model, linear regression model as well as other panel and time series forecasting methods. Xu et al. (2018), have employed the nonlinear autoregressive networks with exogenous input methods to predict the dynamic association for the input and output variable of the study. The researchers applied a similar technique in the context of the Chinese economy to predict the trends in carbon dioxide emissions while using data from 1978 to 2016. Their study results confirm the fact that that level of carbon emission in China is increasing (Wu et al., 2018).

Although the linkage between energy consumption and carbon emissions is widely observed, however, the association between public health factors and energy consumption has not been investigated enough. For example, Qu et al. (2017) consider the association between energy consumption from different sources, environmental, and

Vol: 13 **No:** 2 **Year:** 2021 **ISSN**: 1309-8055 (Online) (**pp.** 1-21) **Doi:** 10.34111/ijefs.20212001

public health factors in the context of the economy of China (Li et al., 2021). Both long run and short run associations were tested during the study period of 1985-2014. For an in-depth analysis, energy consumption variables like coal consumption, oil and clean energy, environmental pollution through SO_2 emissions, soot, and dust emissions, and finally health proxies like the proportion of cardiovascular and respiratory disease were added in the model. The reason for selecting these variables is their vital significance in the Chinese context. The findings of the study confirmed the fact that there is a significant association between energy consumption, environmental pollution, both in the short and long run. Furthermore, public health levels descend with reference to soot and dust emissions over time. Sun et al. (2018), consider future energy consumption in Beijing along with the economic aspects of public health. Their paper has estimated the $PM_{2.5}$ emission as caused by the energy consumption in the economy of Beijing during 2020, 2025 and 2030, respectively, which were selected through baseline scenario.

Based on the above discussion, the present study sets out to consider energy consumption from two major sources, environmental concerns because of carbon dioxide emission as well as key indicators of public health expenditure in the economy of ASEAN. This is done with a view to take stock of these dynamic variables in a single coherent research work. After literature review, the paper describes the research design and methodology used to reach findings. This is followed by an in-depth discussion of the research outcomes. In the last sections of the study, conclusions along with study implications and recommendation are provided.

2. LITERATURE REVIEW

The current section of this research reviews relevant literature regarding the understudy constructs and their relationships:

2.1 Energy Consumption

In this study two major sources of energy consumption are under consideration. One is known as fossil fuel energy consumption, while the second is observed under the umbrella term of renewable energy consumption. The concept of fossil fuel energy consumption reflects the consumption from the various traditional sources like oil, coal, and natural gas for various economic and industrial activities (Martins et al., 2018). On the other side, renewable energy consumption points to that portion of energy that is consumed through the renewable energy sources like Biomass, Wood, and wood waste. Municipal solid waste, Hydropower, and Wind etc. (Sipra et al., 2018; Zakir Hossain et al., 2014). The present study focuses on both energy sources, and their data was collected based on the World Development Indicators for the period 1985-2015.

2.2 Natural Environment's Pollution

To predict the future extent of pollution in the natural environment, various measures are used in existing literature. However, the present study considers two major measures, which are CO_2 emissions from gaseous fuel consumption (kt) and CO_2 emissions from liquid fuel consumption (% of total). Both measures reflect on the level of carbon dioxide emissions in the natural environment measured through kt and as a percentage of the total. The data for the stated variables are also collected through WDI during the study period identified above.

2.3 Public Health Dynamics

As stated earlier, public health a significant policy concern for every country, and a reasonable amount of investment has been spent by the regional economies on it (Fonseca et al., 2018). This study has added three major dynamics to reflect of public health expenditures in all four panel ASEAN economies. These are identified as Domestic private health expenditure per capita (USD), Current health expenditure (% of GDP), and External health expenditure (% of current health expenditure) in all four targeted economies. The data for these variables are also collected from WDI, as collected, compiled and collated by the World Bank.

2.4 Energy Consumption and Natural Environment Pollution

The consumption of energy from different sources affects the natural environment, including air, water, and natural resources. These include traditional energy resources, also known as fossil fuels such as oil, petroleum, coal, natural gas, and ore, and renewable energy resources, which are sustainable natural resources that can be used for energy (Muhammad et al., 2019). The consumption of fossil fuels causes the release of environmental pollutants like CO_2, while the consumption of renewable energy does not emit CO_2 emissions, but it is an effective way to control environmental pollution (Gorus et al., 2019). A literary article of Waheed et al. (2018), checks the influences of renewable energy consumption, forestry, and agriculture production for Pakistan. For reaching accurate results about renewable energy consumption, forestry, and agriculture production, annual data is acquired over the period from 1990 to 2014, and the Autoregressive Distributed Lag model is then employed to examine their impact on CO_2 emissions levels. The study results indicate that agriculture and forest have a significant negative impact on CO_2 emissions, which means CO_2 emissions can be minimized with an increase in renewable energy consumption, agriculture, and forest area. Hanif et al. (2019), analyze the impact of fossil fuels consumption, economic growth, and foreign direct investment on carbon emissions in fifteen emerging Asian states. This empirical research is based on the panel data for the period from 1990 to 2013 and the application of the Autoregressive Distributive Lag (ARDL) model. The study findings indicate that faster economic growth has a positive association with the level of CO_2 emissions and fossil fuels consumption.

Vol: 13 **No:** 2 **Year:** 2021 **ISSN**: 1309-8055 (Online) (**pp.** 1-21) **Doi:** 10.34111/ijefs.20212001

2.5 Energy Consumption and Health Expenditures

Healthcare expenditures may be of different sorts (precautions from health damage or cure from diseases after the attack) and may be observed at different levels (domestic, current, and eternal health expenditures) (Azam et al., 2019). Different types of energy resources that are consumed affect health expenditures in different ways. Renewable energy resources keep the environment and natural resources safe and thus, minimize health expenditures at all levels. Whereas the consumption of non-renewable energy resources like fossil fuels may cause adverse consequences for public as well as lead to increased health sector expenditures (Fatima et al., 2021). The research work of Apergis, Ben Jebli, et al. (2018), analyzes the relationship of per capita GDP and renewable energy consumption on CO_2 emissions and health expenditures. The study collected cross panel data for 42 sub-Saharan Africa countries for the period spanning from 1995 to 2011. The study implies that the per capita GDP has an impact on CO_2 emissions, while renewable energy is found to have a negative impact on CO_2 emissions. The change in the amount of CO_2 emissions into the air positively affects the total expenditures incurred on provision of health services within a region. A study conducted by Alola (2019), indicates that an increase in greenhouse gas emissions causes climate change which is well-recognized in public because climate change has a direct impact on public health. CO_2 emissions is a prominent greenhouse gas that negatively affects environmental quality and human health. This study also reveals that much of the responsibility for generating carbon dioxide emission in the country lies with fossil fuels consumption; thus, fossil fuels positively influence the extent or amount of health expenditures within the country. Research by Wang et al. (2019), investigates the interrelationship between economic growth, fossil fuels, CO_2 emissions, and health expenditures. The regressive distributive lag (ARDL) model was applied, and the Pakistani economy was examined through data pertaining to economic growth, fossil fuels, CO_2 emissions, and health expenditures, collected for the period of 1995-2017. This study analyzes that in a country where fossil fuels are used both at a domestic and commercial level, there is a large amount of CO_2 emissions, which adversely affect the health of living beings and compels the government to invest more heavily in health-related expenditures.

3. METHODOLOGY

This study has implemented the panel regression approach to explore the nexus among energy consumption patterns, environmental factors, and public health expenditure in the context of the ASEAN states. Moreover, the variance inflation factor (VIF) was used by the researchers to test multicollinearity. The VIF equations are as under:

$$R^2_Y \longrightarrow \quad Y_{it} = \alpha_0 + \beta_2 X_{2it} + \beta_3 X_{3it} + \beta_4 X_{4it} + \beta_5 X_{5it} + e_{it} \tag{1}$$

$$j = R^2_Y, R^2_{X1}, R^2_{X2,} R^2_{X3,} R^2_{X4,} R^2_{X5} \tag{2}$$

Vol: 13 **No:** 2 **Year:** 2021 **ISSN**: 1309-8055 (Online) (**pp.** 1-21) **Doi:** 10.34111/ijefs.20212001

$$Tolrance = 1 - R_j^2 \quad VIF = \frac{1}{Tolerance} \tag{3}$$

In addition, the current study used the panel data, and the present study has applied the four-panel regression models, which are, Ordinary regression estimation or OLS, fixed effect model FEM or fixed effect estimator, random effect model REM or random effect estimator, and finally, the least square dummy variable model or LSDVM. To analyze the association among the study variables, the following equations are developed and tested through STATA-15.

$$CO2GFC_{it} = \alpha_0 + \beta_1 REC_{it} + \beta_2 FFEC_{it} + e_{it} \tag{4}$$

Where;

CO2GFC	=	Carbon emissions from gaseous fuel consumption
i	=	Country
t	=	Time Period
REC	=	Renewable energy consumption
FFEC	=	Fossil fuel energy consumption

In the above Equation 1, the main dependent variable is CO_2 emissions from gaseous fuel consumption (kt) or CO2GFC, which is examined through renewable energy consumption and fossil fuel energy consumption. It means that both energy sources are the main explanatory variables whose effect will be observed through regression parameters like β_1 and β_2; while α_0 will observe the fixed or constant value of the first dependent variable under OLS regression. Lastly, e_{it} Represents the error term of the study. Equation 5 below provides the fixed effect regression model for COEMGFC.

$$CO2GFC_{it} = \beta_{1i} + \beta_1 REC_{it} + \beta_2 FFEC_{it} + u_{it} \tag{5}$$

Where the titles like *it* show the individual entities in the model (4 ASEAN states in the present study), and t indicates the time duration of the study; 1985-2015. After the fixed effect regression equation, Equations 6 and Equation 7 cover the random effect model for CO2GFC.

$$CO2GFC_{it} = \beta_1 + \beta_2 REC_{2it} + \beta_3 FFEC_{3it} + \varepsilon_i + u_{it} \tag{6}$$

$$CO2GFC_{it} = \beta_1 + \beta_2 REC_{2it} + \beta_3 FFEC_{3it} + w_{it} \tag{7}$$

The Equation 8 predicts the association between the first dependent variable and energy sources, based on the effect from the dummy variables too, which is generated through the least square dummy variable model.

$$CO2GFC_{it} = \beta_0 + \beta_1 REC_{it} + \beta_2 FFEC_{it} + \beta_3\_Icid\_2_{it} + \beta_4\_Icid\_3_{it} + \beta_5\_Icid\_4_{it} + u_{it} \tag{8}$$

Vol: 13 **No:** 2 **Year:** 2021 **ISSN**: 1309-8055 (Online) (**pp.** 1-21) **Doi:** 10.34111/ijefs.20212001

After determining the regression equations for the first dependent variables under panel models, the following Equations 9-12 (for simple OLS, FEM, REM, and LSDVM) are used for the second dependent variable, which is CO_2 emissions from liquid fuel consumption (% of total).

$$CO2LFC_{it} = \beta_{1i} + \beta_1 REC_{it} + \beta_2 FFEC_{it} + u_{it} \quad (9)$$

$$CO2LFC_{it} = \beta_1 + \beta_2 REC_{2it} + \beta_3 FFEC_{3it} + \varepsilon_i + u_{it} \quad (10)$$

$$CO2LFC_{it} = \beta_1 + \beta_2 REC_{2it} + \beta_3 FFEC_{3it} + w_{it} \quad (11)$$

$$CO2LFC_{it} = \beta_0 + \beta_1 REC_{it} + \beta_2 FFEC_{it} + \beta_3\_Icid\_2_{it} + \beta_4\_Icid\_3_{it} + \beta_5\_Icid\_4_{it} + u_{it} \quad (12)$$

In addition, the panel regression equations are also developed for all three health-related variables. For example, Equations 13-16 indicate the relationship between domestic private health expenditure (DPHE) per capita (current US$), renewable energy consumption, and fossil fuel energy consumption through all panel models.

$$DPHE_{it} = \beta_{1i} + \beta_1 REC_{it} + \beta_2 FFEC_{it} + u_{it} \quad (13)$$

$$DPHE_{it} = \beta_1 + \beta_2 REC_{2it} + \beta_3 FFEC_{3it} + \varepsilon_i + u_{it} \quad (14)$$

$$DPHE_{it} = \beta_1 + \beta_2 REC_{2it} + \beta_3 FFEC_{3it} + w_{it} \quad (15)$$

$$DPHE_{it} = \beta_0 + \beta_1 REC_{it} + \beta_2 FFEC_{it} + \beta_3\_Icid\_2_{it} + \beta_4\_Icid\_3_{it} + \beta_5\_Icid\_4_{it} + u_{it} \quad (16)$$

Equation 17-20 shows the panel models for the Current health expenditure (% of GDP) and energy consumptions.

$$CHE_{it} = \beta_{1i} + \beta_1 REC_{it} + \beta_2 FFEC_{it} + u_{it} \quad (17)$$

$$CHE_{it} = \beta_1 + \beta_2 REC_{2it} + \beta_3 FFEC_{3it} + \varepsilon_i + u_{it} \quad (18)$$

$$CHE_{it} = \beta_1 + \beta_2 REC_{2it} + \beta_3 FFEC_{3it} + w_{it} \quad (19)$$

$$CHE_{it} = \beta_0 + \beta_1 REC_{it} + \beta_2 FFEC_{it} + \beta_3\_Icid\_2_{it} + \beta_4\_Icid\_3_{it} + \beta_5\_Icid\_4_{it} + u_{it} \quad (20)$$

Finally, Equations 21-24 help determine the impact of renewable energy consumption and fossil fuel energy consumption on External health expenditure (% of current health expenditure) in all four-panel models.

$$EHE_{it} = \beta_{1i} + \beta_1 REC_{it} + \beta_2 FFEC_{it} + u_{it} \quad (21)$$

$$EHE_{it} = \beta_1 + \beta_2 REC_{2it} + \beta_3 FFEC_{3it} + \varepsilon_i + u_{it} \quad (22)$$

$$EHE_{it} = \beta_1 + \beta_2 REC_{2it} + \beta_3 FFEC_{3it} + w_{it} \quad (23)$$

Vol: 13 **No:** 2 **Year:** 2021 **ISSN**: 1309-8055 (Online) (**pp.** 1-21) **Doi:** 10.34111/ijefs.20212001

$$EHE_{it} = \beta_0 + \beta_1 REC_{it} + \beta_2 FFEC_{it} + \beta_3\_Icid\_2_{it} + \beta_4\_Icid\_3_{it} + \beta_5\_Icid\_4_{it} + u_{it} \quad (24)$$

4. RESULTS OF THE STUDY

The results show the descriptive statistics that highlight the number of observations, mean and standard deviation along with maximum and minimum values of the variables. The results indicate that the mean value of CO_2GFC was 1.830 while the average value of CO_2LFC was 1.349. In addition, the mean value of DPHE was 8.558, while CHE was 0.274. Moreover, the average value of EHE was 5.468, and REC was 0.453, and FFEC was 0.342. These values are mentioned in Table 1.

Table 1: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
CO2GFC	124	1.830	0.605	1.228	2.833
CO2LFC	124	1.349	0.526	0.805	1.693
DPHE	124	8.558	0.446	7.667	9.228
CHE	124	0.274	0.301	0.121	0.661
EHE	124	5.468	0.510	4.199	6.499
REC	124	0.453	0.574	0.094	0.890
FFEC	124	0.342	0.309	0.012	0.573

Moreover, VIF was used by the researchers to test multicollinearity. The results indicated that values of VIF are lower than five which is an indication that there is no multicollinearity in the model. These values of VIF are mentioned below in Table 2.

Table 2: Variance Inflation Factor (VIF)

	VIEW	1/VIF
REC	1.508	0.610
FFEC	1.243	0.645
Mean VIF	1.220	.

The present section includes the discussion and analysis of the study outcomes. Initially, Table 3 provides the panel results for all ASEAN economies, covering the impact of energy consumption on the natural environment. It is found that under a simple regression model, the impact of REC is negatively insignificant while implying that there is no impact of REC on CO_2GFC under the full sample of the study. Similarly, under the fixed-effect model and random effect model results, the impact of renewable energy consumption on the natural environment, as measured through CO_2GFC, is found to be

Vol: 13 **No:** 2 **Year:** 2021 **ISSN**: 1309-8055 (Online) (**pp.** 1-21) **Doi:** 10.34111/ijefs.20212001

negatively insignificant. This implies that none of the panel models support the claim that energy consumption from some renewable resources and natural environment in the ASEAN economies are significantly associated with each other.

On the other hand, the impact of fossil fuel energy consumption for the first proxy of the natural environment is negatively insignificant, which implies that higher consumption through fossil fuel is causing more carbon emission in the natural environment of the four ASEAN economies. This impact is justified through a regression coefficient of 0.656 under OLS regression and 0.257 under the fixed-effect model. This substantiates the argument that for every single unit increase in the consumption of fossil fuel energy, there is an increase of 0.656 and 0.257 in the carbon emission of ASEAN countries, which is significant at 1 per cent (i.e., p-value= 0.000). However, under the least square dummy variable model, which is another type of fixed model, no dummy variable in terms of selected entities is found to be significant at any level, except for Icid_2 at 10 per cent. The results for the overall explained variation under OLS, FEM, and REM are 0.214, 0.264, 0.262, and 0.012, respectively. Furthermore, it is found that all four models have considered the total number of years as 30 with the four entities as well.

Table 3. Impact of Energy Consumption on Natural Environment: CO_2 Emissions from Gaseous fuel Consumption (kt)

	CO2GFC	**CO2GFC**	**CO2GFC**	**CO2GFC**
VARIABLES	**OLS**	**FEM**	**REM**	**FEM with Dummies**
	Equation-1	Equation-2	Equation-3	Equation-4
REC	-0.0574	-0.0931	-0.0675	-0.0422
	(0.0979)	(0.103)	(0.0955)	(0.0989)
FFEC	0.656***	0.257***	0.0542	0.0726
	(0.0911)	(0.0970)	(0.0891)	(0.0927)
_Icid_2				0.135*
				(0.0779)
_Icid_3				-0.0145
				(0.0790)
_Icid_4				0.0819
				(0.0774)
Constant	0.574***	0.571***	0.573***	0.519***
	(0.0743)	(0.0754)	(0.0740)	(0.0878)
Observations	120	120	120	120
R-squared	0.214	0.264	0.262	0.012
Number of years		30	30	

REC: renewable energy consumption, FFEC; fossil fuel energy consumption, CO2GFC;

Vol: 13 **No:** 2 **Year:** 2021 **ISSN**: 1309-8055 (Online) (**pp.** 1-21) **Doi:** 10.34111/ijefs.20212001

Carbon emissions from gaseous fuel consumption (kt), Acid indicates country Ids for every single state as observed in the data. Standard errors in parentheses, p*** p<0.01, ** p<0.05, * p<0.1

Table 4 provides the result for the relationship between energy consumption from two major sources and the natural environment in terms of CO_2LFC. The findings under Table 2 show that there is a negative impact of REC on the natural environment, as measured through CO_2LFC. This further justifies under OLS regression estimate, which shows that a unit change in REC can cause a change of -0.420 and vice versa. Similarly, under the fixed-effect model, the impact of the natural environment is negatively significant at 1 per cent with the p-value of 0.000. However, no significant impact of REC on the natural environment of ASEAN economies is observed under REM. Lastly, the LSDVM yields similar results to the those generated through FEM without considering the countries' dummy. Moreover, all the countries' dummies are found to be an insignificant predictor of natural environment degradation. At the same time, highest explained variation is found to be under FEM, which is 36.2 per cent, followed by OLS and LSDVM, respectively.

Table 4. Impact of Energy Consumption on Natural Environment as Measured through CO2LFC

	CO2LFC	**CO2LFC**	**CO2LFC**	**CO2LFC**
VARIABLES	**OLS**	**FEM**	**REM**	**FEM with Dummies**
	Equation-5	Equation-6	Equation-7	Equation-8
Rec	-0.420***	-0.408***	0.0211	-0.408***
	(0.0945)	(0.0956)	(0.0944)	(0.0356)
ffec	0.0469	0.0468	0.0468	0.0468
	(0.0879)	(0.0897)	(0.0884)	(0.0897)
_Icid_2				0.0126
				(0.0753)
_Icid_3				0.0137
				(0.0764)
_Icid_4				-0.119
				(0.0749)
Constant	0.454***	0.454***	0.454***	0.477***
	(0.0717)	(0.0713)	(0.0853)	(0.0849)
Observations	120	120	120	120
R-squared	0.234	0.326	0.102	0.312
Number of cids	4	4	4	4

Vol: 13 **No:** 2 **Year:** 2021 **ISSN**: 1309-8055 (Online) (**pp.** 1-21) **Doi:** 10.34111/ijefs.20212001

After analyzing the impact of energy consumption from two sources on the natural environment, the present section measures the impact of energy consumption on the health of local communities in the selected ASEAN economies. For this purpose, Domestic private health expenditure per capita (current US$) or DPHE is observed as the main dependent variable under all the panel regression models for Table 5. The study findings confirm that REC consumption is positively impacting the DPHE under OLS regression results where the coefficient is 0.104 with the standard error of 0.0987. This shows that higher consumption from some renewable sources means a positive impact on public health and related expenditure and vice versa. Additionally, the fixed-effect model, which controls the heterogeneity among the entities, also depicts that there is a significant and positive impact of REC on DPHE. It means that panel models like FEM also justifies their direct association. However, under random effect results, and findings are found to be negatively insignificant. Lastly, LSDVM shows the findings to be in favor of the alternative hypotheses, which means that there is a direct impact of REC on the Domestic private health expenditure per capita (current US$) among the selected economies. Meanwhile, the findings through all the panel models justify that the highest explained variation is provided by OLS, followed by FEM and LSDVM, respectively. Furthermore, no significant impact of Fossil fuel energy consumption on the health of the local community is observed.

Table 5. Impact of Energy Consumption on Health of Local Community

	DPHE	**DPHE**	**DPHE**	**DPHE**
VARIABLES	**OLS**	**FEM**	**REM**	**FEM with Dummies**
	Equation-9	Equation-10	Equation-11	Equation-12
REC	0.104**	0.290***	-0.00104	0.103***
	(0.0987)	(0.0450)	(0.0987)	(0.082)
FFEC	0.0582	0.0208	0.0582	0.0208
	(0.0918)	(0.0940)	(0.0918)	(0.0940)
_Icid_2				0.0643
				(0.0789)
_Icid_3				0.150*
				(0.0801)
_Icid_4				0.0549
				(0.0785)
Constant	0.452***	0.456***	0.452***	0.388***
	(0.0749)	(0.0747)	(0.0749)	(0.0890)
Observations	120	120	120	120
R-squared	0.120	0.110	0.025	0.119
Number of CID	4	4	4	4

Vol: 13 **No:** 2 **Year:** 2021 **ISSN**: 1309-8055 (Online) (**pp.** 1-21) **Doi:** 10.34111/ijefs.20212001

Table 6 covers the relationship between the second outcome factor that measures the expenditure on the health of the local community in ASEAN economies, and the impact of the two of the major energy consumption sources. The study findings confirm that REC is positively impacting the CHE, as the results are found to be highly significant at 1 per cent. Furthermore, it is claimed that for every single unit change in the value of REC, there is a change of 0.131 on CHEXP. Additionally, under the random effect model, there is a positive and significant impact on CHE. This means that a change in REC under REM is causing a change of 0.521 in CHE, which is highly significant at 1 per cent. However, no effect of REC on Current health expenditure (% of GDP) is found under the fixed effect model and least square dummy variable model. On the other hand, FFEC provides evidence for its adverse effect on health expenditure as a percentage of GDP in all four-panel economies. This essentially means that higher fossil fuel consumption is leading towards lower consumption in the health sector of Indonesia, Malaysia, Thailand, and the Philippines as well. This impact is also found under REM where the impact is negatively significant at 1 per cent (beta= -0.811, p-value= 0.000). Meanwhile, no impact under LSDVM for the sated dummy variables is found.

Table 6. Impact of Energy Consumption on Health of Local Community: Current Health Expenditure (% of GDP)

	CHE	**CHE**	**CHE**	**CHE**
VARIABLES	**OLS**	**FEM**	**REM**	**FEM with Dummies**
	Equation-13	Equation-14	Equation-15	Equation-16
REC	0.131***	0.142	0.521***	0.142
	(0.0124)	(0.0974)	(0.0960)	(0.0974)
FFEC	-0.411***	-0.0302	-0.811***	-0.0302
	(0.0893)	(0.0913)	(0.0293)	(0.0913)
_Icid_2				-0.0122
				(0.0767)
_Icid_3				0.0983
				(0.0779)
_Icid_4				-0.0401
				(0.0763)
Constant	0.447***	0.451***	0.447***	0.439***
	(0.0728)	(0.0726)	(0.0728)	(0.0865)
Observations	120	120	120	120
R-squared	0.102	0.097	0.287	0.048
Number of cid	4	4	4	4

Vol: 13 **No:** 2 **Year:** 2021 **ISSN**: 1309-8055 (Online) (**pp.** 1-21) **Doi:** 10.34111/ijefs.20212001

By the end, Table 7 predicts the impact of energy consumption sources on the health of the local community as measured through external health expenditure in terms of a percentage of total current health expenditure. It is found that there is a significant and positive impact of REC on EHE for panel countries under OLS and FEM, which is 0.107 and 0.818. This means that higher energy consumption from renewable sources in the ASEAN region may lead towards a higher level of expenditure on the health of the local community. However, no significant impact under the random effect model and LASEM or FEM with dummies is found. Moreover, the impact from FFEC on public health expenditure of local community of ASEAN member states is negatively significant at 1 per cent. This means that for every single unit change in the value of FFEC, there is a change of -0.954 on EHE and vice versa. However, an insignificant impact from the rest of the panel model is found. Lastly, the impact from Icid_2 is found to be positively significant under LSDVM.

Table 7. Impact of Energy Consumption on Health of Local Community: External Health Expenditure (% of Current Health Expenditure)

	EHE	**EHE**	**EHE**	**EHE**
VARIABLES	**OLS**	**FEM**	**REM**	**FEM with Dummies**
	Equation-17	Equation-18	Equation-19	Equation-20
REC	0.107***	0.818***	-0.102	-0.818
	(0.0229)	(0.0149)	(0.0932)	(0.0949)
FFEC	-0.954***	-0.111	-0.101	-0.111
	(0.0165)	(0.0890)	(0.0870)	(0.0890)
_Icid_2				0.771***
				(0.0248)
_Icid_3				0.0537
				(0.0759)
_Icid_4				-0.0211
				(0.0743)
Constant	0.592***	0.593***	0.592***	0.565***
	(0.0705)	(0.0708)	(0.0729)	(0.0843)
Observations	120	120	120	120
R-squared	0.221	0.265	0.014	0.140
Number of cid	4	4	4	4

5. DISCUSSIONS

The study results have indicated that renewable energy consumption has a negative impact on CO_2 from gas fuel consumption. These results are supported by the previous study of Waheed et al. (2018), which states that the use of renewable energy sources like

solar power, wind power, Hydropower, biomass, and biofuel reduces the amount of CO_2 emissions into the air in two ways: first, this kind of energy does not release harmful gas and second, the use of this energy reduces the need for harmful non-renewable energy sources which are considered to be the major source of CO_2 emissions. The study results have shown that fossil fuel energy consumption has a positive impact on CO_2 emissions from gas fuel consumption. These results are supported by the previous study of Hanif et al. (2019), which highlights that the use of non-renewable energy sources like fossil fuel enhances the amount of CO_2 into the atmosphere. This is so because during the consumption of fossil fuels, gases like carbon are emitted and after getting mixed with the oxygen in the air, form carbon dioxide. The study results have also indicated that renewable energy consumption has a negative influence on CO_2 emissions from liquid fuel energy. These results are in line with the past study of (Nathaniel et al., 2019). This study analyses the role of renewable energy consumption in minimizing environmental pollution. The study implies that the production and consumption of renewable energy like biodiesel and biofuel are critical solutions to the problem of CO_2 emissions into the air and hence, protecting the environment. The study results have further indicated that fossil fuel energy consumption has a positive influence on CO_2 from liquid fuel energy. These results are in line with the past study of Zhou et al. (2019), which states that the use of fossil fuels like oil, petroleum, natural gas, coal, and ore, releases toxic gases and chemicals and produce harmful wastes. All emit CO_2 emissions into the air and pollute the atmosphere.

The study results have shown that renewable energy consumption has a negative association with domestic private health expenditures. These results match with the study of Ullah et al. (2020), which states that in the regions where renewable energy like energy from the installation of solar plant is produced and consumed for energy purposes, people have to incur less private health expenditures. The study results have revealed that non-renewable energy consumption has a positive association with domestic private health expenditures. These results are in line with the study of Jebli et al. (2020), which states that when people use less amount of fossil fuels and try to replace them with a clean source of energy when performing household functions, they tend to enjoy a more clean environment to breathe in and experience sound health, and therefore lowered levels of health expenditures. The study results have revealed that renewable energy consumption has a negative association with current health expenditures. These results match with the study of Apergis, Jebli, et al. (2018), which states that biomass, biofuel, and solar energy are not only the clean sources of energy that do not adversely affect the quality of the environment but, in fact, also act as a cleanser for the environment and help control health problems and reduces the level of expenditures incurred in provision of health-care services. The study results have revealed that fossil fuel energy consumption has a negative association with the current health expenditures. These results agree with the study of Hao et al. (2018), which analyses the impact of non-renewable energy on health expenditures. According to the views of this study, the

Vol: 13 **No:** 2 **Year:** 2021 **ISSN**: 1309-8055 (Online) (**pp.** 1-21) **Doi:** 10.34111/ijefs.20212001

consistent use of fossil fuels for energy purposes leads to individuals suffering from several health diseases for the treatment of which they must spend additional money. In this sense, the consumption of fossil fuels can be a costly source of energy. The study results have also shown that renewable energy consumption has a negative association with external health expenditures. These results are supported by the study of Ali et al. (2018), which shows that when business organizations adopt a policy to use renewable energy resources for operating different machinery and processes for production and marketing purposes, it not only protects the employees from health problems but also protects individuals and other living beings outside the organizations, helping them avoid incurring health-related expenditures in the future. The study results have revealed that fossil fuel energy consumption has a positive association with external health expenditures. These results are in line with the study of Malik et al. (2018), which posits that when business enterprises are mostly indulged in the consumption of fossil fuels (natural gas, oil, coal, Orimulsion, and petroleum) for the undertaking of plants, infrastructure, and logistics, harmful gas from the consumption of non-renewable energy pollutes the global climate and this, in turn, can adversely affect the health of living beings at a broader level. Hence, the increased use of fossil fuel energy enhances external health expenditures.

6. CONCLUSION

A detailed review of the existing literature reveals that there is a lack of studies that probe into the dynamic effect of core energy consumption sources on environmental pollution and public health factors and related expenditures in the context of the ASEAN economies. To overcome this significant gap, this research study has applied the panel regression models to determine the impact of energy consumption patterns on the two major dependent variables understudy. Four-panel models i.e., simple regression, fixed effect, random effect, and dummy variable models are applied, and findings are discussed and interpreted. Overall, five major dependent variables (two for the environment and three for the public health expenditure) are selected and observed. The study results confirm that renewable energy source is found to negatively impact the natural environment in ASEAN economies, whereas fossil fuel energy consumption has shown an adverse impact on the natural environment. On the side, the impact on the domestic private health expenditure per capita in terms of USD shows a positive impact from REC, while no impact from FFEC is found. Additionally, the impact from REC on Current health expenditure (% of GDP) is positively significant under OLS regression and REM, respectively. However, the impact of FFEC on CHE is negatively significant at 1 per cent through OLS and REM as well. Lastly, the study findings predict that External health expenditure (% of current health expenditure) has a positive influence from REC under OLS and FEM while the negative impact from FFEC. The findings under the present study can be of great value for public health organizations, environmental departments, and experts in the energy sector. REC can provide a viable

solution for not only lowering the harmful impact on the natural environment in these countries but also able to yield a positive impact on the value of public health expenditure. Furthermore, researchers in the field of environmental science, energy economies, and public health can also utilize the present study findings, both, from a theoretical and an empirical perspective. This can potentially help those decision-makers in their relative capacity to formulate responsive policy solutions to these environmental challenges, specifically in the ASEAN. However, it is also observed despite several practical and theoretical implications, this study faced a few limitations that must be addressed and overcome in the future. First, this research does not cover all the ASEAN economies, focusing only on four member states. Second, although panel regression models are a reasonable choice to justify the relationship between the study variables, the presentation of some robust results along with some latest panel models are missing under the present study. Thirdly, this research has considered only two energy consumption sources like renewable and fossil fuel, with no focus on the other sources that fall under both categories. Future studies are highly recommended to expand their vision by addressing these limitations.

REFERENCES

Ali, Q., Khan, M. T. I., & Khan, M. N. I. (2018). Dynamics between financial development, tourism, sanitation, renewable energy, trade and total reserves in 19 Asia cooperation dialogue members. *Journal of Cleaner Production, 179*, 114-131. doi:https://doi.org/10.1016/j.jclepro.2018.01.066

Alola, A. A. (2019). Carbon emissions and the trilemma of trade policy, migration policy and health care in the US. *Carbon Management, 10*(2), 209-218. doi:https://doi.org/10.1080/17583004.2019.1577180

Apergis, N., Ben Jebli, M., & Ben Youssef, S. (2018). Does renewable energy consumption and health expenditures decrease carbon dioxide emissions? Evidence for sub-Saharan Africa countries. *Renewable Energy*, *127*, 1011-1016. doi:https://doi.org/10.1016/j.renene.2018.05.043

Apergis, N., Jebli, M. B., & Youssef, S. B. (2018). Does renewable energy consumption and health expenditures decrease carbon dioxide emissions? Evidence for sub-Saharan Africa countries. *Renewable energy, 127*, 1011-1016. doi:https://doi.org/10.1016/j.renene.2018.05.043

Azam, M., Khan, A. Q., & Ozturk, I. (2019). The effects of energy on investment, human health, environment and economic growth: empirical evidence from China. *Environmental Science and Pollution Research, 26*(11), 10816-10825. doi:https://doi.org/10.1007/s11356-019-04497-4

Doğan, B., Driha, O. M., Balsalobre Lorente, D., & Shahzad, U. (2021). The mitigating effects of economic complexity and renewable energy on carbon emissions in developed countries. *Sustainable Development, 29*(1), 1-12. doi:https://doi.org/10.1002/sd.2125

Fatima, T., Shahzad, U., & Cui, L. (2021). Renewable and nonrenewable energy consumption, trade and CO2 emissions in high emitter countries: does the income level matter? *Journal of Environmental Planning and Management, 64*(7), 1227-1251. doi:https://doi.org/10.1080/09640568.2020.1816532

Fonseca, D. C., Sala, P., Ferreira, B. d. A. M., Reis, J., Torrinhas, R. S., Bendavid, I., & Waitzberg, D. L. (2018). Body weight control and energy expenditure. *Clinical Nutrition Experimental, 20*, 55-59. doi:https://doi.org/10.1016/j.yclnex.2018.04.001

Gorus, M. S., & Aydin, M. (2019). The relationship between energy consumption, economic growth, and CO2 emission in MENA countries: Causality analysis in the frequency domain. *Energy, 168*, 815-822. doi:https://doi.org/10.1016/j.energy.2018.11.139

Hanif, I., Raza, S. M. F., Gago-de-Santos, P., & Abbas, Q. (2019). Fossil fuels, foreign direct investment, and economic growth have triggered CO2 emissions in emerging Asian economies: some empirical evidence. *Energy, 171*, 493-501. doi:https://doi.org/10.1016/j.energy.2019.01.011

Hao, Y., Liu, S., Lu, Z.-N., Huang, J., & Zhao, M. (2018). The impact of environmental pollution on public health expenditure: dynamic panel analysis based on Chinese provincial data. *Environmental Science and Pollution Research, 25*(19), 18853-18865. doi:https://doi.org/10.1007/s11356-018-2095-y

Heidari, H., Turan Katircioğlu, S., & Saeidpour, L. (2015). Economic growth, CO2 emissions, and energy consumption in the five ASEAN countries. *International Journal of Electrical Power & Energy Systems, 64*, 785-791. doi:https://doi.org/10.1016/j.ijepes.2014.07.081

Jebli, M. B., & Kahia, M. (2020). The interdependence between CO 2 emissions, economic growth, renewable and non-renewable energies, and service development: evidence from 65 countries. *Climatic Change, 162*(2), 193-212. doi:https://doi.org/10.1007/s10584-020-02773-8

Klinger, J. M. (2018). Rare earth elements: Development, sustainability and policy issues. *The Extractive Industries and Society, 5*(1), 1-7. doi:https://doi.org/10.1016/j.exis.2017.12.016

Ladha-Sabur, A., Bakalis, S., Fryer, P. J., & Lopez-Quiroga, E. (2019). Mapping energy consumption in food manufacturing. *Trends in food science & technology, 86*, 270-280. doi:https://doi.org/10.1016/j.tifs.2019.02.034

Li, Z.-Z., Li, R. Y. M., Malik, M. Y., Murshed, M., Khan, Z., & Umar, M. (2021). Determinants of Carbon Emission in China: How Good is Green Investment? *Sustainable Production and Consumption, 27*, 392-401. doi:https://doi.org/10.1016/j.spc.2020.11.008

Malik, A., Lenzen, M., McAlister, S., & McGain, F. (2018). The carbon footprint of Australian health care. *The Lancet Planetary Health, 2*(1), e27-e35. doi:https://doi.org/10.1016/S2542-5196(17)30180-8

Martins, F., Felgueiras, C., & Smitková, M. (2018). Fossil fuel energy consumption in European countries. *Energy Procedia, 153*, 107-111. doi:https://doi.org/10.1016/j.egypro.2018.10.050

Mason, K., Duggan, J., & Howley, E. (2018). Forecasting energy demand, wind generation and carbon dioxide emissions in Ireland using evolutionary neural networks. *Energy, 155*, 705-720. doi:https://doi.org/10.1016/j.energy.2018.04.192

Muhammad, B., & Khan, S. (2019). Effect of bilateral FDI, energy consumption, CO2 emission and capital on economic growth of Asia countries. *Energy Reports, 5*, 1305-1315. doi:https://doi.org/10.1016/j.egyr.2019.09.004

Mustapa, S. I., Ayodele, F. O., Ayodele, B. V., & Mohammad, N. (2020). Nexus between Energy Usability, Economic Indicators and Environmental Sustainability in Four ASEAN Countries: A Non-Linear Autoregressive Exogenous Neural Network Modelling Approach. *Processes, 8*(12), 1529. doi:https://doi.org/10.3390/pr8121529

Nathaniel, S. P., & Iheonu, C. O. (2019). Carbon dioxide abatement in Africa: The role of renewable and non-renewable energy consumption. *Science of The Total Environment, 679*, 337-345. doi:https://doi.org/10.1016/j.scitotenv.2019.05.011

Owen, J., Ducker, E., Huggan, M., Ramsey, C., Neville, A., & Barker, R. (2019). Design of an elbow for integrated gravimetric, electrochemical and acoustic emission measurements in erosion-corrosion pipe flow environments. *Wear, 428*, 76-84. doi:https://doi.org/10.1016/j.wear.2019.03.010

Paramati, S. R., Alam, M. S., Hammoudeh, S., & Hafeez, K. (2021). Long-run relationship between R&D investment and environmental sustainability: Evidence from the European Union member countries. *International Journal of Finance & Economics, 26*(4), 5775-5792. doi:https://doi.org/10.1002/ijfe.2093

Pata, U. K. (2021). Renewable and non-renewable energy consumption, economic complexity, CO 2 emissions, and ecological footprint in the USA: testing the EKC hypothesis with a structural break. *Environmental Science and Pollution Research, 28*(1), 846-861. doi:https://doi.org/10.1007/s11356-020-10446-3

Qu, W.-H., Xu, L., Qu, G.-H., Yan, Z.-J., & Wang, J.-X. (2017). The impact of energy consumption on environment and public health in China. *Natural Hazards, 87*(2), 675-697. doi:https://doi.org/10.1007/s11069-017-2787-5

Rehman, A., Ma, H., Chishti, M. Z., Ozturk, I., Irfan, M., & Ahmad, M. (2021). Asymmetric investigation to track the effect of urbanization, energy utilization, fossil fuel energy and CO 2 emission on economic efficiency in China: another outlook. *Environmental Science and Pollution Research, 28*(14), 17319-17330. doi:https://doi.org/10.1007/s11356-020-12186-w

Remiro-Buenamañana, S., & García, H. (2019). Photoassisted CO2 conversion to fuels. *ChemCatChem, 11*(1), 342-356. doi:https://doi.org/10.1002/cctc.201801409

Silvestre, B. S., & Ţîrcă, D. M. (2019). Innovations for sustainable development: Moving toward a sustainable future. *Journal of Cleaner Production, 208*, 325-332. doi:https://doi.org/10.1016/j.jclepro.2018.09.244

Sipra, A. T., Gao, N., & Sarwar, H. (2018). Municipal solid waste (MSW) pyrolysis for bio-fuel production: A review of effects of MSW components and catalysts. *Fuel Processing Technology, 175*, 131-147. doi:https://doi.org/10.1016/j.fuproc.2018.02.012

Sun, R., Wang, Y., & Chen, L. (2018). A distributed model for quantifying temporal-spatial patterns of anthropogenic heat based on energy consumption. *Journal of Cleaner Production, 170*, 601-609. doi:https://doi.org/10.1016/j.jclepro.2017.09.153

Ullah, I., Rehman, A., Khan, F. U., Shah, M. H., & Khan, F. (2020). Nexus between trade, CO2 emissions, renewable energy, and health expenditure in Pakistan. *The International Journal of Health Planning and Management, 35*(4), 818-831. doi:https://doi.org/10.1002/hpm.2912

Waheed, R., Chang, D., Sarwar, S., & Chen, W. (2018). Forest, agriculture, renewable energy, and CO2 emission. *Journal of Cleaner Production, 172*, 4231-4238. doi:https://doi.org/10.1016/j.jclepro.2017.10.287

Wang, Z., Asghar, M. M., Zaidi, S. A. H., & Wang, B. (2019). Dynamic linkages among CO 2 emissions, health expenditures, and economic growth: empirical evidence from Pakistan. *Environmental Science and Pollution Research, 26*(15), 15285-15299. doi:https://doi.org/10.1007/s11356-019-04876-x

Wu, Y., Chau, K., Lu, W., Shen, L., Shuai, C., & Chen, J. (2018). Decoupling relationship between economic output and carbon emission in the Chinese construction industry. *Environmental Impact Assessment Review, 71*, 60-69. doi:https://doi.org/10.1016/j.eiar.2018.04.001

Xu, G., Schwarz, P. M., & Yang, H. (2018). *China's CO1 Emissions Peak with A Dynamic Nonlinear Artificial Neural Network Approach and Scenario Analysis.* Paper presented at the Energy Exploitation and Cooperation in Asia, 6th IAEE Asian Conference, November 2-4, 2018: International Association for Energy Economics.

Zakir Hossain, H. M., Hasna Hossain, Q., Uddin Monir, M. M., & Ahmed, M. T. (2014). Municipal solid waste (MSW) as a source of renewable energy in Bangladesh: Revisited. *Renewable and Sustainable Energy Reviews, 39*, 35-41. doi:https://doi.org/10.1016/j.rser.2014.07.007

Zhou, N., Price, L., Yande, D., Creyts, J., Khanna, N., Fridley, D., . . . Hasanbeigi, A. (2019). A roadmap for China to peak carbon dioxide emissions and achieve a 20% share of non-fossil fuels in primary energy by 2030. *Applied energy, 239*, 793-819. doi:https://doi.org/10.1016/j.apenergy.2019.01.154

Zhu, H., Duan, L., Guo, Y., & Yu, K. (2016). The effects of FDI, economic growth and energy consumption on carbon emissions in ASEAN-5: Evidence from panel

quantile regression. *Economic Modelling, 58,* 237-248. doi:https://doi.org/10.1016/j.econmod.2016.05.003