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Environment, Mix Energies, ASEAN Economies and Education

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ABSTRACT

Education, environment, energies and economic, have several number high impacts of research in 5 years. Data from Dimensions.ai, the most comprehensive research grants database which links grants to millions of resulting publications, clinical trials and patents, have several results about education, environment, energies and economic research, in Studies in Human Society 146 papers, Economics 96 papers, Applied Economics 95 papers, Engineering 93 papers, Policy and Administration 63 papers. Using vosviewer.com analysis, files downloaded from the free version of Dimensions may contain data for at most 2500 documents. (Larger numbers of documents are supported when a subscription-based version of Dimensions is used), we can see that Education have high impact on energy, environment, sustainability and sustainable development. The study aims to investigate the environmental effects of mix energies on the three most polluted countries of ASEAN economies. The study uses the data of the Philippines, Vietnam, and Thailand over the period of 1995-2017 as gathered from the World Bank and Global Economy. The study uses Brush Pagon LM and Pearson CD to test the cross-section dependence among variables while Levin et al., (2002) panel unit root test to check the stationary in the data. Westerlund (2007) cointegration and FMOLS tests are applied to analyze the long-run relationship. The result confirms the adverse environmental effects of fossil fuel electricity generation (FEG) and positive environmental effects of solar electricity generation (SEG), nuclear-power electricity generation (NEG), and geothermal electricity generation (GEG) on the ASEAN economies. Wind electricity generation (WEG) and hydroelectricity generation (HEG) do not significantly contribute to deteriorating the environment. The study suggests using GEG, WEG and SEG methods of producing electricity instead of FEG.

Keywords: Mix Energies, Solar Electricity, Fossil Fuel, Wind Electricity, Hydro Electricity, Nuclear-Power Electricity, Geo-Thermal Electricity
JEL Classifications: O13, Q42, Q43

1. INTRODUCTION

Now a days, universal environmental problems are receiving huge consideration particularly the intensification of a high temperature of earth and air. The governments are gradually conscious of the need to bound these environmental problems from human accomplishments (Gogoi, 2013). These environmental problems are arising due to intense consumption of energy (Chopra, 2016). Nonetheless, a considerable amount of energy is essential for the better performance of economy, but it usually generated from fossil fuels, which is very unadventurous source and has enough contribution in CO_2 emissions that have adverse effects on

environment (Zwolinska et al., 2011; Fujihashi et al., 2015; Kunz et al., 2011; Martínez et al., 2003; Gil-León, 2020). So, the quality of environment is decreasing due to the consumption of energy.

Consumption of energy is increasing gradually due to continuous industrialization and urbanization growth in Association of Southeast Asian Nations (ASEAN). ASEAN energy center estimated 4.4% increase in the consumption of final energy among ASEAN nations in 2030 which is greater than the average growth rate of 1.44%. However, the current level of CO_2 omission in ASEAN nations is relatively small as compared to US and China (Kamran and Omran, 2018; Hussain et al., 2020), but in

50 years ahead, ASEAN state is foreseen to be most pretentious by the increment of CO_2 omission (IFAD). Therefore, this might be suitable for the government of the ASEAN region to produce the electricity by using most suitable and advantageous sources that have less contributions in environmental degradation because different apparatuses and machines that are used in the consumption of energy process, are omitting CO_2 emissions that in turn have adverse effects on the quality of environment. International warming and the changes in climate become the most significant hazard for people of ASEAN nations in 21st century (Zhang, 2008; Janssen, 2020).

It is proposed that there are increases in apprehensions about the international energy demand and releases of toxic gases in the future (Chontanawat, 2018; Mavrotas et al., 1999; Tilman et al., 2009; Vusić et al., 2013). For reducing these apprehensions, international groups are trying to discover and appliance diverse environment-friendly approaches. Production of energy through renewable sources is one of these approaches that include production of energy through wind turbines, solar energy, geothermal, nuclear power, hydroelectricity (Hall and Buckley, 2016; Hong et al., 2016; Wouters et al., 2015; Chen et al., 2020; Dong et al., 2020). Though all these methods of producing electricity have less significant contributions in degrading the environmental quality as compared to conventional sources, however some of these methods have contributions to decreasing the quality of environment (Esha, 2008; Among others). The comparison of all types of energy with their environmental effects is shown in Table 1.

Table 1 shows the differential environmental effects of different types of energy sources (mix energies). Different types of energy having different environmental effects. Some have environmental damaging effects, but some do not have environmental damaging effects. Correspondingly, Table 2 shows the increase in CO_2 emissions per kilowatt electricity production by using different energy sources.

Table 2 shows that the electricity that are generated through Fossil fuels (Coal and Gas) have highest level of CO_2 emissions (minimum of 700 and a maximum of 1280 per kilowatt electricity production while the electricity, produced by using Nuclear Power, have the lowest level of CO_2 emissions (minimum of 3 and maximum of 1280 per kilowatt electricity production).

We have found different studies that tried to find out the impact of energy consumption on environmental degradation (Zwolinska

et al., 2011; Kunz et al., 2007; Gunerhan et al., 2008; Among others). However, until now no study has been found in which the environmental effects of mix energy sources have been investigated. Therefore, current study attempts to empirically investigate the environmental effects of mix energy sources by using the data of most polluted ASEAN nations that are the Philippines, Vietnam and Thailand. So that best policy recommendations can be made for the government of ASEAN regions through which they can produce energy by using those sources that have less contribution to environmental degradation. Until now, no study has been conducted in this scenario.

Education, environment, energies and economic, have several number high impacts of research in 5 years. From data from Dimensions.ai, the most comprehensive research grants database which links grants to millions of resulting publications, clinical trials and patents, have several results about education, environment, energies and economic research, in Studies in Human Society 146 papers, Economics 96 papers, Applied Economics 95 papers, Engineering 93 papers, Policy and Administration 63 papers. Using vosviewer.com analysis, files downloaded from the free version of Dimensions may contain data for at most 2500 documents. (Larger numbers of documents are supported when a subscription-based version of Dimensions is used), we can see that Education have high impact on energy, environment, sustainability and sustainable development.

The remaining paper has the following structure: In section 2 there is brief review of literature and hypotheses. Section 3 represents the data and methodology while empirical findings are represented in section 4. Finally, section 5 concludes the research and paper ends with some practical implications and directions for further research.

2. LITERATURE REVIEW

This section explains the review of existing literature and the construction of hypothesis:

2.1. CO_2 Emission and Fossil Fuels Electricity Generation (FEG)

Zwolinska et al., (2011) were interested in finding out the relationship between FEG and CO_2 emission, for this purpose they conducted a study and found that FEG positively and significantly contributes in CO_2 emissions and concluded that FEG have negative impact on environment because FEG causes to increase the CO_2 emissions that deteriorate the quality of environment.

Table 1: Environmental effects of mixed energies

Environmental effects	Fossil fuel	Wind	Solar	Hydropower	Nuclear	Geothermal
Air and water pollution	✓					
Flooding of land				✓		✓
Global warming	✓				✓	
Thermal pollution of water						
Water disposal	✓					
Mining and drilling	✓		✓			
Construction of plants	✓	✓	✓	✓		

Source: AWEA. CO_2 emissions
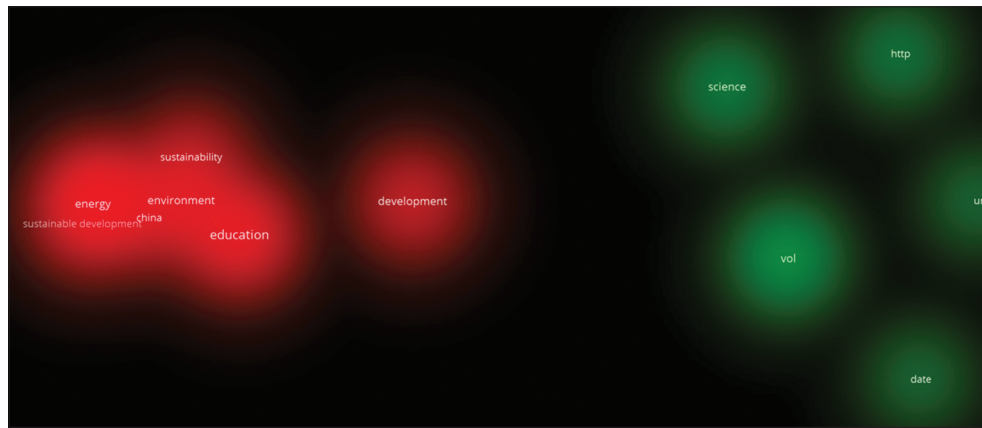
Table 2: Increase in CO_2 emissions Per Kilowatt electricity production

Energy sources	Minimum	Wind
Coal	700	1280
Gas	410	991
Nuclear	3	24
Wind	10	29
Solar	53	79
Hydro	6	27

Source: Guidi et al., (2018)

Hunt and Weber (2019) also revealed the adverse effects of FEG on the environment and proposed that FEG increases noxious gasses that not only reduce the quality of environment but also increases the illness and chronic diseases in children. Perera et al. (2018) revealed that most of the smog in air is the result of FEG methods that includes the production of electricity by using "coal, diesel fuel, gasoline, oil, and natural gas." The study concluded that all these methods adversely affect the environment and have very negative effects on environment. Tyagi et al., (2014) conducted a study for examining the role of energy consumption in the quality of environment. For this purpose, they used FEG as a proxy of energy and concluded a negative impact of FEG on the quality of environment and depicts that FEG has large contributions in increasing CO_2 that continuously decreasing the quality of environment. The above literature leads to construct the following hypothesis:

H_1: "Fossil fuels electricity generation negatively contributes to environmental degradation"

2.2. CO_2 Emission and Wind Electricity Generation (WEG)

Saidur et al. (2011) found a positive relation between WEG and CO_2 omission and concluded that the production of electricity by wind turbines increases CO_2 emissions. Dincer (2003) conducted a study on WEG for elaborating its effects on environment and concluded that WEG has positive effects on environment in such a way that this method does not reduce the quality of environment because this method does not significantly contribute to increasing the CO_2 emissions. Grande Prairie Wind (2014) concluded that WEG has no impacts on environmental degradation, and only a few quantities of CO_2 emission are increased during the preservation

phase of wind turbines that are engrossed by the trees during the route of photosynthesis. Kunz et al. (2007) were interested in investigating the effects of WEG on environment and found an insignificant association between WEG and CO_2 emissions and concluded that if the electricity is produced by using the method of WEG, the depletion of fossil fuel diminishes that lessen the CO_2 emissions. Based on above discussion, it is proposed that:

H_2: "Wind electricity generation insignificantly contributes to environmental degradation"

2.3. CO_2 Emission and Solar Electricity Generation (SEG)

Gunerhan et al., (2008) conducted a study on the generation of electricity by using the solar energy sources and CO_2 omission and concluded that as compared to conventional energy sources, SEG has less contribution in environmental degradation. Mahajan (2012) elaborated the prospective problems of SEG on the environment and concluded that sound and visual disturbance arose during the fixing and annihilation phase of solar systems. Tsoutsos et al., (2005) examined the association between CO_2 emission and SEG and found both positive and negative effects of SEG on environment. According to their study, SEG has fewer contributions in environmental degradation as compared to conventional energy sources but still it has some adverse effects on environment, although solar cells don't release any gases, but their cubicles comprises some poisonous materials that may increase the risk of omitting the substances to the atmosphere in the course of fire. Gish et al. (2019) described SEG as boundless source that has very fewer contributions in decreasing the quality of environment as compared with fossil fuel. The study also elaborated that during the built-up process, there are some negative effects of this method on the quality of environment. The above discussion leads to develop the following hypothesis:

H_3: "Solar electricity generation has an impact on environmental degradation"

2.4. CO_2 Emission and Hydro Electricity Generation (HEG)

Zeleňáková et al. (2018) found a positive effect of HEG on the environment. The study described HEG as a very clean method of producing electricity that has very fewer contributions in CO_2

release. Similarly, Esha (2008) revealed that there is no significant contribution of HEG in the CO_2 omission and concluded that as compare to conventional sources, HEG has positive effects on the quality of the environment. The study further explained that one of the main reasons of environmental degradation is CO_2 omission, and HEG method doesn't contributes in CO_2 omission. Conclusively, the method of generating energy through hydro-electricity generation method does not have adverse effects on environment. Therefore, the study proposed that:

H_4: "Hydro electricity generation has an insignificant impact on environmental degradation"

2.5. CO_2 Emission and Nuclear Electricity Generation (NEG)

Sovacool (2008) investigated the influence of NEG on CO_2 emissions and showed that NEG has less significant contributions in increasing the greenhouse gas emissions. The results showed little environmental influence and lesser specific greenhouse releases. Kunz et al. (2007) also indicated that NEG has very less contribution in decreasing the quality of environment and perceived NEG as confirmed technology that have significant influences in reducing the poisonous gases and additional ecological cargos from the energy subdivision. Shen et al. (2019) reviewed the literature of NEG's effects on CO_2 emissions and concluded that the countries with huge nuclear programs, having better environmental quality as compare to those countries who do not have nuclear programs. The above arguments allow to construct the following hypothesis:

H_5: "Nuclear electricity generation has positive impact in environmental degradation"

2.6. CO_2 Emission and Geo-thermal Electricity Generation (GEG)

Berrizbeitia (2014) examined the impact of GEG on CO_2 emissions and found both positive and negative effects of GEG on CO_2 emissions. The study concluded GEG as an environmentally friendly approach of producing electricity but also indicated its some negative effects on environment that may lessen the quality of environment. Glassley (2014) indicated that as compare to convectional energy sources, GEG has less contributions in environmental degradation, but still it has some effects in decreasing the quality of environment through liquescent and compacted waste, and the usage of land. thus, it is proposed that:

H_6: "Geo-Thermal Electricity Generation positively contributes in environmental degradation"

2.7. Conceptual Framework

Figure 1 represents the conceptuall framework of the study. This study aims to analyse the impact of energy mix in the case of Phillipines, Vietman and Thialand. Environmental degradation is the dependent variable of the study that is measured by CO_2 emission while mix methods of electricity generation are used as indepemdent variables that include FEG (H_1), WEG (H_2), SEG (H_3), HEG (H_4), NEG (H_5), GEG (H_6).

3. DATA AND METHODOLOGY

The study analyzes the impact of FEG, WEG, SEG, HEG, NEG, and GTG on CO_2 emission. The data of three most polluted nations (Phillipines, Vietman and Thialand) from ASEAN economies are collected from World Bank and Global Economy. The data period ranges from 1995 to 2017.

The study uses Brush Pagon LM and Pearson CD for testing the cross-section dependency of each variable. Levin et al., (2002) panel unit root test is used to check the stationary. Westerlund (2007) Cointegration test is used for testing the long run relationship among variables. Fully Modified least square (FMOLS) model is used to estimate the long run results. FEG, WEG, SEG, HEG, NEG, and GTG are used as independent variables while CO_2 emission is used as dependent variable. The explanation and measurement of the variables are presented in Table 3.

3.1. Model Specification

$CO_2it = \beta_0 + \beta_1 (FEGit) + \beta_2 (WEGit) + \beta_3 (SEGit) + \beta_4 (HEGit) + \beta_5 (NEGit) + \beta_6 (GEGit) + e$

Figure 1: Conceptual framework
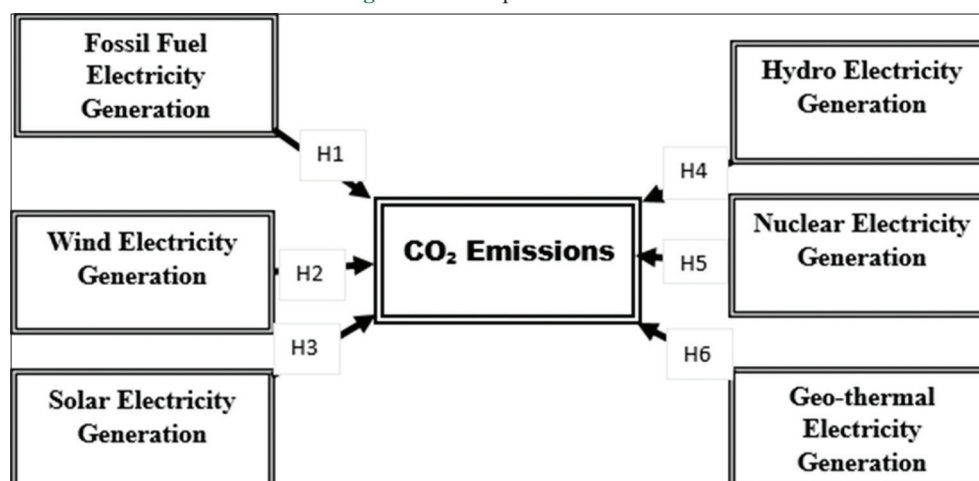
"Where; CO_2 is corban dioxide omission, FEG is fossil fuel electricity generation, WEG is wind electricity generation, SEG is solar electricity generation, HEG is hydro electricity generation, NEG is nuclear electricity generation, GEG is geo-thermal electricity generation, i and t stands for country and the time respectively; while e denotes normally distributed error term."

4. DATA ANALYSIS

Table 4 depicts the results of "Breusch-Pagan LM, BFK and Pesaran CD" tests applied to check the Cross-Section dependence of variables, meaning that either the shock in a selected country have a tendency to be transferred in other countries or not. We have a null hypothesis that there is no cross-section dependence among variables. Null hypothesis is rejected for all variables at the significance level of 1% and 5% which concludes that there exists cross-section dependence among variables. Table 5: Panel unit root test

Table 5 presents the outcomes of a panel unit root test that is used to test the stationarity and order of integration of data. Here, we have a null hypothesis that the series are non-stationary. The study used Levin et al., (2002) unit root test for testing the stationarity of the data. Results elaborate that all the series are non-stationary at level and become stationary at first difference by rejecting the null hypothesis at 1% and 5% level of significance which states that all the variables have an integration of order 1. In other words, all the variables are integrated at I(1).

Table 6 demonstrates the results of descriptive statistics of study variables. 7 variables are being used in the study. The Table shows the mean, median and standard deviation of the data, furthermore, it also shows skewness and kurtosis along with maximum and minimum values.

Normality of residuals also been check through Jarque-Bera test. The null hypothesis for this test is that the residuals are normal, as we can see that all the probability values are significant which rejects the null hypothesis, so the residuals are not normal in our case.

Table 7 elaborates the results of Cointegration. As mentioned above, there is cross section dependence among variables, so the study applied Westerlund (2007) error correction-based panel cointegration tests with boot for testing that either the cointegration (long run relation) exist among the variables or not. The null hypothesis is set as "there is no cointegration" which is strongly rejected at 1% and 5% level of significance and the results conclude that there is presence of cointegration among variables. The study used Westerlund (2007) cointegration as it is vigorous beside cross sectional dependence in the panel data.

As mentioned above, there is presence of Long rung relationship among the variables. Thus, the study used FMOLS for the estimation of Long run coefficient. Table 8, therefore shows the results of FMOLS. The study used FMOLS for the estimation because this method is operative in the removal of endogeneity problem.

Table 3: Description and measurement of variables

Variables	Definition/Measuring Unit
Dependent variable	
Environmental degradation (CO_2 emission)	"Carbon dioxide emissions are those stemming from the burning of fossil fuels and the manufacture of cement. They include carbon dioxide produced during consumption of solid, liquid, and gas fuels and gas flaring."
Independent variable	
Fossil fuel electricity generation (FEG)	"Billion kilowatt-hours of electricity generated from fossil fuels including oil, coal, and natural gas".
Wind electricity generation (WEG)	"Billion kilowatt-hours of electricity generated from wind"
Solar electricity generation (SEG)	"Billion kilowatt-hours of electricity generated from sunlight"
Hydro electricity generation (HEG)	"Hydroelectric generation excludes generation from hydroelectric pumped storage, billion kilowatt-hours is used as measuring unit of HEG"
Nuclear electricity generation (NEG)	"Nuclear electricity net generation (Net generation excludes the energy consumed by the generating units)". The measuring unit of NEG is billion kilowatt-hours.
Geo-thermal electricity generation (GEG)	"Billion kilowatt-hours of geothermal electricity generated"

Table 4: Cross section dependence

Variables	Breusch-Pagan LM	Pesaran CD	Decision
CO_2	33.9274***	5.55546***	H_0 Rejected
FEG	64.5461***	8.0333***	H_0 Rejected
WEG	76.8832***	9.8264***	H_0 Rejected
SEG	87.9267***	4.8264**	H_0 Rejected
HEG	69.2345***	2.8464**	H_0 Rejected
NEG	37.8323***	7.1683***	H_0 Rejected
GEG	44.9827***	9.8222***	H_0 Rejected

"H_0: There is no cross-section dependence, while *, **, ***Represent significant at 10%, 5% and 10%"

Table 5: Panel unit root test

Variables	Level		First difference		Decision
	Intercept	Trend and intercept	Intercept	Trend and intercept	
CO_2	−0.60690	−0.30900	−5.27383***	−6.48867***	I(1)
FEG	−0.6374	−0.8264	−4.6354***	−5.7363***	I(1)
WEG	1.8966	0.9526	9.7263***	8.6247***	I(1)
SEG	1.4017	0.8739	8.6220**	9.8227***	I(1)
HEG	−0.8943	0.7953	9.7226***	7.6725***	I(1)
NEG	1.9372	1.7225	−9.6633***	6.8362***	I(1)
GEG	0.2463	0.3787	6.7383***	8.8812***	I(1)

"**, *** denotes statistical significance at 1%, 5% and 10% respectively"

Table 6: Descriptive statistic

Variables	CO_2	FEG	WEG	SEG	HEG	NEG	GEG
Mean	1.386429	48.57905	0.245952	0.594286	13.34548	34.18304	5.031429
Median	0.950000	38.05500	0.105000	0.715000	9.715000	34.18000	0.960000
Maximum	4.760000	153.3500	0.980000	3.390000	63.47000	36.44000	11.63000
Minimum	0.390000	3.840000	0.020000	0.010000	5.740000	31.84000	0.110000
Std. Dev.	1.104421	37.87325	0.305918	0.586137	10.00839	1.392014	4.867165
Skewness	1.864598	1.221480	1.542894	2.497546	3.273186	-0.021095	0.204869
Kurtosis	5.056528	3.635184	3.630447	13.23863	16.13876	1.837636	1.076240
Jarque-Bera	31.73838	11.15014	17.35921	227.1160	377.0936	1.296500	6.770294
Probability	0.000000	0.003791	0.000170	0.000000	0.000000	0.029960	0.033873

Table 7: Wester lund panel cointegration

Statistic	Value
G_t	-4.8945**
Ga	-7.9274***
P_t	-8.2467***
P_a	-5.8374**

Table 8: Fully modified ordinary least square estimates (FMOLS)

Variables	CO_2 emissions		Decision
	Coefficient	P-value	
FEG	0.0671	0.0053**	H_1: Accepted
WEG	0.1315	0.2918	H_2: Accepted
SEG	−0.0142	0.0653**	H_3: Accepted
HEG	0.8272	0.3426	H_4: Accepted
NEG	−0.0417	0.0002***	H_5: Accepted
GEG	−0.0028	0.0982*	H_6: Accepted
R^2		0.9116	
Adjusted R^2		0.8872	

"*,**,*** represent the significance level at 10.5, and 1%"

The coefficient of FEG (0.0671) is positive and significant at 5% level which shows that 1-unit increase in FEG causes to increase CO_2 emissions by 0.0671 units in long run and representing the negative effects on environment, therefore, H_1 is accepted. Coefficient of SEG (−0.0142) is negative and significant at 5% level of significant, demonstrating that in the long run about 0.0142 units of CO_2 emission is reduced due to 1-unit increase in SEG and concludes the positive effects of SEG on environment, supporting H_3. Similarly, coefficient of NEG (−0.0417) is also significant and negative which shows that by increasing 1-unit of NEG, CO_2 emission can be reduced by 0.0417 units. Here, H_5 is also accepted. Coefficient of GEG (−0.0028) also shows the reduction in CO_2 emissions by 0.0028 units against 1-unit of GEG. H_6 is also confirmed. While WEG and HEG do not have significant contribution in decreasing the quality of environment. Hence accepting H_2 and H_4. Value of adjusted R^2 shows that 88.72% variations in CO_2 emissions are collectively explained by FEG, WEG, SEG, HEG, NEG, and GTG.

5. DISCUSSIONS AND CONCLUSIONS

Education, environment, energies and economic, have several number high impacts of research in 5 years. From data from Dimensions.ai, the most comprehensive research grants database which links grants to millions of resulting publications, clinical trials and patents, have several results about education, environment, energies and economic research, in Studies in Human Society 146 papers, Economics 96 papers, Applied Economics 95 papers, Engineering 93 papers, Policy and Administration 63 papers. Using vosviewer.com analysis, files downloaded from the free version of Dimensions may contain data for at most 2500 documents. (Larger numbers of documents are supported when a subscription-based version of Dimensions is used), we can see that Education have high impact on energy, environment, sustainability and sustainable development.

Universal environmental problems are receiving huge consideration particularly in the intensification of high temperature of earth and air. Government are gradually conscious about the needs to bound these environmental problems from the human accomplishments. These environmental problems are arising due to intense consumption of energy (Chopra, 2016). Nonetheless, a huge amount of energy is essential for the better performance of economy but it usually generated from fossil fuels, that is very unadventurous source and have enough contribution in CO_2 emissions that have negative effects of environment (Zwolinska et al., 2011) and the quality of environment is decreasing due to the consumption of energy. Therefore, the study analyzes the impact of FEG, WEG, SEG, HEG, NEG, and GTG on CO_2 emissions. The data of three most polluted nations (Phillipines, Vietman and Thialand) from ASEAN economies are collected for the period of 1995-2017 from World bank and Global economy. The study use FMOLS model for examining the results.

The study finds the negative effects of FEG on environment as FEG results in increasing in noxious gasses that not only reduce the quality of environment but also increases the illness and chronic diseases in children. The results are consistent with (Zwolinska et al., 2011; Hunt and Weber, 2019). Study didn't find any contribution of WEG and HEG in increasing the CO_2 emission. Only a few quantities of CO_2 emission are increased during the preservation phase of wind turbines that are engrossed by the trees during the route of photosynthesis. Similarly, NEG method doesn't contribute in CO_2 omission, therefore, it doesn't have adverse effects on environment. Results are consistent with (Zeleňáková et al., 2018; Saidur et al., 2011; Aldahmani et al., 2020; Alkamil et al., 2020). SEG, GEG and NEG shows positive effects on environment in such a way that CO_2 emission will be reduced if electricity is produced by using these methods because NEG is perceived as confirmed technology that have significant influences in reducing the poisonous gases and additional ecological cargos

from the energy subdivision and SEG is a boundless source that have less contributions in decreasing the quality of environment as compare to fossil fuel. Results are similar with (Gish et al., 2019; Sovacool, 2008).

The study has some practical implications. First, there is need to use solar, geo thermal and nuclear energy source for the production of electricity. Second, fossil fuels have adverse effects not only on environment but also on the health of children. The government should avoid to produce electricity by using fossil fuel. The study also has some limitations: Firstly, this study used only 3 countries of ASEAN nations. Future study can be conducted by using whole ASEAN economies and can make comparison. Future study may extend the data period for more reliable results.

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