SECTORAL ANALYSIS OF CARBON EMISSIONS AND ECONOMIC FACTORS: DINAMIS MODEL

Firsty Ramadhona Amalia Lubis[1], Suharno[2*], Arintoko[3]

[1]Universitas Ahmad Dahlan, firsty.ramadhona@ep.uad.ac.id , Indonesia
[2*]Universitas Jendral Soedirman, suharno@unsoed.ac.id , Indonesia
[3] Universitas Jendral Soedirman, arintoko@unsoed.ac.id , Indonesia
*Corresponding Author

ABSTRACT
A real challenge in the 21st century is climate change, which is the high concentration of greenhouse gases in the earth's atmosphere caused by increased global temperatures leading to warming. The first research conducted with the EKC hypothesis was conducted by Grosman & Krueger in 1991, which supported the EKC claim that environmental degradation and economic growth are interrelated. The study aimed to examine the influence of GDP variables, renewable energy consumption, forest area, and population on greenhouse gas emissions. The variables used consist of GDP, renewable energy consumption, forest area, and people with the independent variable of greenhouse gas emissions in 6 ASEAN countries. This study uses the Generalized Method of Moments panel model. The results show that the EKC hypothesis is not proven because GDP has no significant effect on emissions, renewable energy consumption has a significant effect on emissions, forest land area has no significant effect on emissions, and population has a significant positive effect on emissions in ASEAN countries.
Keywords: EKC, emissions, renewable energy consumption, population

1. Introduction

Greenhouse gases are increasing in the atmosphere are often associated with humanity's development in all fields, from the economic, social, cultural, and technological aspects, which are closely related. The earth's climate problem in the last few decades has become an international concern. Humans feel the increasing temperature of the planet. Climate change is a challenge of the 21st century; increasing global temperatures in the Earth's atmosphere are caused by greenhouse gases that contribute to global warming (Prakash, 2022).

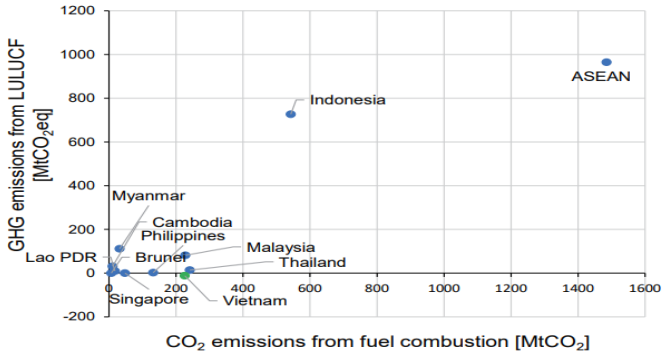


Figure 1.1 Emission development in ASEAN

Figure 1.1 shows Carbon dioxide emissions from fossil fuel combustion and GHG (Greenhouse Gas) emissions from Land Use, land use change and forestry (LULUCF) with their share of GHG emissions in 2016. The ASEAN region produced more GHG emissions while reflecting sizable emissions from forest and cropland at 1,485 MtCO2 and LULUCF at 965 MtCO2eq (top right, left Figure 9). Indonesia is a large net GHG emitter in terms of deforestation and peatland exploitation. Meanwhile, Vietnam produces harmful net GHG emissions from LULUCF. Indonesia, Thailand, Malaysia, Vietnam and the Philippines are ASEAN's largest emitters of carbon dioxide from fuel combustion. In the future, ASEAN needs to adopt low-carbon energy sources in its long-term strategy. This is used to improve energy management and land use functions, both forest and agriculture. So that zero emissions can be achieved in the future.

The level of CO_2 emissions is influenced by economic growth. In general, the relationship between CO2 emissions and economic growth can be seen from three perspectives: first, economic growth is considered to be the cause of increased CO2 emissions. In other words, when the value of economic growth increases, it will increase energy demand, impacting CO2 emissions. Second, economic growth and CO2 emissions have a causal relationship. Third, no two-way relationship runs between CO_2 emissions and economic growth, which is called the neutralization hypothesis (Mardani, et al., 2018).

Underlying all these issues is global population growth, which adds more than 70 million people annually. According to 2019 UN data, 7.8 billion people lived in the world in 2020. By 2050, the world population is estimated to grow to 9.7 billion, with most of the growth occurring in developing countries. Due to continued population growth, economies must produce more goods and services to maintain or improve a country's quality of life. Natural resources that need to be sought or accumulated will increase production as more goods and services are produced. As a result, the supply of natural resources will decrease as they are used, and faster economic growth will also affect planning (Suparmoko, 2016).

Environmental Kuznets Curve (EKC) hypothesis. The first research conducted with the EKC hypothesis was by Grosman & Krueger 1991. The result of economic activity can be environmental pollution which results in environmental degradation and economic growth. Progress is the use of natural resources and the environment. This is in line with research conducted by Grossman & Krueger (Darwanto, Woyanti, Santosa, Sasana, & Ghozal, 2019). This study uses variables of renewable energy consumption, forest area, population, and economic growth in 6 ASEAN countries in analyzing the influence on CO2 greenhouse gas emissions. The novelty of the study uses the SYS-GMM dynamic panel model, which has not been widely used in research. Dynamic panel models are considered to eliminate BIAS when using panel data (Arellano & Bond, 1991).

2. Literature Review

Research by Bilgili, Kocak, & Bulut (2015), Stating that renewable energy has a negative effect on greenhouse gas emissions. shows that factors related to the use of renewable energy negatively influence CO2 emissions. Renewable energy is clean, green, and environmentally friendly because it produces far fewer greenhouse gas emissions than fossil fuels or harms CO2 emissions (Zulaicha, Sasana, & Septiani, 2020). Various negative impacts of environmental destruction that damage living things will be reduced using renewable energy. Renewable energy consumption is negatively related to CO2 emissions, which means that as renewable energy consumption increases, CO2 emissions decrease (Zulaicha, Sasana, & Septiani, 2020).

As a result of increasing CO2 greenhouse gas emissions, climate change causes the environment to be affected by negative externalities including global warming, rising earth temperatures, weather changes, more frequent and more intense storms, and modification of the carbon and water cycles (Harris & Roach, 2021). The hypothesis that then develops is that when the forest area increases, the level of greenhouse gas emissions or CO2 will decrease. This means that there is a negative relationship (Fauzi, 2017).

Carbon dioxide (CO2) emissions have a long-term positive relationship with population growth and mobility. Humans have an essential war to protect the environment because they are energy consumers. Therefore, increasing population growth will increase per capita consumption, affecting carbon dioxide emissions (Pata, 2018). These results align with research (Aye & Edoja, 2017), which studied 31 developing countries worldwide and found that increasing population can increase energy use, increasing pollution.

Simon Kuznet originates the Kuznet curve hypothesis, which depicts the inverted U curve between per capita income and income inequality. In Grossman's (1991) study, the curve is inverted when there are changes in economic growth's scale, composition, and technique. Environmental Kuznet Curve (EKC) hypothesis explains the relationship between environmental damage indicators and income per capita level explained by this idea (Santi & Sasana, 2020). The GDP per capita variable has a positive coefficient value, and the GDP2 per capita squared variable has a negative coefficient value, so the EKC hypothesis is true (Nikensari, Destilawati, & Nurjanah, 2019).

3. Research Methodology

As independent variables, this study uses quantitative data, including renewable energy consumption, forest area, population, and gross domestic product. In contrast, the dependent variable of this study is greenhouse gas emissions in ASEAN, which includes Indonesia, the Philippines, Malaysia, Singapore, Thailand, and Vietnam from 2011-2020. The research uses the System Generalized Method of Moments, a dynamic panel model. Research variables Emissions are gases formed through various combustion processes with units of Metric tons, data obtained from the International Energy Agency. Renewable energy consumption is the amount of renewable energy consumed by the community with units of percent, data obtained from the World Bank. Forest area is the total amount of tree cover in the forest with units of percent, data obtained from the Worldbank. GDP A measure of the growth of the level of life and income per capita with units of percent, data obtained from the World Bank.

According to Baltagi, a common problem in dynamic panels is the correlation between explanatory variables, resulting in biased GLS estimates. This problem can be solved by the GMM Arellano and Bond methods which produce more constant parameters.

Arellano and Bond is a technique that can see the correlation between explanatory variables and lagged values. Because the number N is greater than the number T of observations. The form Arellano Bond suggests is first diff The estimator in the optimal GMM model of (δ1) according to Hansen for N → ∞ and T.

Blundell Bond's System Generalized Method of Moments (SYS-GMM) estimation method estimates the system of equations by combining the first difference moment with the level condition moment. The GMM estimator δ is obtained by minimizing the weighted quadratic function J(δ) as an equation (Baltagi, 2005)

$$y_{it} = \delta y_{1,t-1} + \beta x'_{it} + \mu_{it} \quad \text{.....(1)}$$

Blundell & Bond (1998) attributed the bias and poor precision of the FD-GMM estimator to the weak instruments, which are characterized by their parameter concentration. Furthermore, Blundell and Bond show that additional mild stationarity restrictions on the initial condition process allow the use of the extended SYS-GMM estimator using lag differences of yit. as instruments for the equations in levels, in addition to lag levels of yit as instruments for the equations in first differences. The SMM estimator is shown to have improved efficiency compared to the FD- GMM as δ à and $\frac{\sigma_\mu^2}{\sigma_u^2}$) increases (Baltagi, 2005).

Equation:

(Emisi)it = α + δ (Emisi) it-1 + β1(GDP)it + β2(GDP2)it + β3ln(Consen) it + β4(Forest) it + β5ln(Pop) it + εit

Description :

-Emissions: Emission Co2
- GDP : Economic Growth
- Consen: Energy Consumption
- Forest : Forest Area
- Pop : Total Population

Dynamic panel model specification test. Estimation is carried out using the FD-GMM method; then, the instrument validity test is carried out using the Sargan test, and the instrument's consistency is used using the Arellano Bond test. The Arellano Bond test is used to test the consistency of the instrument used and to ensure that there is no correlation in AR(2) with the error term. This means that the estimate does not have autocorrelation. Meanwhile, the Sargan test is used to identify the variables to be estimated in the valid category. In addition, the Sargan test is also used to estimate GMM to ensure the absence of heteroscedasticity or homoscedasticity.

The expected result does not reject the null hypothesis with a fundamental level of 5% in both tests. Thus, a reasonable conclusion can be drawn from the results of the model specification (Arellano and Bond 1991; Arellano & Bover 1995; Blundell and Bond 1998; Olayiwola, Osabuohien, Okodua, & Ola-David 2015; Adeleye, Osabuohien, & Bowale, 2017). If the test results do not obtain unbiased estimators and valid and consistent instruments in the FD-GMM method, the SYS-GMM method will be used (Blundell & Bond, 1998). The consistency of the SYS-GMM estimator was also Assessed by two specification tests, namely the Sargan test and the Arellano Bond test on AR(2).

4. Results

Estimation of Dynamic Panel Data Regression Model

At this stage, the dynamic panel data regression model is estimated using the first-difference GMM two-step estimator approach and system GMM two-step estimators.

Table 1. Result of FD-GMM

Variabel	Coefficient	Std. Error	Z-Statistic	Prob.
L. Emisi	0,49773	0,20320	2,45	0.014
GDP	-15,0462	6,254	-2,41	0.016
GDP^2	1,82776	1.365	1,34	0.181

LnConsre	-164,451	24,42	-6,73	0.000
Forest	-10,141	41,97	-0,24	0.809
LnPop	131,5251	323,56	0,41	0.684
Cons	-1804,374	5843,75	-0,31	0,757

Source: Stata.14 data processing results

The table below describes the intercept and slope for each independent variable with the SYS-GMM approach.

Table 2. Result of SYS-GMM

Variabel	Coefficient	Std. Error	Z-Statistic	Prob.
L. Emisi	0,6611851	0,199945	3,31	0,001
GDP	-15,52937	7,921018	-1,96	0,050
GDP^2	2,046053	1,609592	1,27	0,204
LnConsre	-144,0878	33,48461	-4,30	0,000
Forest	12,04236	17,7892	0,68	0,498
LnPop	157,9642	50,42488	3,13	0,002
Cons	-2380,53	811,820	-2,93	0,003

Source: Stata.14 data processing results

Dynamic Panel Data Regression Model Specification Test

The panel data regression model specification test is carried out with the Arellano-Bond and Sargan tests. The Arellano-Bond test is conducted to detect the presence of autocorrelation between residual components in both FD-GMM and SYSGMM If the value of m or > or Pvalue < α, reject. GMM consistency is indicated by a significant value (reject) on m (1), while on m (2), GMM consistency is indicated by an insignificant value (fail to reject). Arellano-Bond test results on both. The results of the Arellano-Bond test on both models, namely FD-GMM and SYS-GMM, are shown in Table 3.

Table 3. Result from Arellano-Bond FD-GMM dan SYS-GMM

FD-GMM **Bond-Test**		**SYS-GMM** **Bond-Test**	
Z	**Prob > z**	Z	**Prob > z**
-1,6094	0,1075	-1,0206	0,3074

Source: Stata.14 data processing results

Based on this It can be concluded that the estimation carried out both using the FD-GMM and SYS-GMM approaches are consistent, and no autocorrelation occurs. Autocorrelation. The following specification test conducted is the Sargan test to determine the validity of instrument variables whose number exceeds the estimated parameters. The decision is rejected if the value of the S test statistic > the value of the chi-square table or p-value < α. The results of the Sargan test on both models, namely FD-GMM and SYS-GMM are shown in Table 4.

Table 4. Result Sargan FD-GMM dan SYS-GMM

FD-GMM **Sargan-Test**		**SYS-GMM** **Sargan-Test**	
Chi2(2)	**Prob > chi2**	**Chi2(2)**	**Prob > chi2**
1,386835	0,4999	1,261049	0,8679

Source: Stata.14 data processing results

Table 4 shows the results of the Sargan test on both models, namely the FDGMM and SYS-GMM approaches. The value of the test statistic on both models is S > chi-square table value. Therefore, the decision is to accept both the FD-GMM model and the SYS-GMM model, so the conclusion is that the overidentifying restriction condition in the estimation of the model is valid. The next test is to determine the criterion of randomness by comparing the FD-GMM and SYS-GMM dependent lag estimators with the FEM (Fixed Effect Model) model is biased downward, and the PLS (Pooled Least Squares) model is biased upward. Least Squares) the model, which is biased upwards. The unbiased lag estimator is in between the FEM and PLS models. A comparison of FD-GMM, SYS-GMM estimator with FEM and PLS can be seen in Table 5.

Table 5. Comparison of Model Estimator

Variabel	**CEM**	**FEM**	**REM**	**SUR**	**FD-GMM**	**SYS- GMM**
L. Emisi	1.05428 (0.000)***	0.0956715 (0.734)	1.05428 (0.000)***	1.05428 (0.000)***	0.4977331 (0.014)***	0.6611851 (0.001)***
GDP	-12.19574 (0.063)	-17.19248 (0.036)***	-12.19574 (0.038)***	-12.19574 (0.000)***	-15.04624 (0.016)***	-15.52937 (0.050)**
GDP^2	2.435083 (0.012)	1.599472 (0.282)	2.435083 (0.003)	2.435083 (0.000)***	1.827764 (0.181)	2.046053 (0.204)
Ln Cons Energi	-13.39586 (0.209)	-238.4753 (0.014)***	-13.39586 (0.182)	-13.39586 (0.183)	-164.4511 (0.000)***	-144.0878 (0.000)***
Forest	-2.105832 (0.654)	-44.13379 (0.237)	-2.105832 (0.645)	-2.105832 (0.668)	-10.14123 (0.809)	12.04236 (0.498)
Ln Pop	16.84215 (0.289)	-9.312444 (0.983)	16.84215 (0.266)	16.84215 (0.161)	131.5251 0.684	157.9642 (0.002)***

Source: Stata.14 data processing results

From Table 5, it can be seen that the SYS-GMM coefficients are between the FEM and PLS models. With Thus, the model that meets the criteria of unbiasedness is the SYS-GMM model.

5. Discussion Result Interpretation

(Emisi)it = α + δ(Emisi) it-1 + β1(GDP)it + β2(GDP2)it + β3ln(Consen) it + β4(Forest) it + β5ln(Pop) it + εit ……..(1)

(Emisi)it = α + δ Emisi (0.6611851)**it-1 + β1GDP (**-15.52937) **it + β2GDP2(**2.046053)**it + β3lnConsen(**-144.0878) **it + β4Forest(**12.04236)**it + β5lnPop(**157.9642)**it + εit …….(2)**

Dimana:
Emissi (0.6611851)=> When carbon dioxide emissions increase by 1 Metric ton in the previous period, it will increase the greenhouse gas emissions in Asian countries by 0.6611851 Metric tons.
GDP (-15.52937) => When economic growth increases by 1 percent, it will reduce greenhouse gas emissions in Asian countries by 15.5 Metric tons.
GDP2 (2.046053) => Economic growth, in the long run, has no effect on greenhouse gas emissions in Asian countries.
Consent (-144.0878**)=>** When renewable energy consumption increases by one percent, it will reduce greenhouse gas emissions in Asian countries by 144.0878 Metric tons.
Forest (12.04236) => When forest land area has no effect on Asian countries' greenhouse gas emissions
Pop (157.9642) => When the population increases by 1 percent, it will increase the greenhouse gas emissions of Asian countries by 157,964 Metric tons.

Relationship between Economic Growth Variables (GDPg and GDPg2) and Greenhouse Gas Emissions.

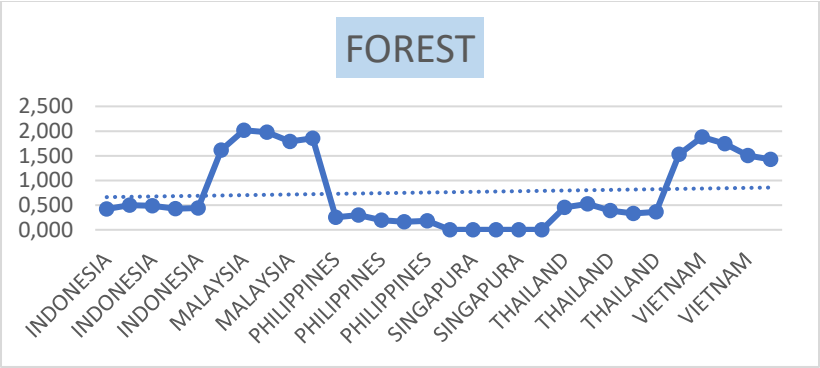
The results showed that economic growth in the short term has a positive and significant effect on greenhouse gas emissions variables. Still, it has had no impact on greenhouse gas emissions for a long time. So the Kuznets curve theory does not apply to the study. Opoku, Amoako, & Amankwa (2014) published the findings of a related study in Ghana, showing that there is short-run equilibrium, but EKC is not proven and has no discernible impact. Ali, Khatoon, Ather, & Akhtar (2015) conducted a similar study in Pakistan, which showed that there is a short-run equilibrium but did not support EKC due to the lack of significance of GDP and GDP squared. As CO2 greenhouse gas emissions are a type of global pollution that can go up or down and is expected to take a very long time, EKC was not shown to be plausible in this study or the six countries in the ASEAN region.

The Relationship Between Renewable Energy Consumption Variables And Greenhouse Gas Emissions.

The results show that when renewable energy consumption increases by one percent, it will reduce greenhouse gas emissions in Asian countries by 144.0878 Metric tons. The analysis found that using renewable energy reduces CO2 emissions. This finding is supported by research by Bilgili, Kocak, & Bulut (2015), according to what factors associated with using renewable energy harm CO2 emissions. Renewable energy is clean and environmentally friendly because it produces far fewer pollutants than fossil fuels, adversely affecting CO2 emissions. Various negative impacts of environmental destruction that damage living things will be reduced using renewable energy. Renewable energy consumption is negatively related to CO2 emissions, which means that as renewable energy consumption increases, CO2 emissions decrease (Zulaicha, Sasana, & Septiani, 2020).

The Relationship Between Forest Variables And Greenhouse Gas Emissions.

The results show that forest land area has no effect on Asian countries' greenhouse gas emissions



Source: World Bank Data (2016-2021)

Graph.1 Data on Asian Forest Land Area

The area of forest land in the study does not affect greenhouse gas emissions because the data used for Singapore's forest land area is 0, affecting the calculation results and causing forest land area to have no significant effect in ASEAN. Reducing greenhouse gas emissions depends not only on forest land area and other factors such as energy use and consumption patterns.

The Relationship Between Population Variables And Greenhouse Gas Emissions.

The results show that the population increases by 1 percent, which will increase the greenhouse gas emissions of Asian countries by 157,964 Metric tons. Population growth and mobility it has a long-term positive relationship with CO2 emissions. Humans have an essential war to protect the environment because they are energy consumers. Therefore, increasing population growth will increase per capita consumption, affecting carbon dioxide emissions (Pata, 2018). These results align with the research of Aye & Edoja (2017), which studied 31 developing countries worldwide and found that increasing population can increase energy use, increasing pollution.

6. Conclusion

Based on the results of this study, it can be concluded that the SYS-GMM approach is better than the FD-GMM approach for modeling greenhouse gas emissions in ASEAN. Variables that significantly affect Suggestions for future research are to conduct Regression IV testing and add other variables such as urbanization, fossil energy consumption, and non-fossil energy consumption.

References

Adeleye, B. N., Osabuohien, E., & Bowale, E. (2017). The Role of Institutions in the Finance-Inequality Nexus in Sub-Saharan Africa. *Journal of Contextual Economics – Schmollers Jahrbuch, 137*(1-2), 173-192. doi:http://dx.doi.org/10.3790/jce.137.1-2.173

Agustin, T., & Yon, S. (2018). Emisi Karbon Dioksida Akibat Konversi Hutan Manjadi Perkebunan Kelapa Sawit di Provinsi Sumatera Utara. *IPB*.

Ali, A., Khatoon, S., Ather, M., & Akhtar, N. (2015). Modeling Energy Consumption, Carbon Emission and Economic Growth: Empirical Analysis for Pakistan. *International Journal of Energy Economics and Policy, 5*(2), 642-630. Retrieved from https://www.econjournals.com/index.php/ijeep/article/view/1011

A'nnisa, L., Sasana, H., & Septiani, Y. (2020). ANALISIS KONSUMSI ENERGI FOSIL, EMISI CO2, KONSUMSI ENERGI TERBARUKAN DAN PERTUMBUHAN EKONOMI TERHADAP PENGELUARAN KESEHATAN INDONESIA PERIODE TAHUN 2000-2017. *Dinamic*, 431-445.

Arellano, M., & Bond, S. R. (1991). Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equation. *Review of Economic Studies, 58*(2), 277-297.

Arellano, M., & Bover, O. (1995). Another Look at The Instrumental Variable Estimation of Error-Components Models. *Journal of Econometrics, 68*(1), 29-51. doi:https://doi.org/10.1016/0304-4076(94)01642-D

Arista, T. R., & Amar, S. (2019). Analisis Kausalitas Emisi CO2, Konsumsi Energi, Pertumbuhan Ekonomi dan Modal Manusia di ASEAN. *Universitas Negeri Padang*.

Aye, G. C., & Edoja, P. E. (2017). Effect of economic growth on CO2 emission in devepoling countries: Evidence from a dynamic panel threshold model. *Cogent Economics & Finance*.

Baltagi, B. (2005). *Econometric Analysis of Panel Data* (3rd ed.). England: John Wiley & Sons, Ltd.

Bilgili, F., Kocak, E., & Bulut, U. (2015). The Dynamic Impact of Renewable Energy Consumption on CO2 Emssions: A Revisited Environmental Kuznets Curve Approach. *Renewable & Sustainable Energy Reviews, 54*, 838-845. doi:http://dx.doi.org/10.1016/j.rser.2015.10.080

Blundell, R., & Bond, S. (1998). Initial Conditions and Moment Restrictions in Dynamic Panel Data Models. *Journal of Econometrics, 87*, 115-143.

Carfora, A., Pansini, R., & Scandurra, G. (2019). The causal relationship between energy consumption, energy prices and conomic growth in Asian developing countries: A replication". . *Journal of Energy Strategy Reviews*, 81-85.

Darwanto, D., Woyanti, N., Santosa, P. B., Sasana, H., & Ghozal, I. (2019). The Damaging Growth: An Empiric Evidence of Environmental Kuznets Curve in Indonesia. *International Journal of Energy Economics and Policy, 9*(5), 339-345.

Faizah, N., Laut, L. T., & Jalunggono, G. (2017). ANALISIS DETERMINAN DEGRADASI LINGKUNGAN, PENGUJIAN EKC DI 9 NEGARA ASEAN PERIODE 2000-2017. *DINAMIC*.

Fauzi, R. (2017). Pengaruh Konsumsi Energi, Luas Kawasan Hutan dan Pertumbuhan Ekonomi terhadap Emisi CO di 6(Enam)NegaraAnggota ASEAN : PendekatanAnalisis Data Panel .

Fitriyanto, F., & Iskandar, D. D. (2019). An Analysis on Determinants of Energy Intensity in ASEAN Countries. *Jurnal Ekonomi dan Studi Pembangunan*, 90-103.

Harris, J. M., & Brian, R. (2018). *Envitonmental and Natural Resource Economics.* LONDON.

Harris, J. M., & Roach, B. (2021). *Environmental and Natural Resource Economics* (5th ed.). New York: Routledge taylor & Francis Group.

Ibrahiem, D. M. (2016). Environmental Kuznets Curve: an empirical analysis for carbon dioxide emissions in Egypt. *International Journal og Green Economics*, 136-150.

IEA. (2019). *Perspectives for the Clean Energy Transition: The Critical Role of Buildings.*

IRENA. (2019). *Transforming the Energy System and Holding the Line on the Rise of Global Temperatures.* Abu Dhabi: International Renewable Energy Agency.

Krisnawati, H., Imanuddin, R., Adinugroho, W. C., & Hutabarat, S. (2015). *Metod Standar untuk Pendugaan Emisi Gas Rumah Kaca dari Sektor Kehutanan di Indonesia (Versi 1).* Pusat Penelitian dan Pengembangan Konservasi dan Rehabilitasi.

Mardani, A., Streimikiene, D., Nilashi, M., Aranda, D. A., Loganathyan, N., & Jusoh, A. (2018). Energy Consumption, Economic Growth, and CO2 Emissions in G20 Countries: Application of Adaptive Neuro-Fuzzy Inference System. *Journal energies*.

Nikensari, S. I., Destilawati, S., & Nurjanah, S. (2019). STUDI ENVIRONMENTAL KUZNETS CURVE DI ASIA: SEBELUM DAN SETELAH MILLENIUM DEVELOPMENT GOALS. *Jurnal Ekonomi dan Pembangunan*.

Nurhayati, A., Ummah, Z. I., & Shobron, S. (2018). KERUSAKAN LINGKUNGAN DALAM AL-QUR'AN. *SUHUF*, 194-220.

Olayiwola, K., Osabuohien, E. S., Okodua, H., & Ola-David, O. (2015). Economic integration, trade facilitation and agricultural exports performance in ECOWAS Sub-Region. In M. Ncube, I. Faye, & A. Verdier-Chouchane, *Regional Integration and Trade in Africa* (pp. 31-46). London: Palgrave Macmillan. doi:https://doi.org/10.1057/9781137462053_3

Opoku, E. E., Amoako, S., & Amankwa, I. (2014). Trade Openness, Economic Growth, and the Environment: the Case of Ghana. *International Journal of Economics, Commerce, and Management, 2*(8), 1-13.

Pata, U. (2018). Renewable Energy Consumption, Urbanization, Financial Development, Income and CO2 Emissions in Turkey: Testing EKC Hypothesis with Structural Breaks. *Journal of Cleaner Production, 187*, 770-779. doi:https://doi.org/10.1016/j.jclepro.2018.03.236

Prakash, A. (2022, December). Boiling Point. *One of the most vulnerable regions to climate change is witnessing the world's biggest jump in greenhouse gas emissions*.

Reksohadiprodjo, S., & Brondjonegoro, A. B. (2000). *EKONOMI LINGKUNGAN* .

Santi, R., & Sasana, H. (2020). Analisis Pengaruh Pertumbuhan Ekonomi, Jumlah Penduduk, Foreign Direct Investment (FDI), Energy Use/ Consumption dan Krisis Ekonomi Terhadap Kualitas Lingkungan Ditinjau Dari Tingkat Carbon Footprint Di ASEAN 8. *Diponegoro Journal of Economic, 10*(2), 1-11.

Shahzad, U., & Riphah. (2015). Global Warming: Causes, Effect and Solutions. *Durreesamin Journal*.

Suparmoko, M. (2016). *Ekonomi Sumber Daya Alam dan Lingkungan.* Yogyakarta: BPFE.

Widyawati, R. F., Hariani, E., Ginting, A. L., & Nainggolan, E. (2021). Pengaruh Pertumbuhan Ekonomi, Populasi Penduduk Kota, Keterbukaan Perdagangan Internasional Terhadap Emisi Karbon Dioksida (Co2) Di Negara Asean. *Jambura Agribusiness Journal*, 37-47.

Zulaicha, A. U., Sasana, H., & Septiani, Y. (2020). Analisis Determinan Emisi CO2 di Indonesia Tahun 1990-2008. *Dinamic: Directory Journal of Economic*, *2*(2), 487-500. doi:https://doi.org/10.31002/dinamic.v2i2.1384