ISSN Online : 2709-4030
ISSN Print : 2709-4022
Vol. 6 No.1, 2022

Analysis on the Determinants of Energy Intensity in South Asia

Dr. Syed Wahid Ali, Muhammad Waseem, Muhammad Kamran Bhatti
wahidbzu@gmail.com

Abstract: Inefficiency use of energy will create many problems including environment degradation. When energy is used inefficiently this will lead to increase the Energy Intensity and degrade the environment as well. The aim of this paper is to investigate the determinants of Energy Intensity in the region of South Asia. For this purpose, the study used panel data, covering thirty-one yearly periods from 1990 to 2021. The current study applied Hausman Test, Redundant Test. The results of these tests state that Fixed Effect Method is more effective for the analysis. The finding showed that GDP, Industry and Non-Renewable Energy are the determinants of energy intensity and Greenhouse Gas Emission. While, GDP^2, Agriculture, Renewable Energy, Services Sector reduce energy intensity and Greenhouse Gas Emission in South Asia.

Keywords: Energy Intensity, Hausman Test, Fixed Effect, Granger Causality Test, South Asia

1. Introduction

The accessibility of inexpensive energy is serious for economic growth of any country. Though, the use of energy, chiefly, Fossil-Fuels-(FF), linked Emissions of Greenhouse Gas, chiefly CO_2, elevate concern about Environmental Degradation. Competent utilization of Energy influence wellbeing of all economies, because of its important effect on Economical, Social Energy, and Environment. Lessening in Energy utilization and competence in energy development has been documented as global precedence's in the framework of a sustainable and Green Economic development.

So, damaging effect on the economy of energy is caused by the inefficiency use of energy. The idea of Energy Intensity-(EI) is directly related to inefficiency use of energy. Energy Intensity-(EI) means how much energy is used to produce one unit of output. According to International-Energy-Agency-***(IEA, 2018)***, Energy Intensity-(EI) is calculated as Energy used per Unit of GDP. Use of Energy is efficient when less energy is used to produce 1 unit of GDP, and inefficient means high energy is used to produce 1 unit of GDP. Higher intensity of energy designates higher cost and less intensity of energy designates less cost of the energy.

Several researchers empirically scrutinized the different factor's effect on utilization of energy; and competences of energy of nationwide economies; as well as the association among these factors. Authors recognized the major aspect of competence of energy and utilization of energy economic growth, investments, fee of energy, changes in structural and technology, population dynamic and improvement in institutional quality. Various Authors point out the association among procedure and energy competence, energy utilization, environment pollution and GDP growth. These studies are conducted in the case of various other regions, all over the world and in different time periods. Efficient utilization of Energy is very essential in today's economy of any country to achieve sustainable economic growth and reducing Poverty, Raising Living Standard, Promoting Infrastructure of different sectors including Primary, Secondary and Tertiary Sectors. Infrastructure

ISSN Online : 2709-4030
ISSN Print : 2709-4022
Vol. 6 No.1, 2022

Promoting will lead to overall economic development. Energy is utilized as an input in the production process. It is very important for developing economies to utilized energy efficiently.

The region South Asia is consists of different countries including Pakistan, Afghanistan, India, Bangladesh, Maldives, Bhutan, Nepal, and Sri Lanka. The Population of South Asia is about One-Fourth of the World's Population, making it the most Populous Region in the World and Major Energy Consumer and Fastest-Growing Energy Demand as well. The reason behind this increasing demand is that, the economy of South Asia region is depends on the Production of Agriculture and Industrial sectors. Countries in this region are developing countries, and in developing countries Increasing economic activity necessitates increased energy consumption, and emerging countries consume more fossil fuels. In Industrial and Agriculture sectors, Fossil Fuels, Crude Oil, and Coal are the energy sources of this region. Every country in this area uses energy differently, depending on its accessibility, economic and commercial viability, fundamental geopolitical scenario, degree of energy sector trade, and energy survey technology. So; inefficient utilization of energy and use of Non-Renewable Energy in the production process is very critical, this will lead to increase the Energy Intensity, Carbon Dioxide Emission, and Greenhouse Gas Emission which will lead to deteriorate the Environmental Quality as well.

2. Relevant Literature Review

Yu, et al (2022), In 82 major nations, investigate the implications of renewable energy development on energy intensity. For this purpose the study used, Dynamic Panel Threshold Regression Model, and Panel Data of 82 Countries from 1996 to 2016. The results of the Dynamic Panel Threshold Regression Model reveal that RE development reduces energy intensity considerably. Economic development has a strong negative influence on energy intensity, but a non-renewable energy consumption structure has a considerable beneficial impact.

Lan et al (2021), In China; empirically exploring the determinants of Energy Intensity(EI) by using Annually-Time-Series Data from 1985 till 2019. The study also used Linear-Autoregressive-Distributed-Lag-(LARDL) and Non-Linear-Autoregressive-Distributed-Lag-(NARDL). The results affirmed by LARDL are that, in long Run energy Intensity is reduce by Energy Prices, and enhanced by technology. Further; the results affirmed by NARDL is that; Technology and prices of energy reduce intensity of energy. Moreover; Globalization and Financial-Development also increase the intensity of energy in China.

In the study of Hao, & Wu, it is investigated the role of Internet-Development on Intensity of Energy in China with the help of Spatial Durbin econometric model to analysis. For this motive, study used panel data of different provinces of China since 2006 till 2017 and comprises this data on different variables like, Energy-Intensity-(EI), Internet-Development-(ID), Population(POP), Gross-Domestic-Product-(GDP), Research-&-Development-(R&D), and Technology(TEC). The results affirmed by the study are that, Development of Internet reduces the intensity of energy in Chinese Province. However, it raises the energy intensity of the surrounding locations.

ISSN Online : 2709-4030
ISSN Print : 2709-4022
Vol. 6 No.1, 2022

Shen and Lin, (2021), How Energy-Intensity is impacted by Chinese Structure of Industry? For this motive study used annual data since 1978 till 2016, and data comprises of different variables like, Intensity of energy(EI), Prices of Energy(PE), Research-&-Development(R&D), Trade(TR), Foreign-Direct-Investment(FDI), and Industrial Structure (IS), are analyzed by Ordinary-Least-Square(OLS) method. The overall results claimed by the study are, At Province Level; Structure of Industry in China is main factor that increase the intensity of energy, also claimed that, Intensity of energy reduced by Trade (Imports & Export), and Prices of energy significantly. Further, FDI negative impact and R&D have no impact on Intensity of energy in China.

Bashir et al, (2021), The study, disclose that, how consumption and Intensity of Energy are impacted by Environmental Taxes, in the region of OECD (Organization for Economic Co-operation & Development) economies. For that reason, panel data is utilize since 1994 till 2018 of selected 29 countries of OECD region. Panel data includes various data of variables, like Intensity of Energy(EI), Energy Consumption(EC), Gross-Domestic-Product-(GDP), Financial-Development (FD), and Trade(TR). Empirical Results declared by Panel Fully-Modified-Ordinary-Least-Square-(FMOLS) and Dynamic-Ordinary-Least-Square-(FMOLS); efficiency and intensity of energy improved largely by accomplishment of environmental tax. While, Intensity of Energy(EI) positively affected by Urbanization(UR), Financial Development(FD), and GDP and Trade are negatively impacted on Energy-Intensity(EI).

Antonietti and Fulvio (2019), exploring the association among prices of energy and intensity of energy in120 countries. Panel data is analyzed for this motive, and dataof prices of energy, intensity of energy, GDP growth, industry, and consumption of energy are analyzed by Dynamic Panel-Data Model and Panel Co-integartion. Results of methods insist that, prices of energy negative impacted on intensity of energy, Consumption, Industry and GDP growth increase the intensity of energy in120 countries selected by this paper.

Kwakwa and Poku (2019), exploring the sources of consumption of electricity and intensity of energy in the area of South Africa; based on the annual data of income, manufacturing sector, urbanizations, trade, and domestic credit, and intensity of energy since 1975 to 2014. The results of FMOLS demonstrate that, energy intensity reduced by income, and; urbanization, domestic credit and manufacturing increases it both intensity and consumption.

3. Data and Methodology of the Study

To find the determinants of Energy Intensity in the region of South Asia, the present study involved Secondary Panel Data from the time span of 1990 to 2021. It was taken from various sources as WDI, EIA, and US-EIA. The model of the study is guided by the existing reviews of literature and the Theory of Dematerialization. The current study applied Fixed Effect Methods for the findings.

Description of Variables

Summary of variables which are used in present study, their abbreviation and their measurement unit are given below in table 4.1

ISSN Online : 2709-4030
ISSN Print : 2709-4022
Vol. 6 No.1, 2022

Table: 3.1 Summary of Variables

Variables	Explanation	Measurement Units
EI	Energy Intensity	MJ/Unit of GDP
AGR	Agriculture Value Added	% of GDP
IND	Industrial Value Added	% of GDP
SER	Services Value Added	% of GDP
GDP	Gross Domestic Product	Annual Growth
GDP^2	Square of Gross Domestic Product	Annual Growth
RN	Renewable Energy	% of Total Consumption
NRN	Non-Renewable Energy	% of Total Consumption
EP	Energy Price	Consumer Price Index

Model Specification

To find the determinants of Energy Intensity in the region of South Asia, the present study utilized the linear trend model. The model can be written as:

$$EI = f\ (AGR, IND, SER, GDP, GDP^2, RN, NRN, EP)$$

The econometric model can also be written as:

$$\mathbf{EI} = \beta_0 + \beta_1 AGR + \beta_2 IND + \beta_3 SER + \beta_4 GDP + \beta_5 GDP^2 + \beta_6 RN + \beta_7 NRN + \beta_8 EP + \mu_i$$

Here,

EI = Energy Intensity
AGR = Agriculture Value Added
IND = Industrial Value Added
SER = Services Value Added
GDP = Gross Domestic Product
GDP^2 = Square of Gross Domestic Product
RN = Renewable Energy
NRN = Non-Renewable Energy
EP = Energy Price
μ_i = Disturbance Term
β_0 = Intercept
β_{12345} = Slope of Coefficients

4. The Data Analysis, Empirical Results and Interpretation

In this section, we examine estimation of various tests. Table 4.2 shows estimated descriptive statistics.

ISSN Online : 2709-4030
ISSN Print : 2709-4022
Vol. 6 No.1, 2022

	EI	AGR	IND	SER	GDP	GDP2	RN	NRN	EP
Mean	5.82	21.08	21.70	49.55	4.17	45.00	51.61	2.69	86.89
Median	3.77	22.00	22.31	49.59	3.90	16.91	51.47	0.14	74.28
Maximum	30.28	48.80	38.26	77.92	30.22	1202.64	95.91	31.78	219.07
Minimum	0.89	4.60	8.05	21.03	-34.67	0.00	0.36	0.00	-23.07
Std. Dev	5.56	9.56	7.05	12.17	5.25	112.47	28.68	6.50	51.16
Skewness	2.57	-0.16	-0.16	-0.53	0.84	6.83	0.18	3.01	0.43
Kurtosis	9.83	2.57	2.10	3.12	17.76	60.69	2.11	11.34	2.28
JB Test	771.3	3.08	9.77	12.46	2355.	37501	9.97	1130.4	14.75
Prob	0.00	0.213	0.00	0.001	0.0000	0.000	0.006	0.000	0.000
Obs.	256	256	256	256	256	256	256	256	256

The Descriptive Statistics of selected indicators is given in Table 4.1. The first row shows the average of EI, AGR, IND, SER, GDP, GDP^2, RN, NRN and EP respectively. The mean value of EI, AGR, IND, SER, GDP, GDP^2, RN, NRN and EP are in second row respectively.

Here we see that AGR, IND and SER are negatively skewed. While, EI, GDP, GDP^2, RN, NRN and EP are positively skewed.

In statistics, kurtosis is used to measure flatness of data set relative to Normal distribution. Kurtosis general value is 3. If the value found greater than 3, this situation referred as Leptokurtic. If the value found less than 3, this situation referred as Platykurtic.

In the Descriptive Statistics EI, SER, GDP, GDP^2 and NRN value is greater than 3, it means these are Leptokurtic and rest of indicators AGR, IND, RN and EP are platykurtic.

Analysis of Multicolinearity

"Multicolinearity is meant by the existence of a perfect or exact linear relationship among some or all explanatory variables of a regression model." When two exploratory variables in a linear regression model are discovered to be associated by proper analysis and a predefined level of accuracy, this is referred to as Multicollinearity. To examine the correlation between dependent and independent variables is necessary. The problem of Multicollinearity between the variables is commonly identified by the Variance Inflation Factors.

Table 4.2: Results of Variance Inflation Factors (VIF)

Variables	Cantered VIF
GDP	1.153180
GDP^2	1.148397
AGR	1.748503
IND	1.405886
SER	4.736734
RN	2.689069
NRN	1.301217
EP	1.737179

ISSN Online : 2709-4030
ISSN Print : 2709-4022
Vol. 6 No.1, 2022

EI(-1)	1.831568
C	NA

According to the table 4.3 above, the value of all variables is less than 10, it designate that there is no existence of Multicolinearity. All variables are moderately correlated because their values lie between 1 to 5.

Analysis of Autocorrelation

The problem of Autocorrelation is arises, when consecutive error term are correlated with each other in Regression Analysis. This problem is checked by the Serial Correlation LM test. The results of Serial Correlation LM test is reported in the table 4.4 below;

Table 4.3: Results of Serial Correlation LM Test

Breusch-Godfrey Serial Correlation LM Test			
F-Statistic	0.616351	**Prob. F(2,230)**	0.5408
Obs* R-Squared	1.348743	**Prob. Chi-Square(2)**	0.5095

According to the results of Serial Correlation LM test, the probability value is insignificant (0.5408), this indicate that we reject Null Hypothesis (H_0), and accept Alternative Hypothesis (H_1) of No Autocorrelation.

Analysis of Heteroskedasticity

"The Problem of Heteroskedasticity arises when constant variance assumption is voileted in the Regression Analysis". The problem of Heteroskedasticity is checked by the Breusch-Pagan-Godfrey test. The results of Breusch-Pagan-Godfrey test are reported in the table 4.5 below;

Table 4.4: Results of Breusch-Pagan-Godfrey Test

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-Statistic	1.055334	**Prob. F(8,246)**	0.3953
Obs* R-Squared	8.461162	**Prob. Chi-Square(8)**	0.3898

According to the results of Breusch-Pagan-Godfrey test, the probability value is insignificant (0.3953), this indicates that we reject Null Hypothesis (H_0), and accept Alternative Hypothesis (H_1) of No Heteroskedasticity.

Analysis of Hausman Test

The Hausman test is used to see whether the Random Effect Method (REM) or the Fixed Effect Method (FEM) is better. Random Effect Method (REM) is more effective if the probability value is larger than 5%, while Fixed Effect Method (FEM) is more effective if the probability value is less than 5%.

Table 4.5: Results of Hausman Test

ISSN Online : 2709-4030
ISSN Print : 2709-4022
Vol. 6 No.1, 2022

Correlated Random Effects – Hausman Test			
Test Summary	**Chi-Sq Statistic**	**Chi-Sq. d.f**	**Prob**
Period Random	5.029489	8	0.0004

In the table 4.7 above, the probability value is (0.0004) significant and less than 5%. So, we reject Null Hypothesis (H_0) and accept Alternative Hypothesis (H_1) and go for Fixed Effect Method (FEM).

Analysis of Redundant Fixed Effect Test

The Redundant test is applying to determine whether the Common Constant Method or Fixed Effect Method is more suitable for this study. If probability value is more than 5% then Common Constant Method is more effective but if the probability value is less than 5% then Fixed Effect Method is more effective. The Results of Redundant Fixed Effects Test is reported in the table 4.8 below;

Table 4.6: Results of Redundant Fixed Effects Test

Redundant Fixed Effects Tests			
Effect Test	**Statistic**	**d.f.**	**Prob.**
Cross-Section F	4.614833	(7,232)	0.0001
Cross-Section Chi-Square	32.329759	7	0.0000

Results of the Redundant Fixed Effects Test indicate that the probability value is less than 5% that is why using the Fixed Effect Method is suitable for this model of the study. So, we accept Alternative Hypothesis (H_1) and reject Null Hypothesis (H_0).

Results of Fixed Effect Regression Analysis

The current study utilized the Fixed Effects Model to determine the factors of Energy Intensity in South Asia. The results of Fixed Effects Regression Analysis are reported in the table 4.9 below;

Table 5.7: Results of Fixed Effects Regression Analysis

Dependent Variable: EI				
Total Panel Observations: 256				
Variables	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
AGR	-0.007763	0.002293	-3.385346	0.0008
IND	0.002442	0.002786	0.876401	0.0517
SER	-0.017866	0.003524	5.069993	0.0189
GDP	0.013006	0.003321	3.916074	0.0001
GDP^2	-0.000288	0.000155	-1.860026	0.0641
RN	-0.006117	0.000959	-6.377812	0.0000
NRN	0.000253	0.002854	0.088791	0.0793
EP	-0.001249	0.000138	-9.059002	0.0004
EI(-1)	0.971940	0.004052	239.8748	0.0000
C	0.519876	0.122272	4.251788	0.0000
R^2	0.996737	**Adjusted R^2**		0.996526
Durbin-Watson Stat	2.160011	**F-Statistic**		472.5071
Prob(F-Statistic)	0.000000			

ISSN Online : 2709-4030
ISSN Print : 2709-4022
Vol. 6 No.1, 2022

Note: Significant Level 1%*, 5%** and 10%***

In the table 4.9 below; the value of Coefficient of Agriculture Value Added (AGR) shows negatively significant(0.0008) impact on Energy Intensity. It demonstrate that If one unit increase in Agriculture Value Added it will bring (-0.007763) unit decline in Energy Intensity. This implies that, using energy saving technologies in agriculture sector in the production process can save much energy and raise the output; this will lead to decline the energy intensity.

The value of Coefficient of Industrial Value Added (IND) shows positively significant(0.0517) impact on Energy Intensity. It demonstrate that If one unit increase in Industrial Value Added it will bring (0.002442) unit increase in Energy Intensity. It is point out that Industrial Sector is more Energy Intensive. Higher level of growth in industrial sector required more energy; this will lead to increase in Energy Intensity.

The value of Coefficient of Services Value Added (SER) shows negatively significant(0.0189) impact on Energy Intensity. It demonstrate that If one unit increase in Services Value Added it will bring (-0.017866) unit decrease in Energy Intensity. This implies that, a move from agricultural to heavy industry occurs during the early stages of economic growth, whereas a shift from resource-intensive and extractive industrial sectors to services occurs during the latter stages of development.

The value of coefficient of Gross Domestic Product (GDP) shows positive and statistically significant(0.0001) effect on the Energy Intensity. If one unit increase in Gross Domestic Product (GDP) it will bring (0.013006) unit increase in Energy Intensity. The value of coefficient of Square of Gross Domestic Product (GDP^2) shows negatively and statistically significant(0.0641) effect on the Energy Intensity. If one unit increase in Square of Gross Domestic Product (GDP^2) it will bring (-0.000288) unit decrease in Energy Intensity. It is indicate that this will lead to an increase in energy consumed per unit of production in the early stages of economic growth and a decrease in energy used per unit output in the later stages.

The value of Coefficient of Renewable Energy Consumption (RN) shows negatively significant(0.0000) impact on Energy Intensity. It demonstrate that If one unit increase in Renewable Energy Consumption (RN) it will bring (-0.006117) unit decline-in Energy Intensity. It is indicate that, increase-in Renewable Energy including Solar, Geothermal, Wind Biomass and Hydropower Consumption decreases energy intensity more effectively.

The value of Coefficient of Non-Renewable Energy Consumption (NRN) shows positively significant(0.0000) impact on Energy Intensity. It demonstrate that If one unit-increase in Non-Renewable Energy Consumption(NRN) it will bring (-0.006117) unit increase in Energy Intensity. Coal, oil, and Natural Gas are the main traditional non-renewable energy sources used in South Asia. The Non-Renewable Energy(NRN) resources were heavily utilised by both manufacturers and common customers to maintain the economy.

The value of Coefficient of Energy Price (EP) shows negatively significant(0.0004) impact on Energy Intensity. It demonstrate that If one unit increase in Energy Price (EP) it will bring (-0.001249) unit decrease in Energy Intensity. It means that, Higher Prices of Energy will reduce the Energy Consumption because of the higher energy bills, this will lead to decrease in energy intensity.

ISSN Online : 2709-4030
ISSN Print : 2709-4022
Vol. 6 No.1, 2022

5. Conclusion

This study's primary goal is to ascertain the "Determinants of Energy Intensity in South Asia." For this purpose the study utilized Panel Data of South Asian Countries including Pakistan, Bangladesh, India, Sri Lanka, Bhutan, Nepal, Afghanistan, and Maldives. The Panel Data of 31 years covered from 1990 to 2021. The study also discusses the relevant theories that are used in this study. The study used the theory of Dematerialization. According to this theory Energy Intensity will be reduced as economy grows. In short, there exist U-Shaped affiliation among Energy Intensity and GDP Growth.

The study also applied the different techniques in this study. First, the study discusses the outcomes of Descriptive Statistics. After this the study discusses the results of Variance Inflation Factor (VIF) for the purpose of Multicolinearity. Study also used Serial Correlation test for Autocorrelation and Heteroskedasticity Test for the problem of Heteroskedasticity. The results of these tests demonstrate that, there is no Autocorrelation and Heteroskedasticity in the data set. After this, the study applied Hausman Test and Redundant Test. The results of these tests state that Fixed Effect Method is more effective for the analysis.
The results of Fixed Effect Method illustrate that, GDP increase Energy Intensity and GDP^2 reduced Energy Intensity. This designate the confirmation of U-Shaped association among Energy Intensity and Economic Growth(EG). Industry and Non-Renewable Energy Consumption also increase Energy Intensity in South Asia. The reason behind this, the industrial sector in South Asia is higher Non-Renewable Energy consumer. This is because of the lack of technology and use of Renewable Energy Consumption. While; on-the other hand, Agriculture, Services, Renewable Energy and Energy Price reduced the Energy Intensity. In Agriculture energy saving technologies including Biomass Energy is used in the production process. Renewable Energy including, Solar, Wind, Biomass and Hydropower reduced the Energy Intensity. Energy Price is also decrease Energy Intensity; higher prices of energy will lead to increase the energy saving technologies.

5. Policy Recommendations

Policymakers ought to formulate Policies that can reduce Energy Intensity. More specifically, it's time to switch the nation's energy supply from traditional to modern sources. In order to reduce energy intensity, the government should also adopt sensible environmental laws that support the import of cleaner and energy-efficient technology.

According to the findings, Energy Intensity is reduced by Agriculture Sectors. This is because of the use of Renewable Energy like Solar, Biomass etc. It is suggested that, government should subsidies Agriculture sector for more use of Modern Energy. The Government should also promote "Organic Farming". This will lead to less energy consumption, less use of Non-Renewable Energy, less use of Water etc. All of these will lead to reduced Energy Intensity.

According to the findings, Industrial Sector is most emery consumer in selected region. Policy makers need to formulate several policies about industrial that boost-up technological innovations. This will encourage reducing the Energy Intensity.

According to the overall findings, Renewable Energy including Solar, Wind, Hydropower, Biomass etc reduced Energy Intensity. It is recommended that; Government should subsidies for Renewable Energy. This will help to reduce energy consumption and promote clean and green environment.

REFERENCES

Yu, S., Liu, J., Hu, X., & Tian, P. (2022). Does development of renewable energy reduce energy intensity? Evidence from 82 countries. *Technological Forecasting and Social Change*, *174*, 121254.

Lan, H., Cheng, C., Jafri, M. A. H., & Sohail, S. (2021). Asymmetric Macroeconomic Determinants of Energy Intensity In China: New Empirical Insights.

Hao, Y., & Wu, H. (2021). The Role of Internet Development on Energy Intensity in China-Evidence From a Spatial Econometric Analysis. *Asian Economics Letters*, *1*(1), 1-6.

Shen, X., & Lin, B. (2021). Does industrial structure distortion impact the energy intensity in China?. *Sustainable Production and Consumption*, *25*, 551-562.

Bashir, M. F., Benjiang, M. A., Shahbaz, M., Shahzad, U., & Vo, X. V. (2021). Unveiling the heterogeneous impacts of environmental taxes on energy consumption and energy intensity: Empirical evidence from OECD countries. *Energy*, *226*, 120366.

Antonietti, R., & Fontini, F. (2019). Does energy price affect energy efficiency? Cross-country panel evidence. *Energy Policy*, *129*, 896-906.

Adom, P. K., & Kwakwa, P. A. (2014). Effects of changing trade structure and technical characteristics of the manufacturing sector on energy intensity in Ghana. *Renewable and Sustainable Energy Reviews*, *35*, https://doi.org/10.1016/j.rser.2014.04.014

IEA (2022), SDG7: Data and Projections, IEA, Paris https://www.iea.org/reports/sdg7-data-and-projections

IEA, 2021. Shaping a secure and sustainable energy future for all. IEA. https://www.iea.org

Grossman, G. M., & Krueger, A. B. (1991). Environmental impacts of a North American free trade agreement. https://doi.org/10.3386/w3914