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Sustainable Energy Indicators for Integration of Thailand Economy with the fame of One Belt One Road Initiative

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Abstract

The objective of this research was to examine the linkages among energy indicators for sustainable development (EISD), Thailand's economy, and One Belt One Road initiative (OBORI). Unit roots test, Johansen cointegration, Vector Error Correction Model (further-VECM), and Granger causality were used to analyze in this study. The energy data of Thailand from 2001 to 2018 year were gathered. The 11 factors were used in the analysis: Gross Domestic Product (GDP), EISD (Household energy use (HEU), Total Final Energy Consumption per capita (FCPC), Total Final Energy Consumption per GDP (FCPG), Total Primary Energy Supply per capita (PSPC), Total Primary Energy Supply per GDP (PSPG), Fuel shares in energy (FSIE), CO_2 emissions per capita (CEPC), CO_2 emissions per GDP (CEPG)), Foreign Direct Investment in Thailand (FDI), and China Direct Investment in Thailand (CDIIT). The findings revealed that GDP was likely to have a long-run correlation with CEPC, CEPG, FCPG, PSPC, HEU, and FDI because the initial coefficient value of the connection equation was negative; nevertheless, the probability value was minor. Because of the little amount of data used, the software was unable to investigate the relationships between all energy variables and GDP. As a consequence, the factors were identified using a stepwise regression technique. Although the causality test found only CEPG and FCPG as being related to HEU and GDP, which were subsequently passed on to CDIIT, the short-run link has a significant impact on the relationship between FDI and GDP.

Keywords: *Energy Indicators, One Belt One Road Initiative, Johansen cointegration, Vector Error Correction Model, Granger causality*

1. Introduction

Energy serves as the foundation for all enterprises and human activities. It has become a critical component in the operation of all activities. (Guo, 2018; Munasinghe, 2009). The trend of the energy consumption increases every year. Energy costs have become a key component of everyday life. In addition, intensifying climate change has made people focus on shifting from fossil fuel use to renewable energy. Measures for energy saving and finding new renewable energy

resources were proposed to solve this problem (Tang et al., 2015). To reduce energy consumption and carbon dioxide emission, energy conservation will be considered as priority due to low cost of investment and often immediately operation. Increasing energy efficiency is an another important concept for reducing energy consumption (Munasinghe, 2009). The key to this concept is the key performance indicators. Policymakers will understand data by using the key performance indicators and can determine the correct management point.

The International Atomic Energy Agency (IAEA) proposed energy indicators for sustainable development (further-EISD) in 2005. The EISD will be used by countries to evaluate their energy systems and measure progress toward nationally set sustainable development goals and objectives. Each nation can choose these indicators that are appropriate and consistent with its operations.

The OBORI is China's economic policy that connects the international economy through 7 routes. Thailand's location can be joined to 4 routes of OBORI economic corridors. Thai government launch the Eastern Economic Corridors (further-EEC) to link with OBORI and drives the economy by establishing project to be the strategic area point of the country. The EEC will be an important investment area for foreign investors. Thus, Thai government must prepare to cover supporting all basic structures and facilities needed for this project. One of all supporting parts is the energy supply. So, the data on energy sector is important for the policymaker use to set policy and action plans.

Therefore, the objective of this study was to analyze the relationships of EISD into the framework of Thailand's economy and OBORI, and be as a guideline for the policymaker.

1.1 Overview Thailand Economy Cooperation

Thai government attempted to develop the economy by joining groups with various countries such as the Association of Southeast Asia Nations (further-ASEAN) in 1967, the World Trade Organization (further-WTO) in 1982, Asia–Pacific Economic Cooperation (further-APEC) in 1989, ASEAN Free Trade Area (further-AFTA) in 1992. Thailand cooperates with five nations; Laos, Myanmar, Vietnam, Cambodia, and Yunnan of China have set Greater Mekong Sub-Regional Economic Cooperation (further-GMS-EC or Economic hexagon), as shown in Figure 1. Thailand's economy is still in flux, fluctuating according to domestic circumstances. Figure 2 depicts Thailand's GDP growth rate.

Thailand's government set the EEC's goal as the tools for pushing long-term economy up, a global business hub, a free economic zone, a free trade zone, and a gateway to Cambodia, Laos, Myanmar, and Vietnam (further-CLMV) (NESDB, 2017). The EEC will be a brand-new route to invest in Thailand for Chinese investors and Chinese investors can use the EEC as an entry point for the OBORI in the ASEAN region. For the long-term investment, the Thai government should remind the three issues are the continuous investment support measures, the skills of workers for the ten targeted industries, and the social and environmental impact (Amornvivat et al., 2018).

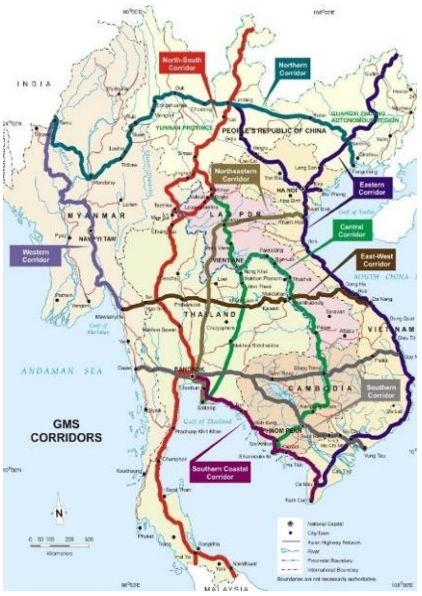

Figure 1 Greater Mekong Sub-Regional Economic Corridors
Source: Learning studio (Learningstudio.info, 2013)

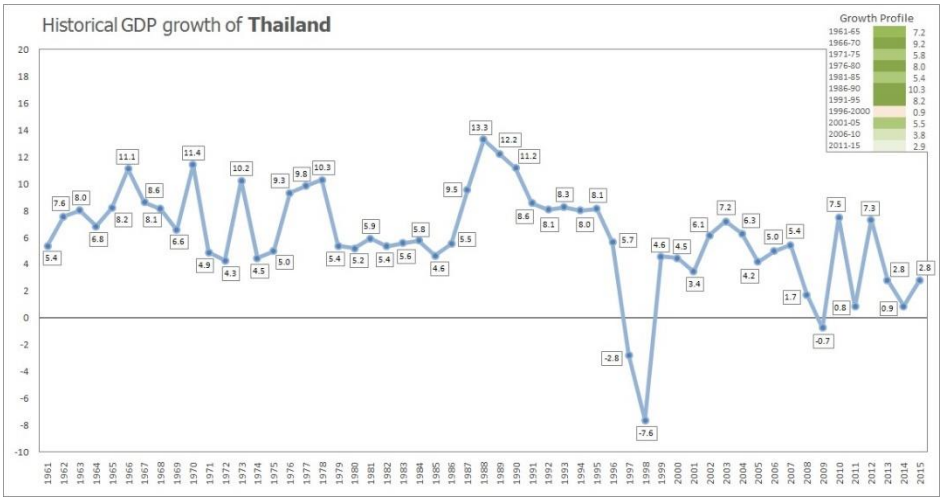

Figure 2 GDP growth of Thailand
Source: Thailand economy Wikipedia (GiovanniMartin16, 2016)

1.2 Overview of OBORI

China's economy rapidly developed and emerged economies of the world (Fang et al., 2018; Feng et al., 2018; Hasanbeigi et al., 2013; Tang et al., 2015; Zhang, 2012). In September 2013, President Xi Jinping published the head of a Silk Road Economic Belt in Kazakhstan. In November 2014, the Chinese government published a new Silk Road fund ($40 billion) in Beijing. In March 2015, the National Development and Reform Commission, the Ministry of Foreign Affairs, and the Ministry of Commerce join published the OBORI concept. In May 2015, China announced specific policies of the OBORI concept (Aoyama, 2016; Sarker et al., 2018). OBOR

has goal concept of implementation is “everyone is invited”. Then in the OBORI plan, 66 countries have joined. The principles of OBORI are cooperation, creation, and sharing. OBORI connects the world into five parts. The five parts comprise policy coordination, infrastructure, commercial unimpeded trade, financial and integration, and people ties discussed together(Council, 2017; Wade, 2015). China and Thailand’s policy (Made in China 2025 and Thailand 4.0) is similar such as changing from labor investment to be technology investment; setting a new era of information of technology; setting a new era of medical; setting tourism for hi-end people; and a good area for joint ventures (Simachaya, 2018).

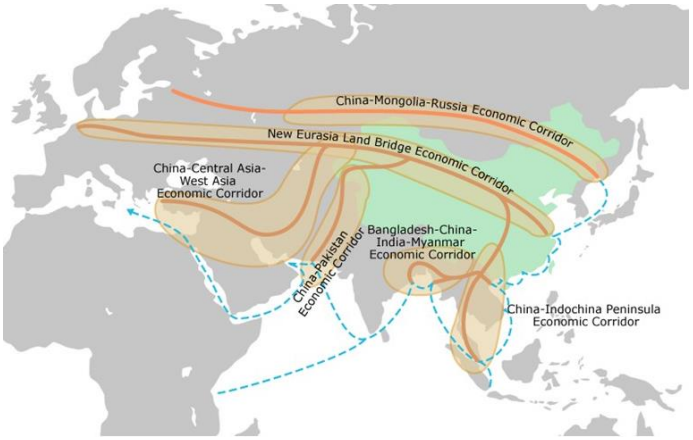

Figure 3 Economic corridors of One Belt - One Road initiative
Source: HKTDC(Council, 2017)

1.3 Overview of EISD

There are thirty indicators in the EISD core set, which are classified into three dimensions (social, economic, and environmental). There are seven themes and nineteen sub-themes to these. In order to be accurate and effective tools, indicators must be based on reliable and consistent statistical data. Obtaining reliable, precise, thorough, and recent data necessitates a significant amount of effort. The metrics must be interpreted considering the economy and energy resources of each country. If indicators are to be used to guide policymaking and strategic decisions, they must show where policy pressure should be applied and where adjustments should be initiated to achieve desired results. As a result, establishing relationships and some idea of causality is a key component of policy monitoring with indicators. Observing trends without knowing how to influence them is ineffective in terms of strategic planning. A complete description of each of the indicators in the EISD core set is provided in Energy indicators for sustainable development: guidelines and methodologies.

1.4 Literature review

Many studies have studied the connection between energy consumption, CO_2 emissions, and economic growth. The results of the studies found that three factors have related in the short-term or the long-term. Most studies have been done using econometric tools. The favor tools are

the causality test (Appiah, 2018; Jamel & Derbali, 2016; Obradović & Lojanica, 2017; Salahuddin et al., 2017; Wang et al., 2017). No research has directly studied sustainable energy indicators and economic growth relationships. There are studies applying sustainable energy indicators, that found the help–policymakers integrate socio-economic and environmental dimensions in their strategy and monitor progress towards sustainable development at a national level(Razmjoo et al., 2019; Taylor et al., 2017; Vera & L.Abdalla, 2006)

2. Methodology

2.1 Data

This research was based on the data of Thailand from 2001 to 2018 year.–The data was collected from the energy data of the Energy policy and planning office, Ministry of Energy, Thailand database from Official statistic registration systems, Office of the national economic and social development council, and CEIC data's Global Database. The factors that use in the analysis are Gross Domestic Product (further-GDP), EISD (Household energy use (further-HEU), Total Final Energy Consumption per capita (further- FCPC), Total Final Energy Consumption per GDP (further- FCPG), Total Primary Energy Supply per capita (further- PSPC), Total Primary Energy Supply per GDP (further- PSPG), Fuel shares in energy (further- FSIE), CO_2 emissions per capita (further- CEPC), CO_2 emissions per GDP (further- CEPG)), Foreign Direct Investment in Thailand (further-FDI), and China Direct Investment in Thailand (further- CDIIT).

2.2 Methodological Research Scheme

In this paper, the authors analyzed two relationships: (1) the relationship between Thailand's EISD and GDP; (2) the relationship between GDP, FDI, and CDIIT. The authors analyzed these data through Johansen cointegration, VECM, and Granger causality. All methods were analyzed using EViews software. The methodological research scheme is shown in Figure 4.

2.3 Methodological procedure in this study

This paper uses the econometrics test to ensure the results can be real-used and reliable. The analysis was started with all data's stationary check by the unit root test. After that, the data was analyzed for a long-run relationship and short-run by Johansen cointegration and VECM. In addition, the causal relationship was analyzed by the Granger causality test.

2.3.1 Unit Root Test

In this paper, all data are time-series data. There must be a stationary test. If the data is nonstationary, the results of the analysis may be a spurious regression. This paper analyzed stationary by ADF Test, that the null hypothesis is $H_0: \theta_1 = 0$ is non-stationary and $H_0: \theta_1 < 1$ is stationary. If the result of the analysis accepts the null hypothesis; H_0 shows the variables that are nonstationary. If the result rejects the null hypothesis; H_0 shows the variables that are stationary. After the unit root test, we can specify the data to integrate order. If the stationary is use level, call Integrate Order as I(0). But, if the data has stationary in the 1st difference or 2nd difference, call integrate order as I(1) or I(2) respectively. The data integration must specify the order used to estimate data in other equation systems.

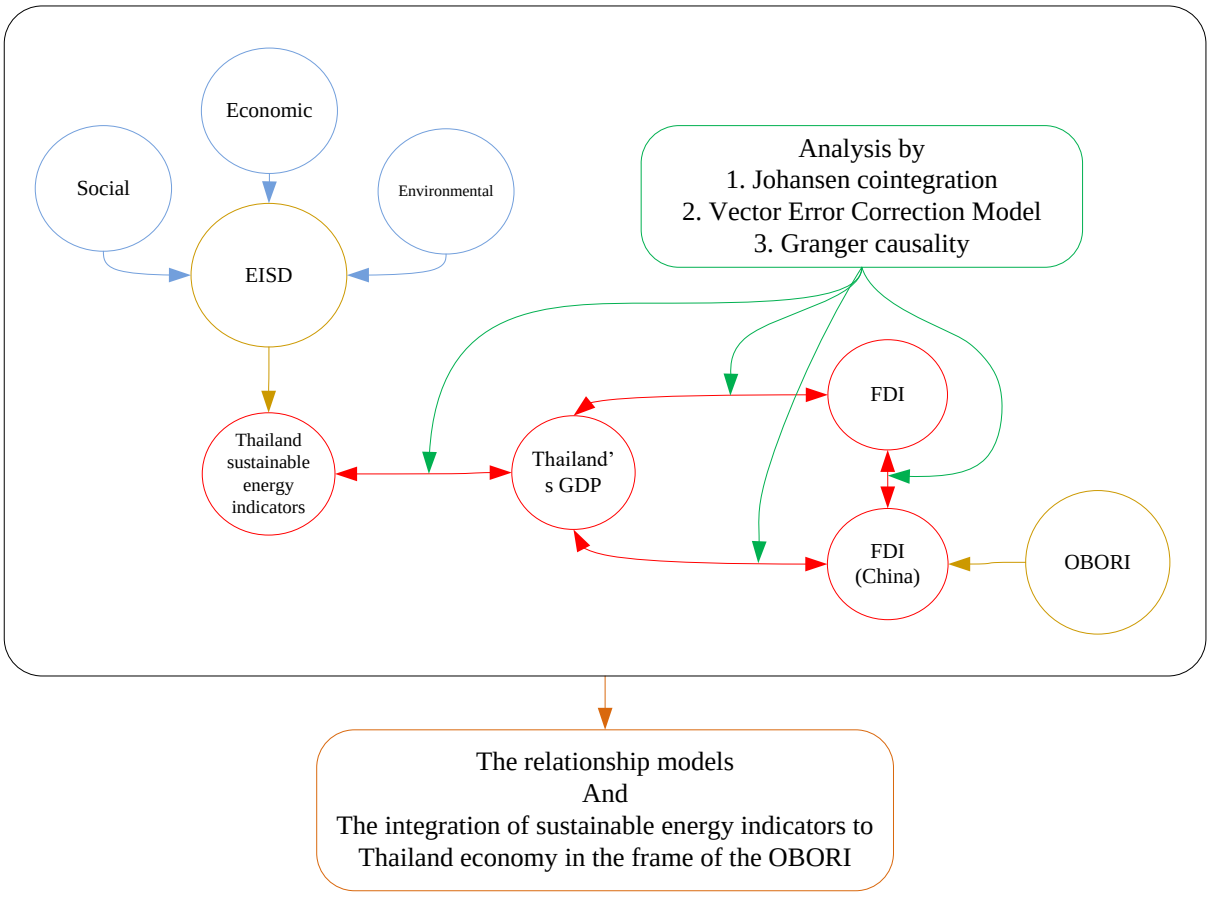

Figure 4 Research Methodological Scheme

2.3.2 Johansen Cointegration:

The Johansen tests use System-based reduced rank regression. Cointegration is movement together of time series data 2 set or more than in steady-state or equilibrium state. Johansen cointegration determined variables are endogenous and estimating parameters by the Maximum likelihood method. This is a Multivariate Cointegration test and uses Vector autoregressive model (VAR) to be a base model. The process of Johansen cointegration test is as follows; First, check the order of the time series of stationary data, which must be the same order. Second, check for the VAR optimal lag selection. Third, determines the model for testing following the model's condition, as follows. (Appiah, 2018; Babatunde & Adefabi, 2005; Bekun et al., 2019; Lertchana & Junjarus, 2011; Lin & Chen, 2017; Liu & Bae, 2018; Mikayilov et al., 2018; Nondo et al., 2011; Obradović & Lojanica, 2017; Ozkan et al., 2012; Satimanon & Sirasoontorn, 2017; Wang et al., 2017)

μt	*option flag*	*description*
0	–nc	no constant
μ_0, $\alpha_{\perp}'\mu_0 = 0$	--rc	restricted constant
μ_0	--uc	unrestricted constant

$\mu_0 + \mu_1 t,\ \alpha_\perp' \mu_1 = 0$	--crt	constant + restricted trend
$\mu_0 + \mu_1 t$	--ct	constant + unrestricted trend

The model of Johansen for analysis as follows.

$$\Delta Y_t = C_0 + \delta_0 T + \alpha \begin{bmatrix} \beta \\ C_1 \\ \delta_1 \end{bmatrix} [Y_{t-1} 1\ T] + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-i} + \varepsilon_t \quad (1)$$

Where,Yis variable matrix,Cis constant,Tis trend value,βis cointegrating vector, and α is Speed of adjustment.

2.3.3 VECM:

VECM allows the researcher to embed a representation of economic equilibrium relationships within a relatively rich time-series specification by combining structural models and time-series models (Cottrell, 2019). VECM is a measure of short-run relationships developed from the VAR model. VECM can show both long-run and short-run relationships from each variable in the model.

The data for the VECM test must be in the same order as time series stationary data and pass the cointegrated test before VECM testing (Babatunde & Adefabi, 2005; Obradović & Lojanica, 2017; Ozkan et al., 2012; Satimanon & Sirasoontorn, 2017; Wang et al., 2017). There are typically three steps in this analysis: firstly, the number of cointegration vectors were determined together with the cointegration rank of the system. Secondly, a VECM was estimated with the rank, but subject to no further restrictions. Thirdly, the cointegration vectors was interpreted as equilibrium conditions with restrictions on the elements of these vectors.

The concept of VECM for cointegration, long-run, and short-run is if the first coefficient value of the equation is negative that means the relation equation likely to cointegration if the probability value is less than 0.05 is significant that means the relationship does cointegration, and if the probability value of each independent variable is significant, that means an independent variable has short-run to the dependent variable.

2.3.4 Granger Causality:

Granger causality is the testing for finding a change of direction of variables. It relates to the relationship by focusing on the variables each other or not (Appiah, 2018; Bekun et al., 2019; Lertchana & Junjarus, 2011; Liu & Bae, 2018; Nondo et al., 2011; Obradović & Lojanica, 2017; Osigwe & Arawomo, 2015; Ozkan et al., 2012; Pradhan et al., 2018; Satimanon & Sirasoontorn, 2017; Wang et al., 2017). The null hypothesis (H_0) is that X is not a granger cause Y (X=/=>Y), or X is not a causality relationship with Y or the transition of X is not impact the transition of Y. The alternative hypothesis (H_A) is X granger causes Y (X==>Y) or X is causality relationship with Y, or transition of X impact on the transition of Y. Step to run the granger causality at first, test for stationary. The second is to determine the optimal lag order of Vector Autoregressive (p) or VAR (p). And the third run Granger causality using lag order from VAR (p). Or run by using VECM.

3. Results

3.1. Unit Root

The empirical analysis unit root test by ADF showed that GDP, FCPG, PSPC, HEU, CEPC, CEPG, FDI, and CDIIT factors are stationary in 1st difference order. The FCPC, PSPG, and FSIE are non-stationary in 1st different order. Then, three factors cannot use in the next analysis method.

3.2. Johansen Cointegration

3.2.1 The relationship between EISD and GDP

The results of analysis by Johansen cointegration showed that there are six equations with cointegration and can be analyzed further VECM. All the six equations are GDP CEPC CEPG FCPG, GDP CEPC CEPG PSPC, GDP CEPC CEPG HEU, GDP CEPC FCPG HEU, GDP CEPC FCPG PSPC, and GDP CEPC HEU PSPC.

3.2.2 The relationship between GDP and FDI and CDIIT

The results of analysis showed that only the equation of GDP and FDI has cointegration and can analyze further VECM.

3.3. VECM

3.3.1 The relationship between EISD and GDP

The analysis result of 6 equations by VECM found that some equations showed a trend to be cointegration but not significant in the long-run and short-run relationship.

3.3.1 The relationship between GDP and FDI and CDIIT

The analysis result of the GDP and FDI equation found that all equations showed a trend to be cointegration but not significant in the long-run relationships. Although FDI is a short-run relationship to GDP, GDP is not a short-run relationship to FDI.

3.4. Granger Causality

All the relationship analyses found that CEPG and FCPG cause HEU and GDP that cause CDIIT. All relationships are unidirectional causation. The analysis result of the causality of CEPG showed the same three times as the result of the causality of FCPG.

The results of the analysis can be illustrated in Figure 5. The result indicated that GDP was likely to have a long-run association with CEPC, CEPG, FCPG, PSPC, HEU, and FDI, with the first coefficient value of the relationship equation being negative; however, the probability value was insignificant. This is because the result was analyzed with a tiny amount of data, and the software was unable to investigate the relationships between all energy indicators and GDP. Therefore, the variables were identified using a stepwise regression technique. The results of the short-run relationship have significant to the relationship between FDI and GDP, while the causality test result found only CEPG and FCPG related to HEU and GDP, which it was passing through to CDIIT.

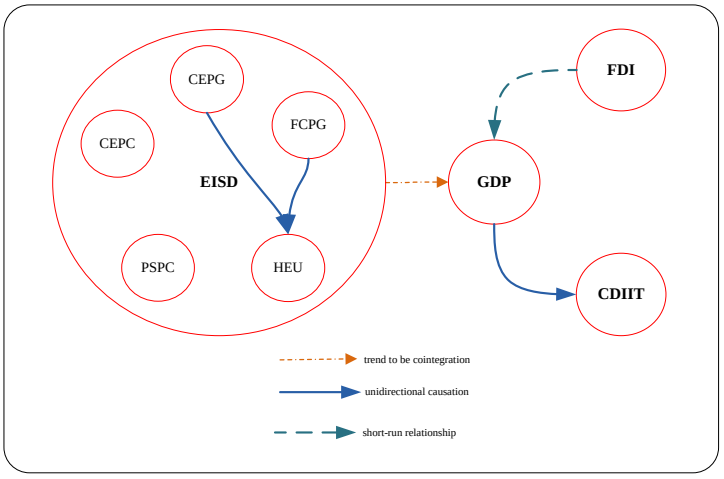

Figure 5 The results of the analysis

4. Conclusions

In this study, short-run relationship and long-run relationship were analyzed among various factors: GDP, CEPC, CEPG, FCPG, PSPC, HEU, and FDI. Unit root, Johansen Cointegration, VECM, Granger Causality were used to analyze the relationship. With the initial coefficient value of the connection equation being negative, the result indicated that GDP was likely to have a long-run correlation with CEPC, CEPG, FCPG, PSPC, HEU, and FDI; nevertheless, the probability value was small. This is because the software was unable to study the links between all energy variables and GDP due to the small amount of data used. As a result, a stepwise regression technique was used to identify the variables. The short-run link has a considerable impact on the relationship between FDI and GDP, although the causality test identified only CEPG and FCPG to be related to HEU and GDP, which were then passed on to CDIIT.

For further study, it should be suggested that using quarterly or monthly data instead of yearly data can enhance the result of analysis. If using quarterly or monthly data in the same period for the analysis, the results will show a more definite relationship between energy indicator variables and GDP.

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