Journal of Multidisciplinary Engineering Science and Technology (JMEST)
ISSN: 2458-9403
Vol. 8 Issue 6, June - 2021

Relationship Between Energy Consumption and Economic Growth in Europe Area

Ali Shojaee
University of Debrecen
Department of Engineering Management and Enterprise
Debrecen, Hungary
ashojaee1992@gmail.com

Seyed Hadi Seyedin*
Islamic Azad University
Science and Research Branch
Faculty of Chemical Engineering
Tehran, Iran.
*corresponding author:
ertebatbama@gmail.com

***Abstract*— In this paper, we investigate the connection between energy utilization and financial development for a few nations in Central Europe. In spite of the fact that there are numerous papers on this subject, the distinction between them and this one is that we think about nations that have not however been examined together. The variable that's utilized for consumption is the ultimate energy utilization, which incorporates the utilization of all shapes of energy (Power, Renewable Energy, Fossil powers, Atomic Energy). In this paper, we utilize board information examination that ponders the associations based on the strategies of settled impact. The information utilized were collected from European databases, Eurostat. Based on the results of the board data regression, we are able conclude that there's a strong correlation between the watched factors. What is required for encourage inquire about is to think about the relationship between factors within the long and short-term. Similarly, curiously would be to ponder the way of integration with nations that have their control sources and energy consumption for GDP optimization.**

Keywords*— Energy Consumption, Economic Growth, RSM, Panel data regression, fixed effect, GDP.

1. Introduction

Energy utilization and financial development have been known to be profoundly related. This relationship brought out the concerns such as natural issues caused by financial development, energy security and a few others (Liddle and Lung, 2014). In this respect the sort of the causal and directional relationship between these two pointers plays noteworthy part in making arrangement choices in an economy. A tremendous writing given to this relationship, but the conclusion on the nexus isn't bound together, and four theories (development, preservationist, input and neutral) rule within the writing (Damette and Seghir, 2013; Hasanov and Mikayilov, 2017 associate alia). The development theory expects that energy utilization causes financial development.
Sequentially, any decrease in energy utilization as a result of preservation approaches will be adversely influence the financial development. The preservation theory accept that the financial development is the most factor of energy utilization and so, financial development will have taken after by an increment in energy utilization. The criticism speculation hypothesizes a bi-directorial causality: Energy utilization influences development and bad habit versa. At long last, the lack of bias speculation shows no causal relationship between energy utilization and development (Ahmed and Azam, 2016; Chen et al., 2007; Yoo, 2006; Hasanov et al., 2017). Clearly, the suitable approach choices change depending the sort of the relationship. For illustration, in the event that energy utilization causes financial development, at that point energy decrease approaches may adversely influence the economy, whereas on the off chance that no such causality exists between energy and GDP, at that point energy preservation and financial development may be practiced together (Masih and Masih, 1997).

2. Literature Review

In this area the comparable considers committed to the energy utilization financial development causality relationship are surveyed. The heading of causality can offer assistance the policymakers take the foremost suitable choices. Based on the observational ponders on the causal relationship between energy consumption and financial development, there's
prove to back bidirectional or unidirectional causality, or no causality, between energy utilization and financial development. Unidirectional causality running from financial development to energy utilization was uncovered by Keppler (2006) for India, by Ozturk et al. (2010) for low-income nations, by Binh (2011) for Vietnam, by Adom (2011) for Ghana, and by Souhila and Kourbali (2012) for Algeria, by Kalyoncu et al. (2013) for Armenia, by Lise and Montfort (2007), Özata (2010), Uzunöz and Akçay (2012) and Ümit and Bulut (2015) for Turkey. In other hand, ponders such as Keppler (2006).
Besides, bidirectional causality was found by Apergis and Payne (2009) for 11 nations of the

Commonwealth of Autonomous States, by Ozturk et al. (2010) for lower-middle wage, by Lee and Lee (2010), Bekle et al. (2010) for 25 OECD Nations, by Pao et al. (2014) for Brazil, by Rezitis and Ahammad (2015) for South and Southeast Asian nations, by Vafaeirad et al. (2015) for 7 Asian nations, by Al-mulali and Mohammed (2015) for Rising nations, Osigwe and Arawomo (2015) for Nigeria and Khobai and Roux (2017) for south Africa. In expansion to them, Erdal et al. (2008), Kaplan et al. (2011), Akpolat and Altıntaş (2013), Bayar (2014), Çakmak (2015) for Turkey come to the comparative conclusion. In a few thinks about, like Ozturk et al. (2010) for upper-middle pay, Kalyoncu et al.

We'll utilize a few nations in Europe in any case of their advancement or energy freedom. In spite of the fact that there are numerous types of investigate on this point, there's no inquire about that covers all the countries in Europe that have accessible measurable information. The most issue of this paper is to think about the connect between the ultimate energy utilization and financial development. We expect relationship of economic growth with energy utilization. In any case, it is fundamental to decide the course of this affiliation, which isn't continuously clearly characterized. What isn't certain is the time when the state expanded control utilization, which come about in an expanded financial development and to what degree is it a reference to the increment. The central address postured in this paper is vital since it uncovers how much is essential to extend the control utilization that would happen as a alter within the financial development. We appear the interface between financial development and the ultimate energy utilization in 30 nations in Europe.

In this paper, the information was collected for the watched nations for last energy utilization, which is made up of energy utilization emerging from strong fills, oil, gas, atomic control, warm, renewable energy sources, and squander. With this data, we watch net household item (GDP) communicated in advertise costs. Utilizing board information investigation, we'll analyze the relationship between the factors in thirty nations in Europe. The watched nations are individuals of the European Union, and we moreover utilized a few States that are noteworthy to the examination but are not members of EU. There are a really expansive number of ponders managing with this investigation. One of the numerous papers on this point is the work of Kasprowicz (2014), entitled "Financial development and energy utilization in 12 European nations: a board information approach".

This paper considers the interface between energy utilization and financial development in 12 nations of the European Union in 13 years. The speculation of this article, which was afterward affirmed, is that there's a positive relationship between energy utilization and financial development. The assessed relapse show incorporates development rates of energy utilization and development rates of net settled capital at genuine costs. The examination states that energy utilization isn't impartial to financial development within the analyzed nations. The taking after work composed on this subject is by Ucan and others (2014), Energy utilization and financial development nexus: Prove from created nations in Europe. This paper analyzes the relationship between the utilize of renewable and non-renewable energy sources and financial development for 15 nations of the European Union over a period of 22 years.

The cointegration test board appears a long-term balance relationship between genuine GDP and utilization of energy from renewable and non-renewable sources. Belke and others (2011) examined the long-term relationship between energy utilization and genuine GDP, 3 counting energy costs. This paper sketched out the utilize of strategies of considering person components which permit the think about of the worldwide and national effect on long-term development. With comparable subject, Hu et al. (2015) considered the association between energy utilization and financial development within the case of mechanical divisions in China. This paper utilized board information watched for 37 distinctive industry segments in China. The paper concludes that within the brief term there's a one-way impact of economic development on energy utilization, whereas within the long term there's a unidirectional effect of energy utilization on financial development.
Bildirici (2014), in his work, clarifies the co-integration connect between the utilization of energy determined from biomass and financial development in move nations. In this case, they are looking at the utilization of biomass as a substitute for energy determined from oil and other fossil powers. The think about affirmed a positive affiliation between the utilization of energy inferred from biomass and financial development. Yang (2015) ponders the interface between energy utilization and financial development in China. China, in an exertion to turn to the feasible green economy, endeavors at diminishing energy utilization in arrange to diminish natural contamination and hence increment its economical GDP. The address that emerges in this work is whether the decrease of the energy utilization has an effect on financial development and to what degree.

The result of the work appears a interface between financial development and energy utilization. Dedeoglu and others (2014) ponder the association between financial development and energy utilization within the previous Soviet nations for ten years. The authors conclude that within the brief term there's no connection between these two factors, whereas within the long run there's an association. Heiko (2012) considered lack of bias speculation between energy utilization and financial movement within the EU nations. What this work appears is that in developed ancient EU Part States the occasion of the lessening of energy utilization leads to an increment in financial

development, whereas within the unused EU part states they came to the inverse conclusion, meaning that an increment in energy utilization leads to the development of financial activity. From this point of view, the comes about of the think about could be valuable for the above-mentioned economies.

3. Energy Sector In Europe

The information utilized in this think about were gotten from the database of Eurostat and eea.europa.eu site, which is the factual office that collects information for the European Union. The energy segment, covering extraction, generation and dissemination specifically utilizes within the EU approximately 1.6 million individuals and creates an included €250 billion to the economy, comparing to 4% of esteem included of the non-financial EU commerce economy. The energy segment moreover produces critical sums of squander, and past exercises have brought about in soil contamination. The division may be a major client of common assets: the fossil powers themselves, water for cooling, hydro control, arrive and crude materials.

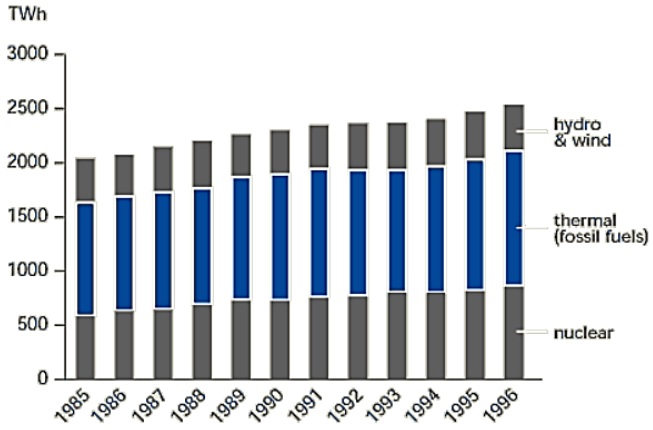

Fig.1. *Electricity supply in EEA member countries.*

Energy frameworks are changing and it is critical to evaluate and evaluate those varieties, measuring the advance towards the set-up objectives and markers can be a valuable apparatus to that reason. fossil fuel energy utilization can be characterized as the remainder between the utilization of fossil fills (oil, strong powers and gas) and net inland energy utilization condition:

$$E_{Fo}(\%) = \frac{E_{Solid-Fuels}+E_{Gas}+E_{Total-Petroleum-Products}}{Gross\ in\ land\ consumption} \qquad (1)$$

Part Nations of the European Financial Zone (EEA), Nations that incorporate the EEA are Austria, Belgium, Bulgaria, Croatia, Republic of Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, and Sweden.

Information that we utilize in this paper are gotten for these nations: European Union (28 nations), Euro range (19 nations), Belgium, Bulgaria, Czech Republic, Denmark, Germany, Estonia, Ireland, Greece, Spain, 4 France, Croatia, Italy, Cyprus, Latvia, Lithuania, Luxembourg, Hungary, Malta, Netherlands, Austria, Poland, Portugal, Romania, Russia, Slovenia, Slovakia, Finland, Sweden, Joined together Kingdom, Iceland and Norway. We utilize a diverse sort of nations that are created and immature, that are in move, that they have claim energy generation and those that depend on other nations in energy generation. We utilize this distinctive nation to improve our paper. The watched period is from 1994 to 2016., on an annually premise. We see at two factors, the Net Household Item at showcase costs and Last energy utilization in tons of oil proportionate.

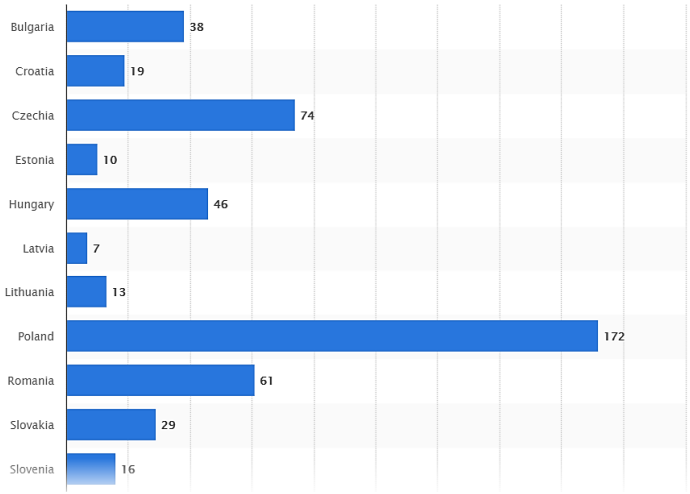

Fig. 2. *Electricity consumption in Central and Eastern European countries in 2019 (in terawatt-hours).*

The information was collected for thirty-one nations, including the European Union nations and nations which are in Europe, and whose energy utilization and energy generation are particular and curiously for this work. The paper planning to include as numerous nations as conceivable, which are in Europe, within the model we are reaching to watch, but there's an issue that less created nations don't have measurements on energy utilization. That's why they have not been considered.

For GDP (Net residential item), we took information on GDP in all the nations watched at showcase costs. Add up to energy utilization is taken for the energy utilization variable, which is gotten by summing the energy utilization of all accessible energy sources, communicated in proportionate tons of oil. We watched nations that are created and long-lasting states of the European Union or the move nations that are less created and along these lines got to be individuals of the European Union. On this basis, we can see that there will be differences in the impact of energy consumption on the economic growth between developed and less developed countries.

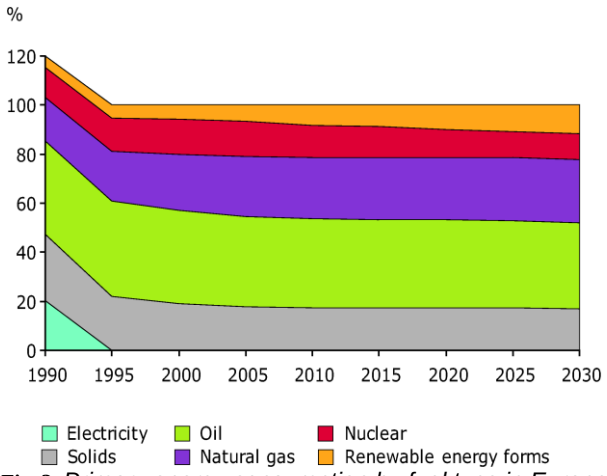

Fig. 3. *Primary energy consumption by fuel type in Europe (eea.europa.eu).*

4. Central Europe Energy Security

Basic Components The proposed expanded participation at the territorial level has the potential to form more practical and competitive energy markets. The basic components will center on natural gas, atomic, efficiencies especially within the lodging field, and clean coal advances [44].

4.1 Natural gas in Central Europe

As famous over, the objective for the locale with regard to normal gas is to form a more proficient advertise. This implies that Russia will proceed to be a noteworthy provider but moreover that the locale ought to alter the flow of its current gas supply relationship by differentiating the supply sources. Noteworthy changes within the worldwide characteristic gas advertise in later a long time have made this totally conceivable both practically and financially. The Joined together States improvement of offbeat gas (shale gas, tight gas, and coal bed methane) has implied much lesser American request on the world advertise, whereas the proceeded improvement of LNG has implied altogether more noteworthy adaptability of supply.

To require advantage of these changes, infrastructure advancement could be a key component. Most importantly, new interconnectors ought to be built between and among the nations within the locale. A North-South hallway, associations with unused improvements in South Eastern Europe, and/or the utilize of fitting interconnectors might bring LNG from the arranged terminals within the north and south, as well as from modern interconnects to Central Asian supplies. In expansion, interconnects with Western Europe ought to be built up that would empower gas streams to be switched into Central Europe in case of genuine setbacks in typical east-west supply streams. Inconceivable the adaptability of such a pipeline arrange will require the foundation of modern exchanging connections with major Western European gas clients.

Germany can be a key calculate in guaranteeing the improvement of such back-up capabilities, counting too supporting the improvement of adequate pipeline capacity to supply for energy security in occasion of disturbance from the east. Such major undertakings almost certainly have to be be financed through government speculations and/or bolster and EU financing and administrative administrations are suitable components that can be coordinated toward such closes. The benefits are plain such advancement of territorial framework and more noteworthy inter-regional exchange will diminish the introduction to either physical or political disturbances [44].

Offbeat gas saves may give extra supplies and be exceptionally accommodating within the region's endeavors to expand its supplies. To be beyond any doubt, the commercial potential has yet to be demonstrated within the locale. Potential for shale gas is seen as essentially a plausibility for Poland and Germany, with constrained topographical potential for Hungary. But there's a genuine prospect for unusual gas to upgrade the supply capacity so that the more noteworthy versatility of supply influences both advertise cost and geopolitical considerations.2 Whereas upgrading security of supply, these measures will to have positive financial impacts. As of now, gas in Central Europe is more costly than in Western Europe since of a need of competition. The extension of supply sources will increment advertise competitiveness and ought to subsequently lower costs with an by and large positive affect on the economies of the CE nations [44].

4.2 Nuclear Energy in Central Europe

Right now, around one-third of the power devoured within the EU is produced by atomic control plants, which is one of the biggest sources of CO2 free energy in Europe. Atomic control is seen by numerous as one of the ways of constraining CO2 outflows inside the EU and, for those member states that wish, is additionally likely to make an imperative portion of their energy arrange. In CE nations atomic control right now accounts for nearly 19% percent of power created over the locale. In spite of the fact that growing atomic era could be a disputable issue for a few nations of the EU, most of the CE locale does not confront the solid open restriction to atomic era seen in some Western European nations. A revitalization and development of the atomic industry will give Central Europe its greatest potential to supply clean electric control and meet EU lower carbon targets.

Given that atomic control, on the off chance that sensibly procured, can be sensibly competitive with different sorts of carbon-generated power on a levelized life cycle taken a toll premise, its utilize can decrease concerns related to the conceivable effect of expanding energy costs on financial development within the locale. This can be especially genuine when one of the key issues facing the locale is to maintain a strategic distance from a showcase overwhelming

position and thus, estimating power for Russian gas. In like manner, in all of the geopolitical, showcase, and climate contexts, atomic control may be a profitable donor to lessening reliance on hydrocarbons. Atomic control isn't cheap in its introductory capital costs. A unused 1,200 MWe atomic reactor likely costs around $ 4.5 billion. Appropriately, it is critical to create financially sensible choices with respect to atomic era capacity, and for this reason, such choices ought to be made in a territorial setting.

As of now, there are 8 atomic plants in a few arranging stages within the CE nations and 5 others moreover being considered in nations in close nearness. Any quick development of atomic plant development is profoundly subordinate on setting up a solid fabricating division in a wide number of ranges related to plant development and operations and on the accessibility of gifted laborers to grow and run the atomic industry. But a territorial approach to building atomic plants, combined with suitable legally binding and/or administrative courses of action, seem guarantee security of supply indeed for nations physically without such a plant. Once more, this underscores the significance of a suitable territorial methodology for the CE nations [44].

4.3 Energy Efficiency in Central Europe

Over the past 20 years, Central Europe has, in general, done well in squandering less energy and in cutting CO2 outflows. This has been a generally slant in Europe as without the investment funds from moved forward energy productivity since 1973, energy utilize in OECD Europe nations would presently be 61% higher. Over the CE locale, the common slant in energy proficiency for electric control has been one of impressive advancement in industry, but much more unassuming advance for family units. This design is especially checked within the modern part states, where the mechanical structure has been changed by end of ancient and wasteful mechanical complexes and the nearness of universal companies that brought more proficient gear and hones. The lodging stock holds the biggest potential for energy proficiency picks up because it was built decades prior without much thought for energy utilization.

The locale can do distant way better, and there's still copious low-hanging natural product, in terms of potential effectiveness changes. The locale has taken a few steps as of now: The Czech Republic's Eco-Energy program is pointed to invigorate business visionaries to diminish energy request for their production; Poland encompasses a Warm Modernization Support; and Hungary gives motivating forces through an Energy Proficiency Ensure Program. Be that as it may, much more broad programs centered on lodging may get important financing from the EU, and would be a critical territorial commitment to the objective of decreasing nursery gas outflows by 20%. For the region, it is exceptionally vital to center on productivity measures to realize this goal since, as famous underneath, the locale has not one or the other the wind nor sun based normal assets to create broad utilize of such renewable energy sources financially doable [44].

4.4 Renewable Energy Sources in Central Europe

The advancement of renewable energy supplies has restricted potential within the locale and shifts broadly depending upon the level of nearby normal assets and the country's execution of approaches to bolster renewable era. The locale sees the EU 2030 objective as a set of political objectives that will be troublesome to bolster without financial activity plans. The renewable power mandate has been a major driving constrain as the locale has constrained capacity to financially utilize renewable energy sources. A few nations have wealthy hydro potential, such as Slovakia, and as a result, their renewable era objectives have been set higher. Other part states, such as Hungary, must depend on more costly innovation, such as wind and biomass.

Within the by and large, however, a significant increment within the utilization of renewables like wind and sun based will require building up linkage's exterior the locale, such as interfacing to the North Ocean wind lattice and or tapping the North African sun-oriented control potential. The region's capacity to get competitively estimated supplies through the expanded interconnects will to empower person nations to bolster a broader cluster of renewable energies and energize the more proficient utilize of energy or energy [44].

4.5 Coal usage in Central Europe

Numerous Central and Eastern European nations have critical coal saves, counting three Visegrad nations: Poland, Czech Republic, and Hungary. As of now, coal era gives the energy for 30% percent of the overall CE installed electric era capacity. In a few nations within the region-including Poland, and Czech Republic-coal is the essential energy source for electric control era, bookkeeping for more than 90% of the overall electricity delivered in Poland. For these nations proceeding the noteworthy utilize of coal is profoundly likely, certainly within the medium term, for among other reasons existing showcase courses of action, employments, costs, and geopolitical concerns.

Coal, of course, raises imperative natural and climate challenges. Since coal let go control plants will proceed to play an imperative part within the CE region's control generation structure, the locale must receive clean coal innovations to decrease CO2 outflows. Clean-burning advances are as of now accessible which can decrease outflows in spite of the fact that with higher taken a toll suggestion. Completely coming to EU climate objectives, accepting coal proceeds to be utilized, will require a few frames of carbon capture and capacity. Critical

innovative endeavors are being embraced with regard to CSS, but as of however, there are constrained advertise arrangements. In like manner, countries that will keep up dependence on coal will moreover have to be have noteworthy other endeavors such as atomic and efficiencies in arrange to realize EU targets [44].

5. GDP Prediction in Europe for The Future

development prospects of the EU are in rate terms to some degree bigger than some time recently the emergency, though for a restricted time period. Based on this rationale, the projection shows higher development rates compared to a comparable projection carried out some time recently the emergency. In spite of this, a changeless misfortune of GDP and welfare is experienced when considering the complete period from 2008 to 2030 [44].

Within the longer term, the EU GDP development is anticipated to moderate down to 1.7% per year between 2020 and 2030. The development designs vary by EU Part State: the Northern and Central Europe are more influenced by the subsidence and recuperate more gradually, but remain on a critical and positive development pace over the long term; the modern Part States that joined the EU in 2004 and 2007 bear an imperative subsidence compared to the tall development experienced over the final few a long time, but they recuperate quicker than the EU normal, taken after by a lull in development rates as they are continuously focalizing towards the EU normal; Southern economies show a comparable development design but their long term prospects are somewhat lower than those of the modern Part States [43].

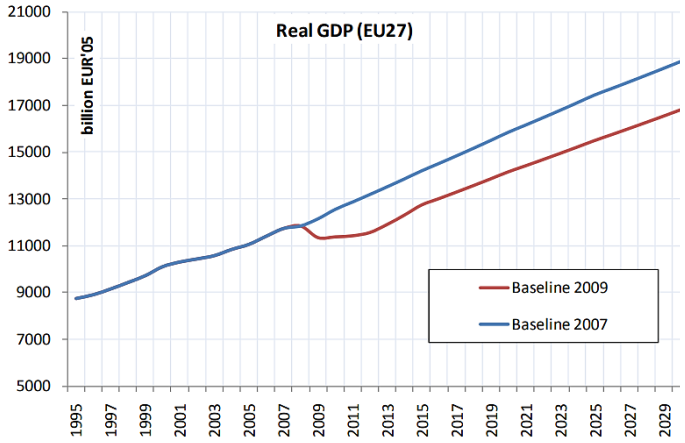

Fig. 4. *GDP index prediction in Europe to 2030 [43].*

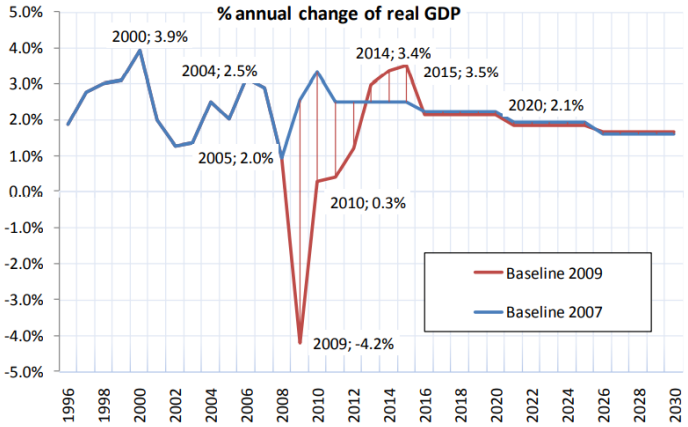

Fig. 5. *Real GDP Change without coronavirus effect [43].*

It ought to be said that the detailed comes about up to presently in this paper is based on Europe Commission condemnation that has not considered coronavirus emergency within the world. Hence, these information are surmised for essential examinations [43].

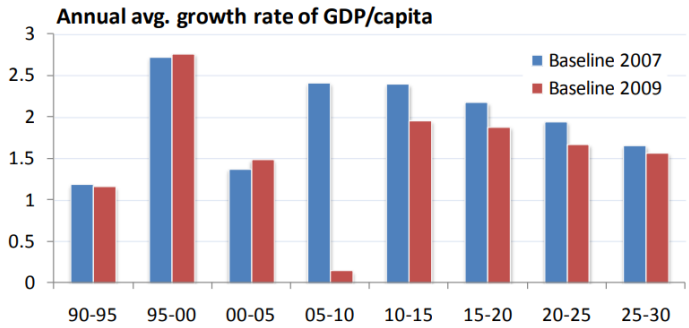

Fig. 6. *Annual average of the growth rate of GDP per Capital in Europe (2007-2009) [43].*

The statistic projection, in agreement with ECFIN's Maturing Report 2009, incorporates an energetic movement drift which makes a difference keeping positive development rates but isn't adequate to support higher development.

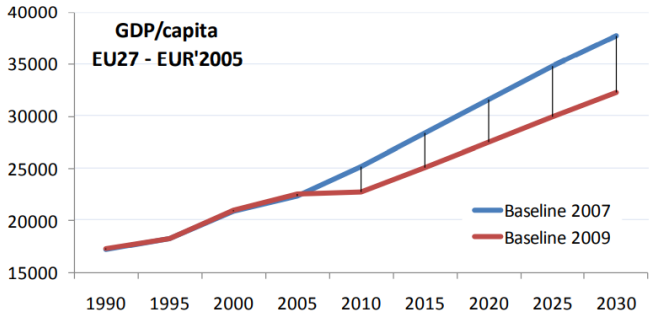

Fig. 7. *GDP per capital from 2005 to 2027 [43].*

Both add up to populace and dynamic populace are accepted to develop at positive, but exceptionally moo, growth rates over the complete projection period; this contrasts past scenarios. As for family units, per capita salary increments at a normal rate marginally lower than 2% per year amid the projection period. In terms of GDP per capita, which has a

critical impact on energy projections, driving households' wage, the modern projection appears lower GDP and higher populace compared to more seasoned scenarios.

Within the long term, GDP per capita increments (in genuine terms) at a normal rate underneath 2% per year. The macroeconomic situation includes progressive and relentless joining of GDP/capita among the Part States. Scattering, strikingly between the ancient and the new Member States, continues within the projection indeed within the long term, but the hole is gradually closing. The suspicions approximately future financial development by segment of action play an imperative part in energy projections. As of now said, 22 segments are considered. The sectoral viewpoint can be summarized as takes after [43].

1. The administrations divisions are anticipated to overwhelm the EU's GDP throughout the projection period. The administrations contribute 72% of net esteem included within the EU in 2005 and are anticipated to contribute 74.7% of the overall by 2030.

2. Non energy seriously businesses show the moment quickest rate of development among the segments and their share is anticipated to stay around 13.5% all through the projection period. The building industry, creating hardware products, is the prevailing industry inside the non-energy seriously mechanical division, developing quicker than the normal. Pharmaceuticals and makeup show tall development within the situation but their share remains or maybe moo. Nourishment, drink and tobacco and other businesses like wood, elastic and plastics, appear critical dynamism, differentiating materials which are anticipated to decline.

3. The energy seriously industry (chemicals, essential metals, development materials, mash and paper) speak to a little share in add up to esteem included (3.4% in 2005). The situation expects that the bulk of mechanical movement in this segment will remain within the EU region and will indeed show a moderate but relentless development (0.7% per year between 2005 and 2030). Be that as it may, the share of this industry will somewhat decrease, coming to 2.65% by 2030. The situation too includes rebuilding inside the preparing and sort of items created by the energy seriously industry. Slowly, their generation blend is anticipated to move towards higher value-added item assortments like uncommon steel, uncommon ceramics and high-quality glass. These shifts have results on energy utilization and the fuel blend.

4. Chemicals are the speediest developing industry, among the energy seriously ones. Pharmaceuticals and natural chemistry develop quicker than fertilizers and inorganic chemistry. The non-metallic minerals segment bears significant lull as a result of the retreat period and the decrease in genuine domain venture; their recuperation is additionally anticipated to be moderate. Press and steel industry is projected to stay dynamic within the EU taking benefits from rebuilding towards higher utilize of scrap fabric and the generation of higher quality conclusion items as a result of innovation advance.

6. Results and Discussion

6.1 Analysis and selection of the model

The experimental design, which includes 3 factors and levels for 20 runs, is reported in Table 1. Design Expert Software (Version 7) was used to describe the response surface method (RSM). RSM analysis was used to identify the optimum values of the experimental factors in a more effective way, and to reveal the important factor interactions. The low level of the variables is (-1), medium level is (0), and high level is (+1). In this part, some responses as GDP from some sources selected in the range of 10000-20000 and the data is approximate.

TABLE. 1. Actual and coded values of the process variables.

Actual values	Low	Medium	High
Fossil Fuels (MTons)	100	150	200
Renewable Energy (TW)	200	225	250
Nuclear Energy (TW)	180	190	200
Response (GDP)	10000	15000	20000
Coded values	-1	0	+1

TABLE. 2. Design summary of energy factors and Model.

20 Runs		GDP (Response)		
Study Type		Response Surface		
Model (Analysis)		Quadratic (Polynomial)		
Initial Design		Central Composite		
High Actual	Low Coded	High Coded	Mean	Std. Dev.
1	-1	1	0	0.826
1	-1	1	0	0.826
1	-1	1	0	0.826
Min	Max	Mean	Std. Dev.	Ratio
10000	20000	14925	2471.209	2

TABLE. 3. Standard deviations of the coefficients (Energy) and interactions that effect on GDP (Smaller is better).

Power at 5% alpha level, Basic Std. Dev. =1.0						
Term	**Std. Err**	**VIF**	**Ri-Squared**	**0.5 Std. Dev.**	**1 Std. Dev.**	**2 Std. Dev.**
A	0.27	1	0.0000	13.3%	38.6%	91.4%
B	0.27	1	0.0000	13.3%	38.6%	91.4%
C	0.27	1	0.0000	13.3%	38.6%	91.4%
AB	0.35	1	0.0000	9.8%	24.9%	72.2%
AC	0.35	1	0.0000	9.8%	24.9%	72.2%
BC	0.35	1	0.0000	9.8%	24.9%	72.2%
A^2	0.26	1.02	0.0179	40.4%	92.7%	99.9%
B^2	0.26	1.02	0.0179	40.4%	92.7%	99.9%
C^2	0.26	1.02	0.0179	40.4%	92.7%	99.9%

6.2 The algorithm of the analysis process

We choose responses under analysis and perform steps displayed as following:

1. Transformation. Select response node and choose transformation.
2. Fit Summary (RSM). Use this to evaluate models for RSM.

3. Effects (Factorials). Choose significant effects from graph or list.
4. Analysis of Variance (ANOVA). Analyze the chosen model and view results.
5. Diagnostics. Evaluate model fit and transformation choice with graphs.
6. Model Graphs. Use these to interpret and evaluate your model.
7. Statistics Analysis of R-Squared (R^2), Adjusted R-Squared (Adj. R^2), Predicted R-Squared (Pre. R^2) and significant variables such as P-value, F-value and T-value.

TABLE. 4. Model summary statistics, adjusted R-Squared (R^2).

Source	Std. Dev.	R^2	Adj. R^2	Pre. R^2	PRESS
Linear	1348	0.761	0.717	0.56	5.37E+7
2FI	1292	0.822	0.74	0.234	9.35E+7
Quadratic	1392	0.841	0.698	-0.22	1.49E+8
Cubic	467	0.989	0.966	-1.36	2.88E+8

6.3 Regression analysis

The regression coefficient, standard error, T-values and P-values for the full quadratic model of the GDP are presented in Table 5. The significance test of the individual model coefficients involves the determination of P and T-values. The T-value represents the
significance of the independent variables on the response. The P-value indicates that the three main factors and two interactions have a statistically significant effect on the response. The fitted linear equation is more acceptable.

6.4 Analysis of Variance for Experiments

Analysis of variance (ANOVA) is used for better analysis of DOE and is complementary to the results. Table 5 represents the results of ANOVA for the GDP statistical analysis. In the ANOVA table in Software, DF is the degree of freedom, Seq SS (R^2) is sequential sum of squares, Adj SS is adjusted R-square, the F-value is a value, when we run an ANOVA test or a regression analysis to find out if the means between two populations are significantly different. Also, F test will tell us, if a group of variables are jointly significant. We can use the F-value when deciding to support or reject the null hypothesis. We should also consider the P-value. The P-value is determined by the F-value. The F-value must be used in combination with the P-value. If we have a significant F-value, it doesn't mean that all your variables are significant. The statistic is just comparing the joint effect of all the variables together. If the P-value is less than the alpha level, it should be studied the individual P-values to find out which of the individual variables are statistically significant. Otherwise, our results are not significant and we cannot reject the null hypothesis. A common alpha level for tests is 0.05. The P-value is the measure of how likely the sample results are, assuming the null hypothesis is true. P-values range from 0 to 1. A small P-value (P<0.05) indicates that the power level has a statistically significant effect on each rate. Table 5, Shows analysis of variance for response surface linear model. Since the P-value is less than 0.001, the Model is significant.

TABLE. 5. ANOVA table of variables for RSM Model.

Source	Sum of Squares	df	Mean Square	F-Value	P-value Prob>F
Model	9.303E+7	3	3.101E+7	17.05	<0.0001
Fossil	3.588E+6	1	3.588E+6	1.97	0.1793
Nuclear	7.767E+7	1	7.76E+7	42.69	<0.0001
Renewable	1.178E+7	1	1.178E+7	6.47	0.0217
Residual	2.911E+7	16	1.819E+6		
Lack of Fit	2.911E+7	11	2.646E+6		
Pure Error	0.0000	5	0.000		
Cor Total	1.221E+8	19			

The Model F-value of 17.05 implies the model is significant. There is only a 0.01% chance that a "Model F-Value" this large could occur due to noise. Values of "Prob > F" less than 0.0500 indicate model terms are significant. In this case B, C are significant model terms. Values greater than 0.1000 indicate the model terms are not significant. If there are many insignificant model terms (not counting those required to support hierarchy), model reduction may improve your model.

TABLE. 6. Statistical important parameters from Software.

Std. Dev.	1348.77	R^2	0.7617
Mean	14925.00	Adj. R^2	0.7170
C.V. %	9.04	Pred. R^2	0.5600
PRESS	5.374E+007	Adeq Precision	13.298

The "Predicted R-Squared" of 0.5600 is in reasonable agreement with the "Adj R-Squared" of 0.7170. "Adeq Precision" measures the signal to noise ratio. A ratio greater than 4 is desirable. Your ratio of 13.298 indicates an adequate signal. This model can be used to navigate the design space. A quadratic model was derived, of which all effects (first, second-order, and interaction) remained significant after model reduction (P<0.05) Consequently, the following equation was obtained. Final Equation in Terms of Coded Factors as linear mathematic form as following:

$$GDP = +14925 + 512.56 * A + 2384.74 * B + 928.6 * C \quad (2)$$

Final Equation in Terms of Actual Factors acording to regration analysis and based on Table 3:

$$GDP = +14925 + 512.56 * (Fossil\ fuels) + 2384.74 * (Nuclear\ Energy) + 928.6 * (Renewable\ Energy) \quad (3)$$

The Diagnostics Case Statistics Report has been moved to the Diagnostics Node. Proceed to Diagnostic Plots. If all the model statistics and diagnostic plots are OK, will finish up with the Model Graphs. According to Fig 8, the Fossil fuels has low

impact on GDP and the line has a slight slope in this diagram.

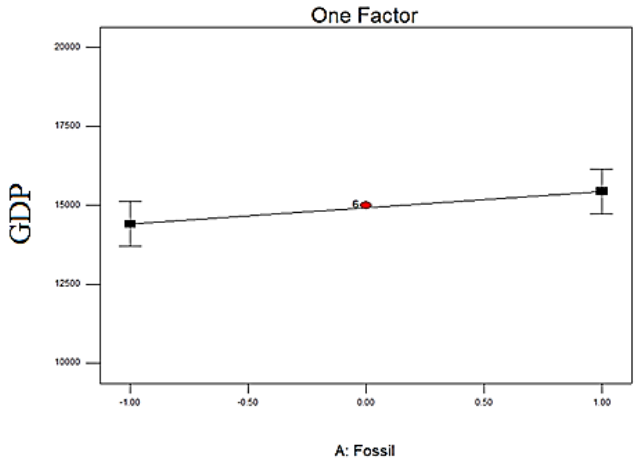

Fig. 8. *Fossil fuel factor effect on GDP.*

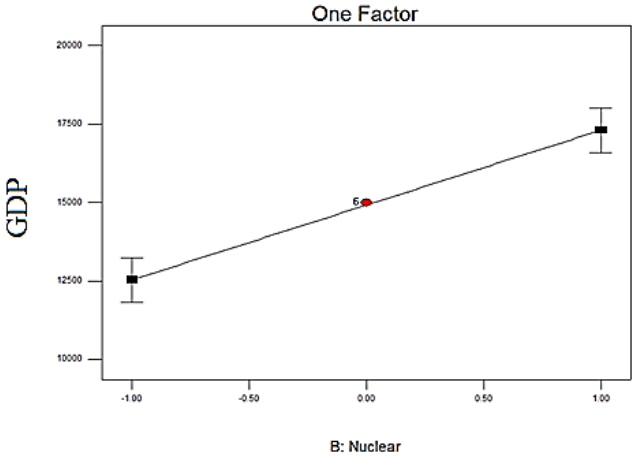

Fig. 9. *Nuclear energy factor effect on GDP.*

According to Fig 9, the Nuclear energy has the most impact on GDP and the line has a high slope in the diagram. In addition, in Fig 10, renewable energy has a greater impact on GDP than fossil fuels, and has a higher slope diagram than in Fig 8.

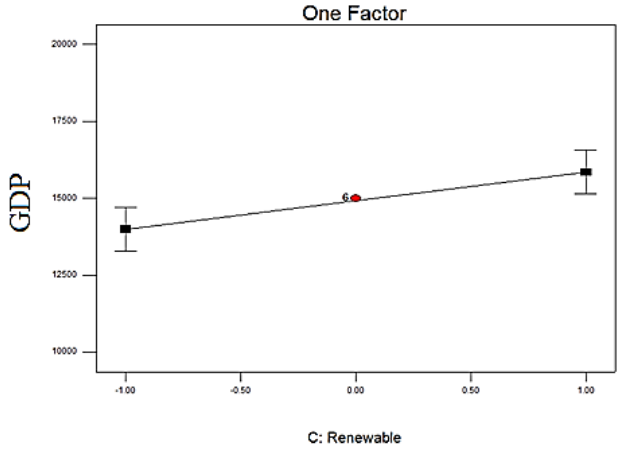

Fig. 10. *Renewable energy factor effect on GDP.*

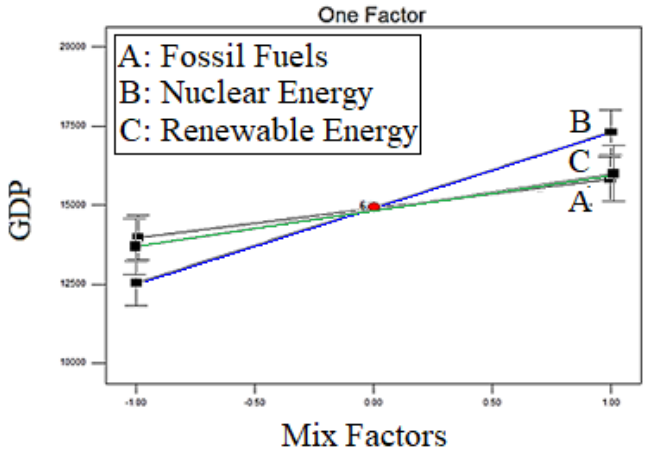

Fig. 11. *All factors that affect GDP.*

As shown in Fig 11, there all energy variables that can affect on GDP. We can see and consider, the nuclear energy, has the most impact of all and the renewable energy is in the second place. Because, as we know, the nuclear energy has low price and accessible in Europe and the supply is easy in relation to other source of energy that might be imported to Europe or other problems such as production price and lack of source in Europe.

6.5 Validation of the RSM Model

The significance test for the regression model was done using the ANOVA table and the results for the GDP. The predicted model was validated to test the fitness of the model for further utilization. The higher coefficient values of multiple regression, predicted R^2 (56%) and adjusted R^2 (71.7%) indicated the fitness and adequacy of the model.

7. Conclusion

From the examination conducted in this paper, we are able conclude that there's a really strong relationship between energy utilization and economic development. Based on the information inspected and the results, able to affirm the first theory within the work of the tremendous nexus of watched factors. We are able to conclude that this affiliation is show in all the checked nations, in any case of their estimate and level of improvement. The information was collected for these nations including the European Union nations and other European nations and their energy utilization, and energy generation are unmistakable and alluring to this work. For GDP, we took information on GDP in all the nations watched in advertise costs.

Total energy consumption is taken for the energy consumption variable, which is obtained by summing the energy consumption of all available energy sources, expressed in equivalent tons of oil. The effect of the important variables for GDP was investigated. The RSM results showed that GDP was directly proportional to the energy consumption and inversely related to fossil fuels or imported energy (oil, gas, solid fossil fuels…). The validity of the model was

verified by fitting the values of the independent variables into the regression model equation. The renewable energy, was demonstrated as having greater influence than the other variables on GDP. Thus, it appears that the renewable energy plays an important role in determining the energy efficiency. thus, GDP can be reduced drastically by the imported energy or fossil fuels. Future research can focus on environmental climate changes, temperature variations and the CO_2 generation in atmosphere based on energy consumption.

We watched nations that are created and long-lasting states of the European Union or the move nations that are less created and got to be individuals of the European Union hence. Based on the comes about gotten, ready to affirm the exceptionally tall relationship between watched variables for nations in move. Be that as it may, in creating nations, there's no relationship between watched factors, most likely since these nations have come to a level of advancement where energy consumption does not have a major effect on GDP. There are a couple of downsides in this paper, for example, the number of the studied nations ought to be expanded conjointly the restriction of data and Covid-19 emergency within the World that impacts on a few conservative lists and past expectations.

This paper watched as it were EU nations and other European nations. We ought to do investigate including all pertinent nations within the world and watch them over a longer period. Curiously for future investigate is the comparability of these two watched factors between nations that are energy free, creating sufficient energy from their assets, and those nations that are not. From this investigate, we should see, in case there's a distinction between these nations or not, or whether there's an advantage to nations that are self-sufficient due to their control sources. In this paper, we didn't need to compare nations that have possess energy generation with those countries that do not have claim energy generation. Besides, a few factors within the field of energy sources were explored up to year 2030 in Europe region. It ought to be famous that, the information that has been analyzed in this ponder, was surmised.

REFERENCES

[1] Liddle, B., Lung, S., Age structure, urbanization, and climate change in developed countries: Revisiting STIRPAT for disaggregated population and consumption-related environmental impacts. Population and Environment, 31, 317-343, 2010.

[2] Damette, O., Seghir, M., Energy as a driver of growth in oil exporting countries? Energy Economics, 37(C), 193-199, 2013.

[3] Hasanov, F., Mikayilov, J. The impact of age groups on consumption of residential electricity in Azerbaijan. Communist and Post-Communist Studies, 50, 157-244, 2017.

[4] Ahmed, M., Azam, M., Causal nexus between energy consumption and economic growth for high-, middle- and low-income countries using frequency domain analysis. Renewable and Sustainable Energy Reviews, 60, 653-678, 2016.

[5] Chen, S.T., Kuo, H.I., Chen, C.C., The relationship between GDP and electricity consumption in 10 Asian countries. Energy Policy, 35(4), 2611-2621, 2007.

[6] Yoo, S.H., The causal relationship between electricity consumption and economic growth in the ASEAN countries. Energy Policy, 34, 3573-3582, 2006.

[7] Hasanov, F., Bulut, C., Suleymanov, E., Review of energy-growth nexus: A panel analysis for ten Eurasian oil exporting countries, renawable and sus. Energy Reviews, 73, 369-386, 2017.

[8] Masih, A.M.M., Masih, R., On the temporal causal relationship between energy consumption, real income, and prices: Some new evidence from Asian-energy dependent NICs based on multivariate cointegration/vector error-correction approach. Journal of Policy Modeling, 19, 417-440, 1997.

[9] Ozturk, I., Aslan, A., Kalyoncu, H., Energy consumption and economic growth relationship: Evidence from panel data for low- and middle-income countries. Energy Policy, 38(8), 4422-4428, 2010.

[10] Binh, P.T., Energy consumption and economic growth in Vietnam: Threshold cointegration and causality analysis. International Journal of Energy Economics and Policy, 1(1), 1-17, 2011.

[11] Adom, P.K., Electricity consumption-economic growth nexus: The ghanaian case. International Journal of Energy Economics and Policy, 1(1), 18-31, 2011.

[12] Souhila, C., Kourbali, B., Energy consumption and economic growth in Algeria: Cointegration and causality analysis. International Journal of Energy Economics and Policy, 2(4), 238-249, 2012.

[13] Kalyoncu, H., Gürsoy, F., Göcen, H., Causality relationship between GDP and energy consumption in Georgia, Azerbaijan and Armenia. International Journal of Energy Economics and Policy, 3(1), 111-117, 2013.

[14] Lise,W., Van Montfort, K., Energy consumption and GDP in Turkey: Is there a co-integration relationship? Energy Economics, 29, 1166-1178, 2007.

[15] Özata, E., Türkiye'de enerji tüketimi ve ekonomik büyüme arasındaki ilişkilerin ekonometrik incelemesi. Dumlupınar Üniversitesi Sosyal Bilimler Dergisi, 26, 101-113, 2010.

[16] Uzunöz, M., Akçay, Y., Türkiye'de büyüme ve enerji tüketimi arasındaki nedensellik ilişkisi: 1970-2010. Çankırı Karatekin Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 3(2), 1-16, 2012.

[17] Ümit, A.Ö., Bulut, E., Relationship between energy consumption and real GDP in Turkey: A co-integration analysis with structural breaks. International Journal of Energy Economics and Policy, 5(4), 968-978, 2015.

[18] Narayan, P.K., Smyth, R., Energy consumption and real GDP in G7 countries: new evidence from panel cointegration with structural breaks. Energy Economics, 30(5), 2331-2341, 2008.

[19] Apergis, N., Danuletiu, D., Energy consumption and growth in romania: Evidence from a panel error correction model. International Journal of Energy Economics and Policy, 2(4), 348-356, 2012.

[20] Karagöl, E., Erbaykal, E., Ertuğrul, H.M., Türkiye'de ekonomik büyüme ile elektrik tüketimi ilişkisi: Sınır testi yaklaşımı. Doğuş Üniversitesi Dergisi, 1, 72-80, 2007.

[21] Apergis, N., Payne, J.E., Energy consumption and economic growth: Evidence from the commonwealth of ındependent states. Energy Economics, 31(5), 641-647, 2009.

[22] Ozturk, I., Acaravci, A., CO2 emissions, energy consumption and economic growth in Turkey. Renewable and Sustainable Energy Reviews, 14(9), 3220-3225, 2010.

[23] Lee, C., Lee, J. A panel data analysis of the demand for total energy and electricity in OECD countries. Energy Journal, 31(1), 1-23, 2010.

[24] Bekle, A., Christian, D., Frauke de, D., Energy Consumption and Economic Growth: New İnsights İnto the Cointegration Relationship. Ruhr Economic Paper No. 190, 2010.

[25] Pao, H.T., Li, Y.Y., Fu, H.C., Causality relationship between energy consumption and economic growth in Brazil. Smart Grid and Renewable Energy, 5, 198-205, 2014.

[26] Rezitis, A.N., Ahammad, S.M., The relationship between energy consumption and economic growth in South and Southeast Asian countries: A panel vector autoregression approach and causality analysis. International Journal of Energy Economics and Policy, 5(3), 704-715, 2015.

[27] Al-mulali, U., Mohammed, A.H., The relationship between energy consumption and GDP in emerging countries. International Journal of Energy Sector Management, 9(1),77-93, 2015.

[28] Osigwe, A.C., Arawomo, D.F., Energy consumption, energy prices and economic growth: Causal relationships based on error correction model. International Journal of Energy Economics and Policy, 5(2), 408-414, 2015.

[29] Khobai, H., Roux, P.L., The relationship between energy consumption, economic growth and carbon dioxide emission: The case of South Africa. International Journal of Energy Economics and Policy, 7(3), 102-109, 2017.

[30] Erdal, G., Erdal, H., Esengün, K., The causality between energy consumption and economic growth in Turkey. Energy Policy, 36, 3838-3842, 2008.

[31] Kaplan, M., Ozturk, I., Kalyoncu, H., Energy consumption and economic growth in Turkey: Cointegration and causality analysis. Romanian Journal of Economic Forecasting, 2, 31-41, 2011.

[32] Akpolat, A., Altıntaş, N., Enerji tüketimi ile reel GSYİH arasındaki eşbütünleşme ve nedensellik ilişkisi: 1961-2010 dönemi. Bilgi Ekonomisi ve Yönetimi Dergisi, 8(2), 15-127, 2013.

[33] Bayar, Y., Türkiye'de birincil enerji kullanımı ve ekonomik büyüme. Atatürk Üniversitesi İktisadi ve İdari Bilimler Dergisi, 28(2), 253-269, 2014.

[34] Cakmak, I., Energy consumption and GDP in Turkey: Cointegration and causality analysis. International Journal of Management and Applied Science, 1(9), 130-132, 2015.

[35] Kasprowicz. R, «Economic growth and energy consumption in 12 European countries: a panel data approach», Journal of International Studies, Vol. 7, No. 3, pp. 112-122, 2014.

[36] Ucan. O, Aricioglu. E, Yucel. F,. «Energy consumption and economic growth nexus: Evidence from developed countries in Europe», International Journal of Energy and Policy, Vol.4, No.3, 2014, pp. 411-419, 2014.

[37] Belke. A, Dobnik. F, Dreger. C, (2011). «Energy consumption and economic growth: New insights into the cointegration relationship», Energy Economics 33, pp. 782-789, 2011.

[38] Hu. Y, Guo. D, Wang. M, Zhang. X, Wang. S, «The relationship between energy consumption and economic growth: Evidence from China's industrial sectors», Energies, Vol. 8, pp.9392-9406, 2015.

[39] Bildirici. M, «Relationship between biomass energy and economic growth in transition countries: panel ARDL approach», GBC Bioenergy, Vol. 6, pp. 717-726, 2014.

[40] Yang. L, Yang. T, «Energy consumption and economic growth from perspective of spatial heterogeneity: Statistical analysis based on variable coefficient model», Annals of Operations Research, Vol. 228, pp. 151-161, 2015.

[41] Dincer Dedeoglu, Ali Piskin, A dynamic panel study of energy consumption–economic growth nexus: evidence from the former Soviet Union countries, OPEC Energy Review, 2014.

[42] Haiko. V, «The relationship between energy consumption and economic activity in EU-27 countries: testing the neutrality hypothesis», Journal of Policy Modeling, 2012.

[43] Prof. P. Capros, Dr. L. Mantzos, N. Tasios, A. De Vita, N. Kouvaritakis, EU energy trends to 2030 and UPDATE, EUROPEAN COMMISSION Directorate-General for Energy in collaboration with Climate Action DG and Mobility and Transport DG, 2009.

[44] Franklin D. Kramer, John R. Lyman, and Mihaela C. Carstei, Central Europe and the Geopolitics of Energy, Energy and environment PROGRAM, Atlantic Council, 2019.

Author: Ali Shojaee is a highly-motivated engineer, who is a hard worker and responsible person. He is humble at work, able to learn fast and can solve problems with caution. MSc Engineering Management University of Debrecen National Excellence Scholarship Holder (Stipendium Hungary) 2017 -2020. BA Petroleum Engineering at University Technology PETRONAS (Malaysia) 2013–2017. Foundation in Engineering (Petroleum), PETRONAS 2012–2013. Publication is in the field of How Technology aid the Iranian Drilling Industry" (Iranian Drilling Magazine 2015). Work Experience, Oil and Natural Gas Corporation Limited (ONGC), Ahmadabad Asset (India)- Summer Internship, gained experience in Drilling, Exploration & Subsurface activities, 2016. Tech Mahindra Hungary- Google project, 2019-2020. Programming and Simulation Software: ECLIPSE, Landmark, Petrel, MATLAB, Dev C++.
University of Debrecen, Debrecen, Egyetem tér 1, 4032 Hungary.
Tel: +36308981151
E-mail: ashojaee1992@gmail.com

Author: Seyed Hadi Seyedin has been a Chemical Engineering student at SRBIAU University. Detail driven, focused and skilled Doctor of Chemical Engineering with more than 6 years of experience in leading Petroleum Company, taking positions of Process Engineer, Chemical Engineer in R&D as well as lecturing Chemical Engineering courses in University, with wide breadth of knowledge in industrial chemical processes. Seyed Hadi Seyedin has published more than 16 research articles in the field of Process, wastewater treatment, Fluidized Bed, Coating, CFD Simulation, and Nozzles. Moreover, he has registered an International PCT patent with the title of 'Modern Process for Spent Caustic Treating and Converting Wastewater into Valuable By-Products with Process Simulation by ASPEN Plus' in 2020.
Science and Research Branch, Islamic Azad University, Daneshgah Blvd, Simon Bolivar Blvd, Tehran, Iran.
Tel: +989197044123
E-mail: Ertebatbama@gmail.com