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Article

The dynamics of energy production: a composite index

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A R T I C L E I N F O

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A B S T R A C T

Energy is a sector of production of considerable interest. Today's era is particularly dependent on energy. Both continuous technological upgrading and the increase in living standards require ever-greater energy security. Many countries in the world are formulating their policies in order to secure energy resources. Energy security is one of the most important objectives of any country in the international economic system. All countries are trying to secure energy resources whether they are endowed or through trade. However, the main issue that arises is the production of energy. Energy production has a direct and indirect impact on a country's economy. It is therefore essential to properly investigate those factors that determine energy production. What are those factors determining energy production? There are many factors that can determine energy production. This study will attempt to set an analytical framework that can analyze the factors that determine energy production. The methodology applied is the construction of a composite index (CI).

1. Introduction

Energy is the most important aspect of the present international trade. Without energy resources, a country cannot achieve its economic objectives. What should be noted is that while the requirements for energy products around the world have increased at the same time, the resources for energy creation are limited in both quantity and scope [1]. Energy is essential for economic growth, and securing energy – increasing efficiency in energy use – is a key factor [2]. Essentially, proper availability of energy leads to economic growth. The particular role played by energy leads us to the concept of energy security. Surveys such as Liao et al. [3] and Gupta [4] have highlighted the need for a continuous and cheap supply of energy, citing the energy supply security. The prices of energy products are a very basic criterion of energy supply security. As Shafiee and Topal [5] and Paldam [6] mention, cheap energy is a precondition to reaching a proper growth rate. But what about the countries that have energy resources and others that do not? Although the existence of energy resources can be a strong economic advantage, the economic performance of a country does not depend solely on the availability of energy resources. An example of this condition is the "Dutch Disease". This occurs when an explosion of resources leads to a reduction in the internal incentives for production and/or the international competitiveness of a country [7]. Surveys such as [8-11] have investigated the "Dutch Disease". A special element in energy is the global energy market. A key feature of the energy sector is the complexity of this trade sector. In particular, many factors such as the uncertainty of economic policy or political risks could have a significant impact on the economic activity of many countries that could affect the coverage of domestic demand and foreign exports [12-14]. What is certain is that the adequacy of energy resources drives economic development, it can secure through trade, technology, or the availability of natural resources. Whether a country is an energy exporter or an importer, energy production is important for economic development [15]. The importance of energy production can be highlighted by what Vipin [16] mentions. Especially it is mentioned that greater energy production is associated with higher investment, income, and a stronger real exchange rate. Further energy production leads to increased domestic production and imports of capital and consumption goods. The subject of this study is this: What are the factors that determine a country's energy production? The author's assumption is that the production of energy in a country is determined both by the external dimension, which is expressed by its export dynamics in international trade, and by the internal dimension, which is expressed by its economic dynamics. In order to properly answer this question, a quantitative tool should be created that can properly answer this question. The Composite Indicator (CI) will essentially try to create the analytical framework that explains the dynamics of energy production. The remainder of this paper is structured as follows: In the second section, the methodology of the composite index is outlined. The third section presents the theoretical framework of the index. The fourth section describes the normalization of the indicators. In the fifth section, the aggregation and the validation of the index are displayed. The final section concludes. This research is based on developing a composite index that explains the dynamics of energy production.

2. Methodology

The primary objective of the study is to construct an Energy Production Dynamics Index that measures the dynamics of energy production in a quantitative manner. The same procedure is followed by Karakostas [16]. The methodology to be followed will be based on a quantitative method. The index to be created is a Composite Index, Hudrliková [17]. Nardo et al. [18] state that the use of the Composite Index is one of the future methods of international comparison. Freudenberg [19] indicates what a composite index is. In particular, he states that a composite indicator is the mathematical combination of individual indicators.

Based on reference [20], composite indicators are an increasingly applied instrument for comparing countries' performance at specific levels. Cases include competitiveness, globalization, innovation, etc. The construction of the composite index will be followed by the OECD Handbook on Constructing Composite Indicators [21], which is an appropriate reference for methodological proposals. The method of Normalization that will be used to build the Index is the Min-Max Normalization Method. Schwab [22] reported that Normalization is essentially the process by which units of measurement are converted from the original units to common units of measurement. According to the OECD [21] the Min-Max normalizes the indicators so that they have the same range by subtracting the minimum value and dividing by the range of the index values. The Min-Max Normalization equation method is as follows:

$$C = (Value - Min) / (Max - Min) \quad (1)$$

The method of normalization and concentration used by the World Economic Forum to construct the Global Competitiveness Report is used. In particular. the World Economic Forum applies the Min-Max method (ranging from 0 to 100) for the normalization of each sub-index. The normalization methodology followed by the World Economic Forum is as follows, according to [23], each sub-index is upgraded according to the following formula:

$$Score_{i.c} = (Value_{i.c} - wp_i / frontier_i - wp_i) * 100 \quad (2)$$

where $Value_{i.c}$ is the value of sub-index i of country c, the worst performance (wp_i) is the lowest acceptable value for sub-index i and frontieri corresponds to the highest value (at best possible result) for sub-index i.

According to [24], the Min-Max Normalization method is followed by Fraser institute: Economic Freedom of the World (EFW index) and World Economic Forum (WEF) Growth Competitiveness Index (GCI). Regarding the concentration stage, the procedure used by the World Economic Forum is followed. In other words, the process of finding the average is followed. Reference [25] states that one of the five concentration-weighting measures (complex indicators) is the arithmetic mean. The IMD World Competitiveness Ranking uses the calculation of the average as a method of concentration [26]. The procedure is mentioned in the Global Competitiveness Report. Mazziotta et al. [27] mention that commonly applied aggregation options include additive aggregation (arithmetic mean). The formula for assessing arithmetic mean is the following:

$$x = \sum i^n =1x / N \quad (3)$$

According to Mazziotta and Pareto [27] there is no common method to build a composite index. Although, they mention four steps to structure a composite index. The first step is the definition of the phenomenon. The second step is the selection of a group of individual indicators. The third step is the normalization of the individual indicators. The last step is the aggregation of the normalized indicators. There are many examples of the construction of indicators aimed at interpreting the characteristics of the energy sector. Examples are indicators constructed by the International Energy Agency (IEA), which measure the intensity or market share of energy sources [28]. Still, Badea et al. [29] built an index with which they tried to measure energy security supply.

The index in this study consists of five (5) sub-indicators. The first indicator of the composite index will be expressed at the Real Effective Exchange Rate (REER) [30]. The choice of the real effective exchange rate was made because it is an appropriate measure of the relative value of a state's currency compared to the currencies with which it trades. The largest value of the Real Effective Exchange Rate has a negative effect on the composite index. The smallest value has a positive effect on the composite index. The second indicator of the composite index will be expressed with the Revealed Comparative Advantage - Balassa index - (RCA) [31]. The choice of comparative advantage was made because it is an appropriate measure for comparing the relative advantage or disadvantage that a country has in the trade flows of a particular category of goods or services. The largest value of the Revealed Comparative Advantage has a positive effect on the composite index. The smallest value has a negative effect on the composite index. The third indicator of the composite index is the Elasticity of Supply [32]. The choice of supply elasticity was made because it could express the quantitative relationship between the supply of a good and its price. The largest value of the Elasticity of Supply has a positive effect on the composite index. The smallest value has a negative effect on the composite index. The fourth indicator is the Elasticity of Demand. The choice of demand elasticity was made because it could express the quantitative relationship between the demand for a good and its price. The fifth indicator of the composite index is the percentage of GDP Growth [33]. The largest value of the percentage of GDP Growth has a positive effect on the composite index. The smallest value has a negative effect on the composite index. The databases of this research are: Chatham House, Bank for International Settlements, and, The World Bank.

In order to accomplish this, will be calculated firstly, the Real Effective Exchange Rate of the selected countries. Secondly, the Revealed Comparative Advantage of the selected countries in terms of oil, gas, coal, and other fuel fossils, and thirdly, the Elasticity of Supply and Demand of the selected countries in terms of oil, gas, coal, and other fuel fossil and lastly the percentage of GDP Growth of the countries. The countries indicatively chosen are the United States, Saudi Arabia, Russia, and Canada. The selected countries are among the top ten (10) energy producers [34]. The function of the composite index is as follows: the higher the value of the index - between the selected countries - the greater the energy production. In other words, there is a similar relationship. The operation of the composite indicator is based on the comparison of the selected countries. The selected data cover the years 2017, 2018, and, 2019 and was selected based on availability and because they are the most recent years before the Covid 19 [35]. The criteria for each indicator were based on literature analysis. This formed the basis for the development of the composite index. In the next section, the theoretical framework of the index is mentioned.

3. The Theoretical Framework of the Composite Index

The pillars of the composite index of this study are basically divided into two aspects. The first aspect includes sub-indices that express the country's export potential. This aspect includes the Real Effective Exchange Rate, the Revealed Comparative Advantage, and the Elasticity of Supply. The second aspect of the composite index belongs to the sub-indicators, which express the country's internal economic potential. This aspect includes the Elasticity of Demand and the rate of GDP Growth. The exchange rate is particularly important for countries worldwide, whether they are energy importing or exporting countries. As Alekhina and Yoshino [36] reported, energy (oil) prices can affect price levels in energy importing countries and exporting countries affecting energy export revenues and state budget revenues. Surveys such as references [37-40] have shown the relationship between energy (oil) prices and real exchange rates. A key element with regard to the exchange rate in energy-exporting countries is the choice of the appropriate exchange rate regime. Ouchen [41] and Cruz-Rodriguez [42] stated that the choice of exporting energy countries varies. Many countries choose to "peg" their exchange rates to the dollar like the Gulf countries, while other countries have floating exchange rates (Norway, Australia, New Zealand, and Canada). Al-Sadiq et al. [43] reported that due to the lack of a strong set of economic, structural, or institutional variables that can explain status options among exporters, results in the existence of many different exchange regimes. Although many energy-exporting countries have different exchange rate regimes, a yardstick of their exchange rate policies is necessary. The existence of different exchange regimes has led to the choice of the real effective exchange rate as the first pillar of the composite indicator of this study.

As mentioned above, many countries have a comparative advantage in energy exports. An appropriate investigative measure with regard to energy exports is the Revealed Comparative Advantage. Falkowski [44] researching Russian exports between Russia and China and the EU later used the methodology of comparative advantage to show that Russia has a comparative advantage in oil exports. Chen [45] researching the dynamics of the BRICS countries in terms of global value chains used the method of comparative advantage proving that Russia has an advantage in energy exports. Obadi [46] in researching Yemen's export potential with the United States used the method of comparative advantage proving that Yemen has an advantage in oil among others. Khatibi [47] used the Balassa index to show Kazakhstan's export potential with the EU by showing that Kazakhstan has a comparative advantage in energy. Romero-Marquez and Moreno-Brid [48] analyzed the evolution and competitiveness of its oil and non-oil exports to both the United States and global based on the revealed comparative advantage. Both the price elasticity of supply and the price elasticity of demand for energy products are particularly important. Surveys such as [49-53] have dealt with the elasticity of demand. Surveys such as [54-58] have dealt with the elasticity of supply. Surveys such as [59-61] have dealt with the simultaneity of supply and demand. The importance of elasticity is central because an inelastic price has the potential to affect energy efficiency in both developing and developed countries [62]. Interesting is the observation made by [63] which separates the reasons why the elasticity of both supply and demand exists, and it is industrial production and business cycles. The choice of elasticity of demand and supply in the present study was made because it is an appropriate measure of efficiency and suitability both for the energy exports that a country may have and for the imports of energy. The relationship between GDP and energy has been mostly analyzed. Ito [64] has dealt with the role of energy in economic development. A key element in the relationship mentioned above is the link between energy consumption and economic growth [65]. Surveys such as [66-69] have dealt with the relationship between energy consumption and economic growth. Pao [70] and Vafaeirad et al. [71] mention the two-way relationship between energy consumption and economic growth. The relationship between energy consumption and GDP is particularly important because they essentially interact with each other. There are many factors that determine the development of energy intensity for a country. Examples are the industrial structure, the demand saturation, the technical progress, the demographics, and the economic structure [72]. The reason is that energy can determine the economic and social development of countries and the growth of GDP [73]. The choice of GDP was made because it is an appropriate quantitative criterion for energy production. As mentioned above, the sub-indicators selected in this research effort identify both dimensions (internal and external) of economic activity that a country has in the global economic system. A country may be a net exporter of energy or a net importer of energy. This does not mean that energy production is determined only by the exports or imports that the country may have at a given time. Energy production can also be determined by internal circumstances such as industrial production, energy prices, consumption, etc. In the next section, the normalization of the indicators is shown.

4. Normalization of the Indicators

The sub-indicators will be calculated in this section. The normalization method applied is the Min-Max method as mentioned above. This method of normalization was chosen because of the fact that it keeps a relationship among the original data [74]. The reported method normalizes the data by comparing and determining the optimal value as the largest and the worst value as the smallest. The composite index of the present study has defined firstly as the best price of the RCA as the highest price, secondly, as the best price of GDP Growth as the largest price, thirdly, the elasticity of supply as the highest price, fourthly the elasticity of demand as the highest price and as the best price with regard to the REER as the lowest price [75]. Table 1 in the Appendix shows the normalized values of the sub-indicators of the composite index. In the next section, the composite index will be aggregated and validated.

5. Aggregation and Validation of the Composite Index

In this section, the aggregation of normalized sub-indices will be done. As has been mentioned the method of aggregation is the method of average. As Petkovová et al. [76] reported, the mainly used or recommended methods for aggregation are arithmetic and geometric averages. Continuing they state that the main advantages of these methods are both simplicity and general awareness of their calculation. Table 1 shows the average of the selected countries for the years 2017, 2018, and 2019.

As we can see from the calculation of the average for the selected countries, the USA has the highest price, followed by

Russian Federation, Saudi Arabia, and finally Canada. For the composite indicator constructed in this study to prove the function, it would be appropriate to validate it. A correlation method such as (Pearson or Spearman) would not be effective because of the small range of data.

Table 1. The average of the normalized sub-indices for the selected countries.

Year	United States Index Value	Saudi Arabia Index Value	Russian Federation Index Value	Canada Index Value
2017	58.27	48.55	52.07	35.16
2018	67.46	38.45	60.04	36.99
2019	74.54	38.84	51.64	31.90

The correlation coefficient is influenced by the range of observations [77]. The validation of the index will be done by comparing the values of the index with the Total Energy Production for the selected countries. In order to make this comparison, the median of both the index values and the total energy production values will be calculated. Table 2 shows Total Energy Production for the countries selected. Table 3 shows the comparison of the Values of the Index with the Total Energy Production of the selected countries.

Table 2. The Total Energy Production of the selected countries

Year	Total Energy Production - United States	Total Energy Production - Saudi Arabia	Total Energy Production - Russian Federation	Total Energy Production - Canada
2017	83.42	27.08	59.84	21.63
2018	90.35	27.86	62.14	22.51
2019	96.71	26.80	64.06	22.42

Table 3. The comparison of the Values of the Index with the Total Energy Production of the selected countries

	United States – Index Value Median	Saudi Arabia – Index Value Median	Russian Federation – Index Value Median	Canada – Index Value Median
	67.46	38.84	52.07	35.16
Total Energy Production - Median 2017 - 2019	90.35	27.08	62.14	22.42

From the above comparison, it appears that the composite index can prove its functionality due to the fact that there is a link between the Composite Index and Total Energy Production for the countries selected. The next session concludes.

6. Conclusion

In the present study, research was done on those factors that drive energy production in the countries of the USA, Saudi Arabia, the Russian Federation, and Canada. From the results of the comparative study, we observe that the U.S. has the highest value, which means that U.S. energy production is the largest among the countries selected. Then, Russia has the second-highest value, followed by Saudi Arabia, and finally, there is Canada. The pillars on the basis of which the composite indicator is built have the appropriate interpretative ability to determine the characteristics of energy production. In particular, REER demonstrates whether the exchange rate helps the trade competitiveness of a country. As has been mentioned there are different exchange rate regimes between the selected countries. For example, the U.S. has the “exorbitant privilege”. Russia and Canada have fluctuating exchange rates. Saudi Arabia has “pegged” its currency with the dollar. Due to the fact that there is a differentiation in the implementation of appropriate policy and the absorption of shocks occurring in the global economic system, the REER measure is the most appropriate measure. Next, comparative advantage is a key measure of proof of a country's competitiveness. It is certain that the adequacy of energy resources helps the competitiveness of one country by creating a high comparative advantage over other countries. The sufficiency of energy resources alone does not mean that a country can be competitive in the energy sector. Technology can be an element that enhances energy efficiency and hence energy exports. Moreover, finding and exploiting energy sources can boost a country's energy exports and, as a result, energy production, to the existence of new and constantly formed energy resources, the comparative advantage has been chosen. Energy supply and demand are fluid and this is because of the international energy market. Although some countries have large market shares, not all countries in the world would want total energy dependence on one or a few trading partners. Energy is considered a branch with high inelasticity. However, the continuous admission of new players into the energy arena and the ever-increasing demand for energy inputs have made it necessary to shape the energy policy of the energy-producing countries. Both the elasticity of supply and demand are appropriate measures. Finally, energy production is directly related to GDP. Many factors determine energy demand such as income, industrial production, consumption. etc. Many industrialized countries try to secure energy resources so that they can stimulate their production. Many developing countries may require more energy because of the rise in their standard of living. Pillars chosen in this study try to cover both the export status of countries and the domestic economic aspect. Energy production is an issue that has many important effects on a country. Whether a country is a net exporter of energy or a net importer does not mean that energy production is fixed. That is, if a country is a net exporter, price fluctuations or the existence of new competitors may influence its decision on whether to produce energy. Moreover, if a country is a net importer of energy, business cycles or fluctuations in prices may influence decisions regarding energy production. In conclusion, the composite indicator constructed in this study sets an analytical framework for interpreting energy production. Energy production is particularly important because it basically determines a country's economy. If a country is an exporter of energy then energy production can identify - among other things - potential exports based on energy products. If a country is a net importer of energy, energy production can determine – among other things – consumption or industrial production. The functionality of the composite indicator is based on the fact that the interpretation of energy production can lead to a detailed picture of a country's economy.

Ethical issue

The author is aware of and complies with best practices in publication ethics, specifically with regard to authorship (avoidance of guest authorship), dual submission, manipulation of figures, competing interests, and compliance with policies on research ethics. The author adheres to publication requirements that the submitted work is original and has not been published elsewhere in any language.

Data availability statement

Data sharing is not applicable to this article as no datasets were generated or analyzed during the current study.

Conflict of interest

The author declares no potential conflict of interest.

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Appendix

Table 1. The normalized values of the sub-indicators for the selected countries

United States														
Year	***RCA of Oil***	***RCA of Gas***	***RCA of Other Fuel***	***RCA of Coal***	***Elasticity of Oil Supply***	***Elasticity of Gas Supply***	***Elasticity of Other Fuel Supply***	***Elasticity of Coal Supply***	***REER***	***GDP Growth (annual %)***	***Elasticity of Oil Demand***	***Elasticity of Gas Demand***	***Elasticity of Coal Demand***	***Elasticity of Other Fuel Demand***
2017	*54.67*	*100.00*	*100.00*	*100.00*	*41.87*	*46.00*	*43.89*	*100.00*	*0.00*	*81.22*	*29.60*	*88.63*	*0.00*	*29.85*
2018	*82.16*	*100.00*	*100.00*	*100.00*	*100.00*	*99.83*	*39.61*	*8.12*	*0.00*	*100.00*	*25.69*	*88.98*	*0.00*	*100.00*
2019	*83.27*	*100.00*	*100.00*	*100.00*	*100.00*	*0.00*	*93.33*	*100.00*	*0.00*	*100.00*	*42.55*	*100.00*	*100.00*	*24.38*
Saudi Arabia														
Year	***RCA of Oil***	***RCA of Gas***	***RCA of Other Fuel***	***RCA of Coal***	***Elasticity of Oil Supply***	***Elasticity of Gas Supply***	***Elasticity of Other Fuel Supply***	***Elasticity of Coal Supply***	***REER***	***GDP Growth (annual %)***	***Elasticity of Oil Demand***	***Elasticity of Gas Demand***	***Elasticity of Coal Demand***	***Elasticity of Other Fuel Demand***
2017	*100.00*	*0.49*	*2.72*	*0.00*	*100.00*	*100.00*	*0.00*	*74.24*	*2.19*	*0.00*	*100.00*	*0.00*	*100.00*	*100.00*
2018	*100.00*	*0.09*	*2.39*	*0.00*	*41.09*	*99.88*	*0.00*	*100.00*	*1.81*	*0.00*	*100.00*	*0.00*	*93.10*	*0.00*
2019	*100.00*	*0.00*	*2.62*	*0.00*	*12.71*	*100.00*	*89.72*	*72.42*	*13.00*	*0.00*	*0.00*	*48.65*	*4.56*	*100.00*
Russian Federation														
Year	***RCA of Oil***	***RCA of Gas***	***RCA of Other Fuel***	***RCA of Coal***	***Elasticity of Oil Supply***	***Elasticity of Gas Supply***	***Elasticity of Other Fuel Supply***	***Elasticity of Coal Supply***	***REER***	***GDP Growth (annual %)***	***Elasticity of Oil Demand***	***Elasticity of Gas Demand***	***Elasticity of Coal Demand***	***Elasticity of Other Fuel Demand***
2017	*54.18*	*50.84*	*0.00*	*92.61*	*15.77*	*3.72*	*100.00*	*40.87*	*82.96*	*67.72*	*45.40*	*91.72*	*83.18*	*0.00*
2018	*52.24*	*38.68*	*0.00*	*82.37*	*22.24*	*100.00*	*100.00*	*0.00*	*100.00*	*66.07*	*0.00*	*100.00*	*100.00*	*78.92*
2019	*50.38*	*40.80*	*0.00*	*97.32*	*12.57*	*95.63*	*100.00*	*0.00*	*93.22*	*92.90*	*16.62*	*98.34*	*3.74*	*21.43*
Canada														
Year	***RCA of Oil***	***RCA of Gas***	***RCA of Other Fuel***	***RCA of Coal***	***Elasticity of Oil Supply***	***Elasticity of Gas Supply***	***Elasticity of Other Fuel Supply***	***Elasticity of Coal Supply***	***REER***	***GDP Growth (annual %)***	***Elasticity of Oil Demand***	***Elasticity of Gas Demand***	***Elasticity of Coal Demand***	***Elasticity of Other Fuel Demand***
2017	*0.00*	*0.00*	*2.89*	*16.34*	*0.00*	*0.00*	*64.23*	*0.00*	*100.00*	*100.00*	*0.00*	*100.00*	*87.57*	*21.21*
2018	*0.00*	*0.00*	*5.56*	*17.21*	*0.00*	*0.00*	*36.65*	*10.53*	*96.10*	*60.71*	*45.68*	*84.08*	*86.45*	*74.84*
2019	*0.00*	*1.34*	*6.92*	*18.53*	*0.00*	*93.99*	*0.00*	*41.09*	*100.00*	*84.70*	*100.00*	*0.00*	*0.00*	*0.00*

Table 2. Real Broad Effective Exchange Rate - Index 2010=100, Average.

Year	***United States***	***Saudi Arabia***	***Russian Federation***	***Canada***
2017	114.91	114.21	88.37	82.92
2018	113.71	113.12	81.12	82.39
2019	117.05	112.45	84.07	81.67

Table 3. GDP growth (annual %) - United States Canada Russian Federation Saudi Arabia

Year	***United States***	***Saudi Arabia***	***Russian Federation***	***Canada***
2017	2.33	-0.74	1.82	3.04
2018	2.99	2.43	2.80	2.77
2019	2.16	0.33	2.03	1.88

Table 4. The values of exports for Oil

Year	*United States*			
	bn $			
	Exports of oil of US	*Exports of oil Total*	*Exports of Goods and Services US**	*Total Goods and Services Exports**
2017	95.20	1600.00	2384.00	23001.00
2018	144.00	2100.00	2534.00	25200.00
2019	142.00	2000.00	2520.00	24776.00
Year	*Saudi Arabia*			
	Exports of oil of Saudi Arabia	*Exports of oil Total*	*Exports of Goods and Services Saudi Arabia*	*Total Goods and Services Exports*
2017	150.00	1600.00	2399.00	23001.00
2018	208.00	2100.00	3149.00	25200.00
2019	185.00	2000.00	2858.00	24776.00
Year	*Russian Federation*			
	Exports of oil of Russian Federation	*Exports of oil Total*	*Exports of Goods and Services Russian Federation*	*Total Goods and Services Exports*
2017	163.00	1600.00	4107.00	23001.00
2018	211.00	2100.00	5103.00	25200.00
2019	192.00	2000.00	4815.00	24776.00
Year	*Canada*			
	Exports of oil of Canada	*Exports of oil Total*	*Exports of Goods and Services Canada*	*Total Goods and Services Exports*
2017	65.80	1600.00	5187.00	23001.00
2018	79.80	2100.00	5569.00	25200.00
2019	81.30	2000.00	5555.00	24776.00

Table 5. The values of exports for Gas

Year	United States			
	bn $			
	Exports of Gas of US	*Exports of Gas Total*	*Exports Goods and Services of US**	*Total Goods and Services Exports**
2017	21.50	336.00	2384.00	23001.00
2018	32.70	420.00	2534.00	25200.00
2019	32.60	401.00	2520.00	24776.00
Year	*Saudi Arabia*			
	Exports of Gas of Saudi Arabia	*Exports of Gas Total*	*Exports of Goods and Services Saudi Arabia*	*Total Goods and Services Exports*
2017	4.80	336.00	2399.00	23001.00
2018	5.80	420.00	3149.00	25200.00
2019	4.40	401.00	2858.00	24776.00
Year	*Russian Federation*			
	Exports of Gas of Russian Federation	*Exports of Gas Total*	*Exports of Goods and Services Russian Federation*	*Total Goods and Services Exports*
2017	22.80	336.00	4107.00	23001.00
2018	31.20	420.00	5103.00	25200.00
2019	29.80	401.00	4815.00	24776.00
Year	*Canada*			
	Exports of Gas of Canada	*Exports of Gas Total*	*Exports of Goods and Services Canada*	*Total Goods and Services Exports*
2017	10.20	336.00	5187.00	23001.00
2018	10.20	420.00	5569.00	25200.00
2019	9.40	401.00	5555.00	24776.00

Table 6. The values of exports for Coal

Year	*United States*			
	bn $			
	Exports of Coal of US	*Exports of Coal Total*	*Exports of Goods and Services US**	*Total Goods and Services Exports**
2017	13.40	180.00	2384.00	23001.00
2018	16.20	203.00	2534.00	25200.00
2019	13.70	182.00	2520.00	24776.00
Year	*Saudi Arabia*			
	Exports of Coal of Saudi Arabia	*Exports of Coal Total*	*Exports of Goods and Services Saudi Arabia*	*Total Goods and Services Exports*
2017	0.96	180.00	2399.00	23001.00
2018	0.80	203.00	3149.00	25200.00
2019	0.57	182.00	2858.00	24776.00
Year	*Russian Federation*			
	Exports of Coal of Russian Federation	*Exports of Coal Total*	*Exports of Goods and Services Russian Federation*	*Total Goods and Services Exports*
2017	21.50	180.00	4107.00	23001.00
2018	27.10	203.00	5103.00	25200.00
2019	25.50	182.00	4815.00	24776.00
Year	*Canada*			
	Exports of Coal of Canada	*Exports of Coal Total*	*Exports of Goods and Services Canada*	*Total Goods and Services Exports*
2017	6.50	180.00	5187.00	23001.00
2018	7.30	203.00	5569.00	25200.00
2019	6.50	182.00	5555.00	24776.00

Table 7. The values of exports for Other Fuel

Year	*United States*			
	bn $			
	Exports of Other Fuel Fossils of the US	*Exports of Other Fuel Fossils Total*	*Exports of Goods and Services US**	*Total Goods and Services Exports**
2017	5.40	26.00	2384.00	23001.00
2018	6.90	30.70	2534.00	25200.00
2019	5.80	28.40	2520.00	24776.00
Year	*Saudi Arabia*			
	Exports of Other Fuel Fossils of Saudi Arabia	*Exports of Other Fuel Fossils Total*	*Exports of Goods and Services Saudi Arabia*	*Total Goods and Services Exports*
2017	0.50	26.00	2399.00	23001.00
2018	0.53	30.70	3149.00	25200.00
2019	0.45	28.40	2858.00	24776.00
Year	*Russian Federation*			
	Exports of Other Fuel Fossils of Russian Federation	*Exports of Other Fuel Fossils Total*	*Exports of Goods and Services Russian Federation*	*Total Goods and Services Exports*
2017	0.62	26.00	4107.00	23001.00
2018	0.54	30.70	5103.00	25200.00
2019	0.48	28.40	4815.00	24776.00
Year	*Canada*			
	Exports of Other Fuel Fossils of Canada	*Exports of Other Fuel Fossils Total*	*Exports of Goods and Services Canada*	*Total Goods and Services Exports*
2017	1.10	26.00	5187.00	23001.00
2018	1.40	30.70	5569.00	25200.00
2019	1.40	28.40	5555.00	24776.00

Table 8. The Values and the Weights of the Countries – Supply

	Oil Supply		*Gas Supply*		*Coal Supply*		*Other Fuel Supply*	
United States								
	bn	mt	bn	mt	bn	mt	bn	mt
Year	Value	Weight	Value	Weight	Value	Weight	Value	Weight
2016	69.2	191	15.1	41.3	6.6	73.2	4	41.8
2017	95.2	229	21.5	60.1	13.4	121	5.4	41.6
2018	144	285	32.7	68.5	16.2	136	6.9	40.7
2019	142	189	32.6	82.5	13.7	114	5.8	39
Saudi Arabia								
	Value	Weight	Value	Weight	Value	Weight	Value	Weight
2016	203	664	6.5	17.2	0.95	1.3	0.44	6.8
2017	150	381	4.8	9.3	0.09	0.49	0.5	5.5
2018	208	389	5.8	10	0.08	0.29	0.53	5.1
2019	185	375	4.4	9.1	0.05	0.23	0.45	5.3
Russian Federation								
	Value	Weight	Value	Weight	Value	Weight	Value	Weight
2016	126	409	18.7	73.6	13	188	601	2.7
2017	163	411	22.8	78.7	21.5	220	622	2.9
2018	211	402	31.2	93.5	27.1	235	545	2.3
2019	192	392	29.8	104	25.5	249	482	2
Canada								
	Value	Weight	Value	Weight	Value	Weight	Value	Weight
2016	47.9	201	7.8	34.1	4.2	36.4	0.79	3.6
2017	65.8	182	10.2	36.7	6.5	37	1.1	4.6
2018	79.8	173	10.21	32	7.3	40.2	1.41	4.4
2019	81.3	161	10.4	30.1	6.5	40.8	1.4	4.8

Table 9. The Values and the Weights of the Countries – Demand.

	Oil Demand		Gas Demand		Coal Demand		Other Fuel Demand	
United States								
	bn	mt	bn	mt	bn	mt	bn	mt
Year	Value	Weight	Value	Weight	Value	Weight	Value	Weight
2016	144	547	8.8	37.4	1.9	13.5	1.4	4.8
2017	181	506	11.2	39.3	2	11.6	1.8	5.1
2018	217	468	10.4	32	2.2	9.9	2.5	5.5
2019	191	343	10.1	31.5	2.21	11.1	2.2	5.2
Saudi Arabia								
	Value	Weight	Value	Weight	Value	Weight	Value	Weight
2016	1.9	3.6	0.32	0.017	0.1	0.29	0.17	0.46
2017	3	6.2	0.3	0.108	0.13	0.37	0.15	0.35
2018	4	8.3	0.18	0.31	0.33	0.78	0.16	0.32
2019	3.5	8.2	0.5	0.002	0.29	0.74	0.17	0.39
Russian Federation								
	Value	Weight	Value	Weight	Value	Weight	Value	Weight
2016	1.1	1.5	0.05	0.15	0.37	22.5	0.1	0.5
2017	1.3	1.5	0.56	1.7	0.66	26.3	0.12	0.45
2018	1.4	1.4	0.86	9.9	0.64	25.5	0.23	0.42
2019	1.2	1.2	1.2	11.5	0.59	25.1	0.37	0.49
Canada								
	Value	Weight	Value	Weight	Value	Weight	Value	Weight
2016	21.5	65.5	1.9	1.8	0.75	6.6	0.58	2.6
2017	23	61.3	3	10.3	1	7.5	0.63	2.601
2018	29	60.7	2.7	7.9	1.4	9.3	0.79	2.5
2019	25.7	30.2	2.6	9.4	1.7	8	0.67	2.7