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Review article

ALTERNATIVE ENERGY AS A NEED FOR A NEW WORLD ORDER

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Abstract

The distribution of natural resources plays an important role in the formation and development of international economic activities. Energy sources are unevenly distributed on the globe. The most important energy potentials are geological resources (natural resources located in the Earth's crust). Today, energy represents the blood flow of the modern economy and it's the most important product in the international economy, where modern production and transportation cannot be imagined without it. After transformation from wood to coal and then to oil and gas, the future will transform the third major transformation from oil and gas to alternative energy. The unequal distribution of energy potentials on the globe created the dependence of the economies of many countries of the world from the spaces which possess energy potentials (oil and natural gas). This phenomenon of dependence of economies and of economies of powerful Europe came to the surface during the current conflict between Russia and Ukraine, where gas and Russian oil are the energy sources that have created dependency in all Western Europe's economies. Utilization of alternative energy potentials which are numerous, solar and wind energy would be the solution of the problem for the missing amount of energy for many countries of the world.

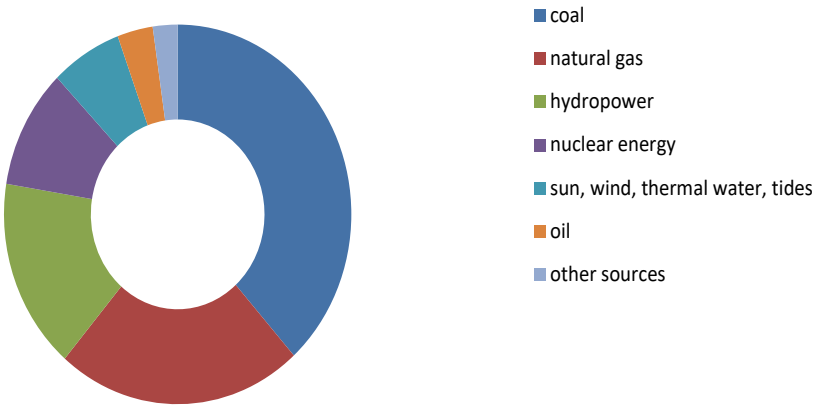
Keywords: energy, coal, oil, gas, solar energy etc.

1. Introduction

The most important modern energy sources are fossil fuels (oil, natural gas and coal). They are unevenly distributed on earth and possess energy for a given country, present a significant advantage in its economic development while its absence is a major weakness of any national economy. Today, most developed economies of the world which represent 15% of the total population, use about half of world energy production[1]. The difference is up to ten times greater than consumption in underdeveloped countries. With the increase of the world's population and economic development, the demand for energy also increases, but at the same time the pressure for clean environment raises, the main criteria are low carbon waste. Recent years ecological and environmental problems caused using coal, oil and other high carbon energy sources have become increasingly prominent. Intensive use of coal, oil and gas is the cause of many environmental global problems, such as: acid rain, greenhouse effect, climate change, etc. With increasing demand for green ecological environment, natural gas and new alternative energy (solar and wind) will become more demanding as primary energy. It is estimated that if fossil fuel consumption remains approximately at the current level, oil reserves will be depleted in the next 40 years of natural gas in 60 years and coal in about 300 years.

[1] Energy Resources and Potentials, chapter 7, 2021

Graph 1. Electricity generation according to fuels used for 2017



Source: World Nuclear Association 2019

Electricity production in 2017 was a total of 25721 TWh (tera watt / hour), of which 37.5% of this energy is produced from coal, 22.1% from natural gas, 16.6% from water, 10.2% from uranium (nuclear energy), 1.5% from the sun, 4% from wind, 2% bio energy, 0.4% tides and thermal waters, 3.3% from oil and 2.4% from other sources[2].

2. Coal

Coal is a sedimentary, organic combustible rock composed mainly of carbon, hydrogen and oxygen. It is a fossil fuel formed by vegetation that lies between rocky layers and altered by the combined effects of pressure and heat over millions of years. The degree of change that coal undergoes after it is baked from peat to anthracite known as coal determines its physical and chemical characteristics and is called the "grade" (quality) of coal. Low quality coal, such as lignite and coal under bituminous, is characterized by high moisture levels, low carbon content and consequently low energy content. The largest coal reserves are concentrated in the northern hemisphere between northern latitude 35º-50º, but according to experts the world reserves are thought to be 891,531 trillion tons. In the following tables we will reflect the coal reserves which mean deposits that increase the economic productivity threshold and the resources that mean deposits that are known but currently not economically recovered or exist as geological indicators.

Table 1. Coal reserves by regions, estimate for 2018 in%

Regions	I-first quality coal	II-second quality coal (lignite)
USA	32.1	13.4
Canada	0.6	1
W, C, E. Europe, Turkey	2.9	22.3
Former Soviet Union	18.1	37.4
Africa	4.2	0
Middle East	0.05	0
China	24	3.8

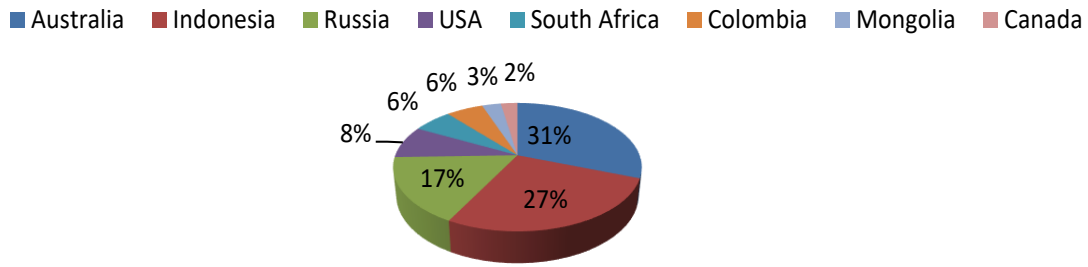
[2] BP Statistical Review of World Energy, 68th edition, 2019

East Asia, South Asia, Pacific	1	3.4
India	10.2	1.5
Japan	0.05	0
Oceania	5.4	15.4
Latin America	1.4	1.8
World	100	100

Source: Energy Resources and Potentials

The largest coal resources have: USA, China, Russia and India, who use them for their own needs, while Oceania mostly for export.

Graph 2. The largest coal exporters in the world for 2018



Source: Statistical Review of World Energy 2019

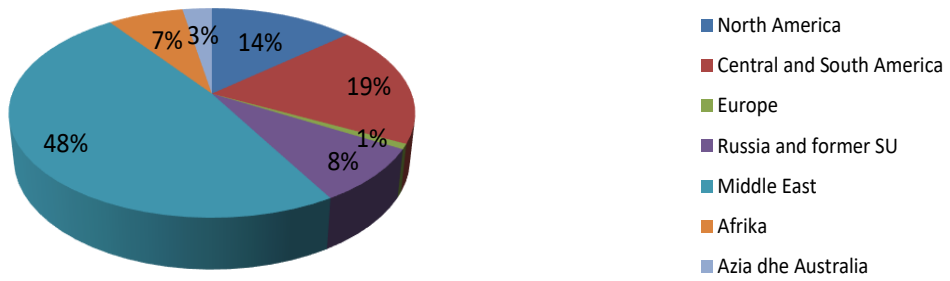
If we analyse the conditions, factors and consequences of coal mining, we can identify some characteristic factors that limit the use of coal, such as:

- Combustion of coal emits large amounts of harmful gases into the atmosphere.
- Exploitation is underground (expensive) and surface (destroys the environment)
- Not suitable for long distance transport.
- It is not suitable resource of energy for moving vehicles (trains, boats, cars).

3. Oil

In the twentieth century there was a great change in the use of energy, oil became the dominant energy source for the world economy and the result of this, twentieth century was called the "Oil Century" and oil was called "black gold".

Graph 3. Proven oil reserves according to 2018 studies



Source: BP Statistical Review of World Energy

Exploitation of oil reserves by the possessing states brings them large export revenues and energy independence. The respective states have their own policies regarding the exploitation of oil, based on the number of reserves and the needs they have for increasing revenues as states.

Table 2. Crude oil production in thousands of barrels per day for 2016, 2017 and 2018 for the most productive countries in the world

States	Years			Participation in world production in% during 2018
	2016	2017	2018	
USA	8831	9352	10962	13.18
Canada	3678	3977	4302	5.17
Venezuela	2242	1992	1425	1.71
Russia	11003	11017	11201	13.46
Saudi Arabia	10688	10175	10534	12.66
Norway	1648	1617	1515	1.82
United Arab Emirates	3384	3280	3301	3.96
Iran	4090	4471	4156	4.99
Iraq	4375	4469	4550	5.47
Kuwait	2860	2704	2737	3.29
China	3999	3846	3798	4.56
World	81351	81639	83161	100

Source: BP Statistical Review of World Energy

Russia is the first country in the world to exploit its oil reserves, although it is not the country with the largest oil reserves in the world. It participates in the production of crude oil (extraction) with 13.46% worldwide. Oil transport is realized through water transport by special ships (tankers), where Japan is the country with the largest fleet of tankers. Transportation of oil through pipelines is one of the most important and expensive transportation as an investment. The longest oil pipeline in the world is the one that connects the USA and Canada (Enbridge-Lakehead) with a length of 5363 km, the "Company" oil pipeline connecting Russia and Germany (Ukraine, Belarus, Poland respectively Hungary, Slovakia, Czech Republic) with a length of 4000 km, Transcaucasia oil pipeline with a length of 1760 km, oil pipeline built under the sea with a length of 1200 km that connects the North Sea with the Sea of Norway, etc.

4. Natural gas

Exploitation and consumption at high rates of oil, posed a risk to existing reserves which led to large-scale production and use of natural gas. Natural gas is a fossil fuel that pollutes the environment very little compared to oil and coal. Natural gas is associated with sources of oil, coal and in swampy areas where methane is created as a result of anaerobic decomposition of organic matter. Its main combustible component is methane and other constituents such as butane, ethane and propane. Typical non-combustible components of natural gas are nitrogen, carbon dioxide and hydrogen sulphate. Natural gas sources are in porous underground rock formations composed mainly of sandstone.

Table 3. Estimates of natural gas reserves in% according to different organizations and institutions

Regions	OPEC (2008)	BP (2009)	Cedigaz (2010)	BP (2018)
Europe	3.4	3	2.3	2
Former Soviet Union	31.7	30.1	31.4	31.9
Africa	8	8.1	7.8	7.3
Middle East	40	41.2	40.7	38.4
Asia	8.3	8.3	8.7	9.2
North America	4.4	5.2	4.6	7
South America	4.2	4.1	4.5	4.2
World	100	100	100	100

Source: Energy Resources and Potentials, Statistical Review of World Energy

The largest reserves of natural gas have the Middle East and the Commonwealth of Independent States of the former USSR. Of course, estimates vary as a result of exploitation for the period, development of technique and technology, methods used by the institutions.

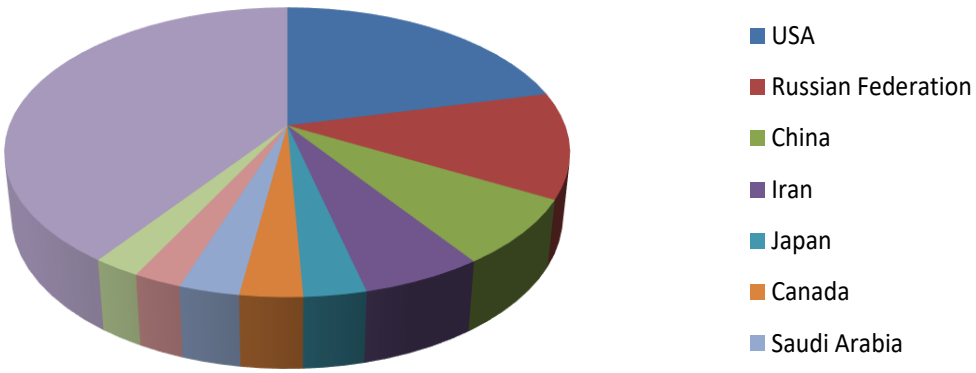
Table 4. Largest natural gas producers by regions for 2018

Regions	BKM (billion cubic meters)	%
North and Central America	1230.6	31.8
Europe	250.7	6.5
B. e Sh.P. të ish BS	831.1	21.5
Africa	236.6	6.1
Middle East	687.3	17.8
Asia and Oceania	631.7	16.3
World	3867.9	100

Source: Statistical Review of World Energy 2019

The largest productive regions for 2018 are North and Central America, the Commonwealth of Independent States of the former USSR, the Middle East. The largest producers of natural gas are Russia, Iran, Qatar, Saudi Arabia, USA, United Arab Emirates, etc. Researchers have concluded that about 22% of gas reserves are related to oil reserves which mean that their exploitation is related to oil exploitation.

Graph 4. The largest consumers of natural gas for 2018



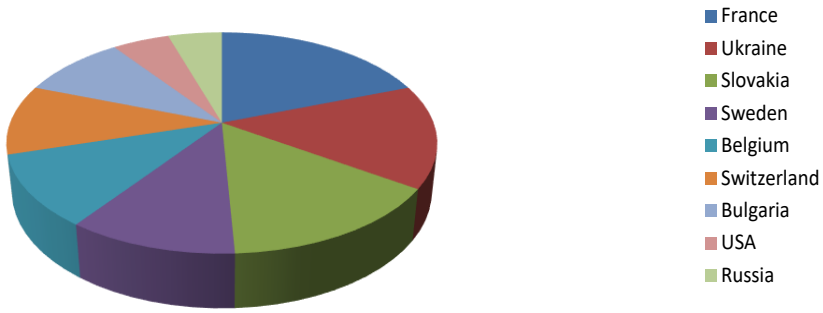
Source: Statistical Review of World Energy 2019

The industry is the largest consumer of natural gas with about 4/5 of total production, while the largest consuming countries are the USA with about 21.2% of world consumption, the Russian Federation 11.8% (2/3 of electricity is produced in power plants that work with natural gas), China 7.4%, Iran 5.9% while from Europe the largest consumer is Germany with 2.3% of total world consumption and Great Britain with about 2% of total world consumption. The largest exporter of natural gas is Russia. Exports are made through pipelines and tankers, but the gas must be converted to a liquid state. The main pipeline is from Russia to Western Europe called the "South Stream", but ongoing problems with Ukraine have led Russia to bypass Ukraine and build the "North Stream" pipeline. The ongoing war between Russia and Ukraine has highlighted the dependence of Western European countries, in particular Germany and Great Britain, on gas imported from Russia. This is exactly what requires alternatives to energy sources. An investment to avoid this dependence is gas pipeline Iran-Turkmenistan-Turkey-Balkan Peninsula-Adriatic Sea to Western Europe.

5. Nuclear energy

Nuclear energy is a clean, safe, reliable and competitive source of energy. It is the source of energy that can replace a significant portion of fossil fuels (coal, oil and gas) that massively pollute the atmosphere and contribute to the greenhouse effect. Nuclear energy is obtained by special processes called nuclear fusion or the process of splitting large atoms into small atoms, a process that releases large amounts of energy, uranium and thorium ores. Nuclear energy is clean because it does not produce carbon dioxide, sulphur dioxide, nitrous oxide or other pollution, which means zero impact on greenhouse effect and global warming. One gram of uranium gives more energy than a ton of coal or other fossil fuel and the waste is a million times smaller than fossil fuels. The biggest problem is the radioactive waste, i.e., the space where it will be stored because half-destruction of waste requires a period of hundreds of thousands of years. Another problem is the misuse or enrichment of conventional weapons with this element that leads to mass destruction of the plant, animal and human world. The cost of electricity generated by nuclear power plants is cheap and competitive with other energy sources but requires large investment in plant construction and highly skilled manpower. Uranium is found concentrated in rocks, soils and waters, bound to other elements such as Uranus, lignite, monazite and phosphates. Researchers have estimated that the uranium available in the earth's crust is about 100 tons (Tt), of which 25 Tt are located at depths up to 1.6 km of the earth's crust and the amount of uranium dissolved in seawater is estimated at 4.5 giga tons (Gt). Countries with uranium resources are Australia, Canada, Nigeria, Kazakhstan and Namibia, with smaller resources are countries of Western Europe, North and South America. The electricity produced in nuclear reactors has a steady increase as a result of the characteristics mentioned above and the constant demand for electricity as a result of the increase in the world's population.

Graph 5. States producing electricity from uranium to nuclear power plants for 2018



Source: World Nuclear Association, 2019

The largest producers of electricity from nuclear reactors are France with 72% of total electricity or 63.1 GWE with 58 reactors, Ukraine with 56% or 13.1 GWE with 15 reactors, Slovakia with 55% or 1.8 GWE with 4 reactors, Sweden 40 % or 7.6 GWE with 7 reactors, USA with 19% or 97.9 GWE with 96 reactors, Japan 30% or 31.7 GWE with 33 reactors, Russia with 18% or 29.2 GWE with 38 reactors. The amount of electricity generated by nuclear reactors will depend on energy market developments from fossil fuels, hydropower, technological developments, and the exploitation of uranium resources.

6. Hydropower

Hydropower is a renewable, inexhaustible potential that depends on the distribution of hydropower resources and accounts for about 90% of renewable energy and about 16.6% (year 2017) of electricity in the world. Currently, about 160 countries in the world use hydropower plants to produce energy with a capacity of more than 1270 GW (year 2018). Leading countries with about 52% of installation capacity are China, Brazil, Canada, USA and Russia. Today, in 65 countries about 50% of national energy production comes from this source, in 25 countries about 90% (99.3% Canada) and 12 countries in the world are 100% dependent on hydropower. Regarding the structure of utilization of water resources, the potential of rivers is used, and the energy of tides and waves is in the experimental phase, i.e., very small. Developed countries already have almost 50% utilization of their river flows for energy production, where Switzerland has an efficiency of 99%, Japan 90%, Norway about 93% and USA about 90%, while developing countries lag far behind have a utilization of about 20%. Viewed by country, China has the largest installed capacity of hydropower plants (large hydropower projects such as the largest hydropower plant in the world, the "Three Gorges", on the Yangtze River), followed by Canada, USA, Brazil, Russia and India (energy projects over the last 10-15 years have included it in most of the world). Environmental problems related to the development and further use of rivers are mainly conditioned by ecological causes and social responsibility due to the degradation of existing ecosystems by the construction of large water reservoirs.

7. Alternative energy

7.1. Solar energy: Solar energy is the largest, inexhaustible and comprehensive source on the earth's surface. To look at the magnitude of solar energy according to the International Energy Agency, the average radiation that strikes the Earth's surface in one hour is approximately equal to the energy consumed by all human activities in a year. The idea of using solar energy has existed since the 70s of the XX century, but through solar cells for family use. Solar energy conversion technologies could provide electricity generation as well as a range of energy services, including heating, cooling and natural light. The amount of solar radiation on the earth's surface is of varying amount depending on the season and latitude. Sunlight travels through the atmosphere to the earth's surface but decreases due to reflection, scattering and absorption by particles into the atmosphere where the reflection coefficient is estimated to be between 30-35%. On a cloudless day the direct radiation is calculated between 80-90% of the total radiation, while on a foggy and cloudy day the direct radiation is 0% and the ambient light consists of indirect or diffused light. Solar electromagnetic radiation in the Earth's atmosphere or solar constant is about 1366 W / m². The average radiation that reaches the surface is 697 W / m², which when multiplied by the earth's surface results in a possible theoretical estimate of about 104762 TW / year (3300000 EJ / year) and together with the radiation coming to the surface of the oceans total radiation is over 349206 TW / year (11000000 EJ / year). These estimates do not consider weather conditions. Monikue Hoogwijk in a 2004 study assessed the theoretical potential with average radiation data obtained from the Office of Climate Research which records empirical data on radiation for the last 30 years. This study estimates that the theoretical potential of solar energy input is lower by about 20000 TV / year (630000 EJ / year). The use of solar energy does not carry risks, as it does with nuclear energy, it is not a problem with transport like coal and the production of electricity from this source has no pollution. The most suitable areas with solar radiation per unit area are arid and semi-arid areas between latitude 15 ° and 40 ° and at high latitudes where air density and diffusion absorption are lower. Other important factors in the function of solar radiation per unit area that directly affect are soil structure, soil cover, land water area ratio, slope, sand displacements, protected area areas, forest areas, development of agriculture as an activity, areas of urban areas, etc.

Table 5. Built-in photovoltaic storage capacities in MW

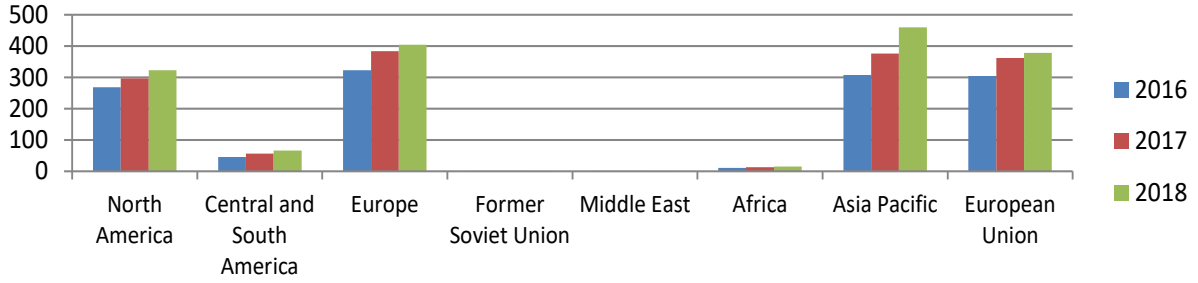
Year	2014	2015	2016	2017	2018
North America	18504	26132	37908	46578	57118
Central and South America	810	1823	2696	4903	7206
Europe	91985	100700	107899	117059	128758
Former Soviet Union	9	67	103	267	600
Middle East	905	1153	1636	2183	3181
Africa	1725	2260	3398	4284	6093
Asia	64377	94526	144609	216990	248873
Total	178315	226661	298248	392263	487829

Source: BP Statistical Review of World Energy 2019

7. 2. Wind energy: The total kinetic energy of the Earth's winds is large and the usable technical and economic potentials of the wind energy depend on the development of technology. The use of wind energy is very early, i.e., windmills which have their origins in the ninth century in Iran and in the twelfth century in NW Europe. It is impossible to estimate a renewable resource potential

without including clear assumptions in the technology's technical-economic performance profile. The technical potential defines the upper limit of wind energy that can be used effectively by technologies. Theoretical potential describes the total kinetic energy within the troposphere. This is estimated at 11.8–13.9 J / m², which corresponds to 604–711 EJ for a given time. What limits the extraction of wind energy in total is the natural speed at which kinetic energy is distributed in the atmosphere through friction. This is a difficult number to calculate directly, but it can be deduced from the global land energy budget in theoretical analysis. Estimates vary according to researchers over the years, from 3600 TW / year (Lorenz, 1967) to 370 TW / year (Hubbert, 1971), while a more recent estimate (Sorensen, 2004) suggests a natural distribution of 2000–5100 TW / year. The largest producers of wind energy are Germany, Spain, USA and India, but important is the fact that the EU target is for 20% of the total energy to be from wind energy.

Graph 6. Wind power generation in TW / h



Source: BP statistical review

8. Conclusion

Energy is a major source of economics because production and consumption activities include energy as a basic input. Energy is one of the most important inputs for economic development. From a physical point of view, the use of energy promotes economic productivity and industrial growth and is essential for the functioning of any modern economy. Barney & Franz (2002) argue that energy is responsible for industrial development in a modern economy, while representing less than one tenth of the cost of production and directly affects GDP growth. Fossil fuels account for 65% of total human energy use. Continued use of fossil fuels has led to a steady increase in the concentration of CO2 in the atmosphere. Because of that, the developed countries of Western Europe closed the coal and nuclear power plants due to the risk they have and replaced them with natural gas power plants. Natural gas and oil as energy began to be imported from Russia through the pipelines they built. The introduction of natural gas as a major commodity in the economies of Western European countries (Germany, Italy, Great Britain, etc.) created a great dependence of this region on Russia. The current war between Russia and Ukraine has brought to the surface this issue which requires other sources of energy. This current war seeks to create a new world order where Russia seeks world-class primacy based on the idea of energy power which means to bring the economies of countries that use its energy to their knees. To slow down climate change, develop sustainable energy sources, and avoid dependence on energy sources that do not have it (oil and gas), the world community must support the major energy transition from fossil fuels to renewable and alternative energy. The goal of the energy transition is for renewable energy to be around 50% by 2050 and 100% by 2100. One of the goals of this energy transition proclaimed by the US government is energy independence.

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