

ENERGY CONSUMPTION AS AN INDICATOR OF ECONOMIC GROWTH

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ABSTRACT

Energy - is manifested in the provision of various needs of people. We can add daily individual needs such as food, heating, communications, transportation, education, and social conditions. Social needs cover such broad areas as safety, clean water delivery, outdoor lighting, waste management, education, and health care. In other words, energy is a requirement at every stage, from the production of all the needs we have mentioned to their distribution.

Since energy is a limited and depleted factor of production, it is indispensable for social development. Today, its careful and efficient use is essential and the subject of various studies. In particular, much attention is paid to environmentally friendly renewable energy sources. On the other hand, the growing energy demand, which is one of the essential factors affecting countries' economic growth, remains relevant. Economic growth - reflects an increase in the level of national income and per capita income. Since ensuring economic growth is one of the main goals of countries, each country wants to ensure its own energy independence or sustainable energy reserves. In providing economic growth, not only the amount of energy used is of great importance, but also the efficient use of energy to increase production. It should be carefully emphasized that an increase in energy consumption not only leads to economic growth but, as a result of economic growth, more energy is consumed. In other words, in each case, more energy consumption is needed to achieve the economic growth that countries aim for, and the energy infrastructures and resources required for economic growth must be ready. It is necessary to expand research on alternative energy sources and close the gaps in countries' energy needs through their consumption.

Keywords: alternative energy sources, energy needs, energy consumption, economic growth, efficient use of energy

INTRODUCTION

Energy consumption is one of the basic requirements for improving the living standards of all people. It affects social development in many ways. For example, due to lighting made by electrical energy, people could work longer. The electrical energy used has allowed people to use various household appliances and increase efficiency in their work. Electricity consumption has allowed less use of other heating sources. Namely, traditional fuels such as wood and coal, which pollute the environment and air, have begun to be used less. In our daily life, energy can be used directly or more complexly by converting it to other mechanisms. Generating electrical energy from renewable sources such as wind, solar, and hydroelectric will allow environmental protection [25]. At the same time, people's knowledge has increased thanks to computers, television, and internet applications. In a word, energy is an indispensable consumption product used in heating and cooling buildings, storing food, entertainment, people's working life and practicing their profession, and other areas of life [28]. That is, energy has an indispensable place in human life, and there is an important relationship between electricity consumption and economic development.

Energy sources

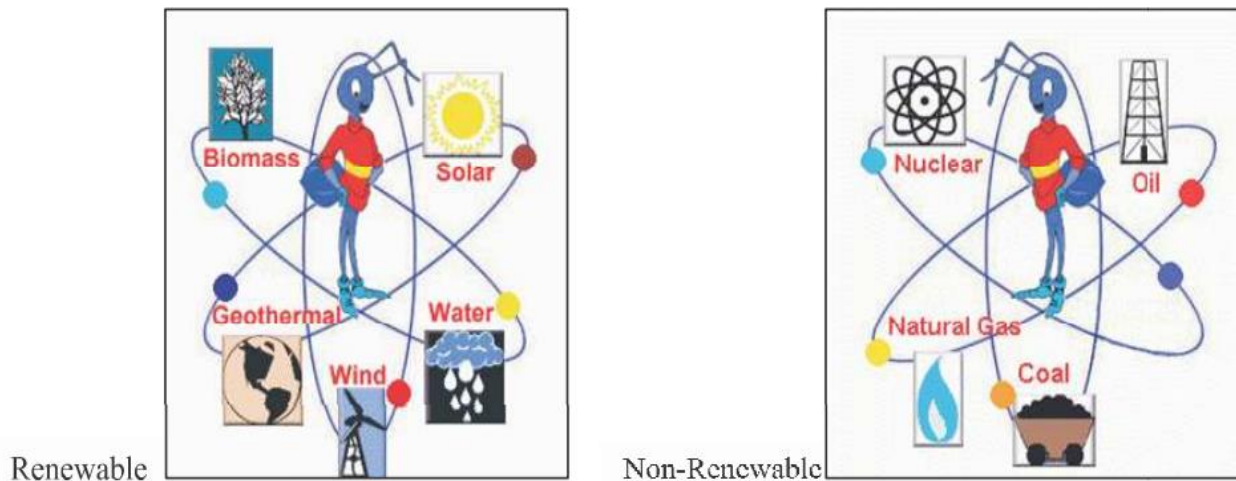
Energy sources have three main characteristic features, such as:

- scarcity,
- unequal distribution around the World,
- energy conversion causing environmental pollution.

According to their production, energy sources are divided into primary and secondary. Primary Energy Sources are fossil energies of animal and plant origin [8-9]. They differ significantly in terms of ease of transportation, export potential, environmental impacts, end-use flexibility and substitution potential, and other aspects [10]. These resources are also called exhaustible energies. Here we can include energy products such as coal, oil, and natural gas. We can consist of solar, geothermal, wind, sea-wave, and biomass (wood, manure, etc.) energies in Secondary Energy Sources. These resources are also called renewable energies [24]

Figure 1.

Renewable and non-renewable energy



Source: Lecture Notes on Renewable Energy Sources Subject Code: BEE1703, p.6

Energy consumption

The country's energy consumption rate varies according to the area and sector in which it is used. Although the volume of these sectors varies according to the countries, they can be classified as follows:

- household sector,
- transport sector,
- agriculture sector,
- industry sector and others.

A large amount of energy consumption in these country sectors indicates high activity. For example, the high amount of energy used in agricultural production may mean that production is increased in that country's agricultural industry [5-9]. On the other hand, the energy consumption indicator of a country can be seen as an indicator of the standard of living or welfare in that country. The pace of economic development and standard of living are two factors that determine energy demand [26]. As a result, the growth in total energy demand reflects the changing nature of production and consumption in an economy. In particular, if countries are out of the industrialization phase of development, then the income elasticity of energy demand decreases [18].

Economic growth and energy

Energy is one of the basic building blocks of economic development, and the relationship between economic growth and energy consumption has been analyzed for many years. With globalization's changing and developing conditions, the economic reflections of energy consumption have started attracting all countries' attention.

While energy is not the only factor driving economic growth, it is a crucial input [27]. If the consumed energy is wholly based on the country's domestic resources, the energy-producing sector creates added value like any other industrial sector. Suppose this sector produces more efficiently compared

to other industries. In that case, it develops faster than the general development rate of the economy over time and affects the economy positively [2-4].

The literature has two different views on the relationship between energy and growth. According to the pro-energy approach, the impact of energy on economic growth is clear, and energy is the main input factor, such as labor and capital. In other words, energy is one of the main factors affecting economic growth. However, according to the Neoclassical approach, the effect of energy consumption on growth is negligible. It argued that the effect level of energy on economic growth would be low since energy costs occupy a shallow place in the Gross Domestic Product.

Namely, the conclusion that Cheng [1-3] reached in his research based on the data of India for the years 1952-1995 is as follows. In the study where energy consumption, economic growth, capital, and labor variables were used, it was found that the changes were cointegrated. It concluded that causality is from economic growth to energy consumption in the long and short run and from capital to economic growth in the short run.

Yuan, Zhao, Yu, and Hu [23] found a one-way causality relationship between electricity consumption and economic growth. They reported that a shortage in electricity supply would harm output growth. The authors highlighted that a sufficient electricity supply is necessary for a steady output increase. That is, the steady increase in electricity supply must be maintained to support output growth in China. Karagöl et al. [16] found that the relationship between electricity consumption and economic growth is positive in the short run. They stated that this effect is harmful in the long run. Electricity consumption is not only a primary input in the development of the industry but also a fundamental factor that increases people's quality of life. Therefore, it plays an essential role in economic development. Increasing electricity consumption per capita reduces electricity and energy costs in the long run.

Saatçi and Dumrul [19] conducted research in Turkey between 1960 and 2008. According to the research results, it has concluded that electricity consumption is adequate for growth. In the long run, a 1% increase in electricity consumption increased economic growth by 0.33% - 0.37%.

Thus, labor, capital, and energy, defined as essential inputs in the production process, are in a particular competition within the economy. The information has competitive power to the extent of the economic benefit it provides compared to its price. The economy will demand and consume more energy if there is high competition in the energy sector. Since the efficient energy input is consumed more, the rate of development of the economy will increase. In other words, economic growth will be higher as more energy is used due to increased efficiency. Because of this process, a significant relationship exists between energy consumption and economic development. But in this case, another question comes to mind. Does every situation with a decrease in energy consumption adversely affect economic growth? Doesn't efficient use of energy lead to a reduction in energy consumption? Of course, efficient energy use leads to a decrease in energy consumption. In this case, economic development occurs at a higher level [15, 22].

Development of Countries and Primary Energy Consumption in 2021

The COVID-19 pandemic declared a global emergency, has had different effects worldwide. Not only has it cost people's lives, but it has also threatened their livelihoods and businesses. The energy industry, in particular, has faced tremendous pressure from the pandemic. This situation showed that countries should take serious steps to develop sustainable resources and renewable energy infrastructure. The slowdown in production activities in countries naturally caused a significant decrease in global energy demand. According to the data from the International Energy Agency (IEA), global energy demand in the first quarter of 2020 decreased by 3.8% compared to the same period in 2019. A decline in global energy demand resulting from the response to the pandemic had repeatedly outstripped the impact of the 2008 financial crisis, reversing the rising trend in energy demand over the past five years.

After the COVID-19 pandemic in 2021, the energy system in the global economy has strongly recovered. It is possible to see this situation in statistical data.

According to the data of "Renewable Energy Market Update Outlook for 2022 and 2023," annual renewable capacity additions broke a new record in 2021, increasing 6% to almost 295 GW, despite the continuation of pandemic-driven supply chain challenges, construction delays, and record-level commodity prices for raw materials. In 2022 and 2023, solar PV and wind energy costs are expected to remain higher than before the pandemic due to higher commodity and shipping prices. However, their competitiveness is strengthened by much sharper increases in natural gas and coal prices [14]. Renewable capacity is expected to grow by more than 8% to approximately 320 GW in 2022. However, the new policy is being implemented slowly. In that case, growth will remain stable in 2023 as the expansion of solar PV will not fully offset the decline in hydropower and the steady annual increase in wind power.

On the other hand, globally, growth forecasts for 2022 and 2023 were revised by 8% from December last year, despite intense political support and downward projection in the People's Republic of China, the European Union, and Latin America.

In Table 1, the energy consumption and GDP ratio of some countries in 2021 is given.

Table 1.

GDP and primary energy consumption, 2021

Countries	GDP, Billion US dollars	Primary energy consumption, Exajoules
US	22,996.075	92.97
China	17,744.640	157.65
Japan	4,932.556	17.74
Germany	4,262.767	12.64
United Kingdom	3,187.626	7.18
India	3,176.296	35.43
France	2,957.425	9.41
Italy	2,101.275	6.36
Canada	1,988.336	13.94
Russian Federation	1,778.530	31.30
Saudi Arabia	833.541	10.82
Turkiye	817.508	6.83
Austria	477.084	1.48
Finland	271.610	1.16
Greece	188.684	1.05
Azerbaijan	54.622	0.66

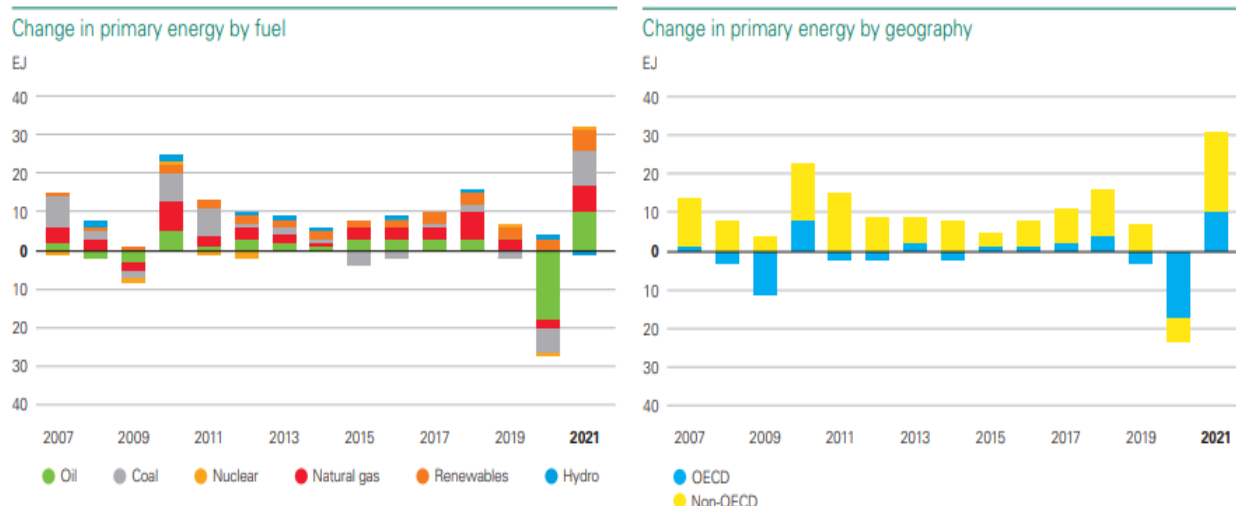
Source: <https://stats.oecd.org/index.aspx?DataSetCode=EO>, April 2009, BP Statistical Review of World Energy 2022, p.8

Table 1 shows that countries' GDP and energy consumption do not change at an increasing rate. For example, while the GDP in the US is 22,996.075 billion US dollars and the energy consumption is 92.97 EJ, the GDP in China is lower, i.e., 17,744,640 billion US dollars, but the energy consumption is higher, i.e., 157.65 EJ.

Primary energy experienced the most significant increase in history, with 31 EJ in 2021. The increase in direct power in 2021 compared to 2020 was driven by China's 10 EJ expansion and emerging economies' 13 EJ growth. Since 2019, primary energy consumption in emerging economies has increased by 15 EJ, mainly reflecting growth in China (13 EJ).

Figure 2.

Primary energy in 2021 grew by its largest amount in history, with emerging economies accounting for most of the increase

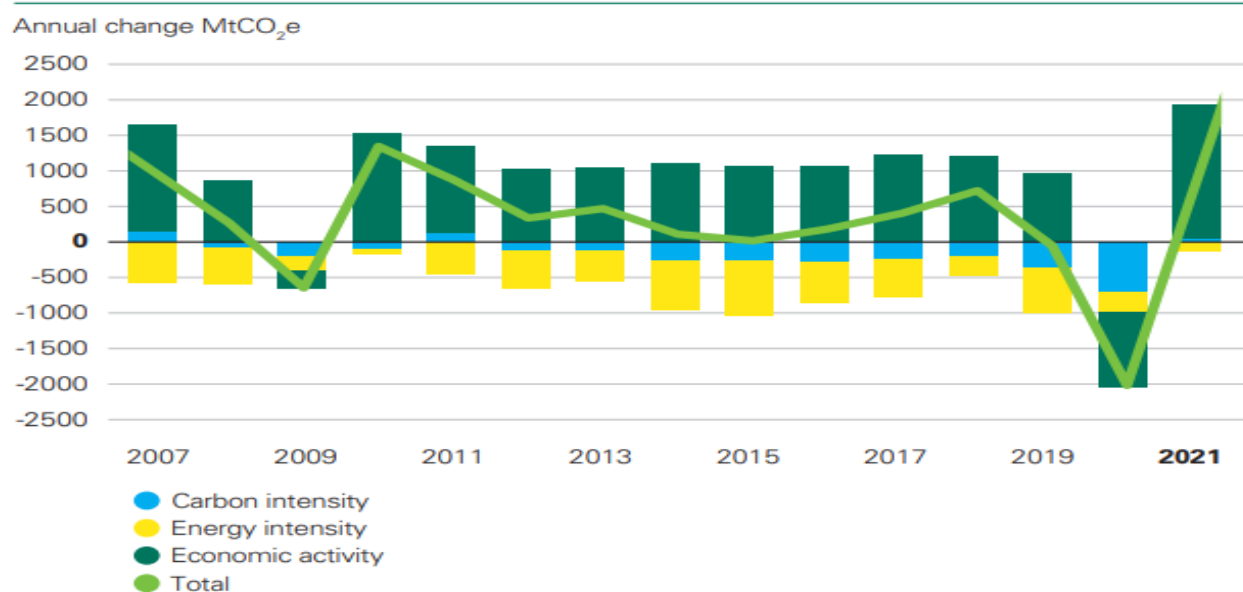


Source: *BP Statistical Review of World Energy 2022*, p.4, <https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2022-full-report.pdf>

Figure 2 shows that energy demand in advanced economies in 2021 was 8 EJ below 2019 levels. The increase in primary energy between 2019 and 2021 was entirely driven by renewable energy sources. Primary energy use in 2021 was 1.3% above 2019 levels. The volume of emissions from energy rose again in 2021. The sharp increase in emissions in 2021 is explained by economic growth (Figure 3).

Figure 3.

The increase in carbon emissions in 2021 was driven by the rebound in economic growth



Source: *BP Statistical Review of World Energy 2022*, p.5, <https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2022-full-report.pdf>

Energy consumption rose sharply as economic activity recovered from quarantines and other COVID-19-related measures. Carbon density and energy density remained essentially unchanged in 2021.

In general, investment in appropriate technologies should increase not to harm the environment through energy consumption. Capital expenditures on low-emission technologies in the energy sector are growing, and this situation stands at the center of clean electricity for sustainable energy in the future [10, 22].

CONCLUSION

One feature distinguishing electrical energy from other energy sources is that it cannot be stored, and that is, it must be consumed as soon as it is produced. However, due to advances in electricity technology, its ability to use heat, light, and power generation, which was not found in other energy sources, has increased the importance of electricity over time. Using a large part of the consumed electrical energy as a production input is essential for developing countries.

Although the relationship between energy consumption and growth has been studied in the literature extensively, there are debates about the direction of causality between these two variables. That is, there has yet to be a consensus on whether economic growth will lead to energy consumption or whether energy consumption is the engine of economic growth.

The level of total output evaluates the size of the country's economy. As the economy's incremental output increases, energy needs also increase accordingly. Energy is an essential input for all sectors, especially the industrial sector. The growth in the level of development of the economy fuels energy consumption in every industry. The fact that energy is an indispensable input in industrial production is a serious obstacle, especially for developing countries that need more energy resources.

Because energy consumption, which has an indispensable place in today's conditions, is becoming more critical daily. It is through the use of energy that countries can produce more goods and services and raise their living standards. The fact that there is always a need for energy based on development, determining costs, and realizing growth makes energy important.

From the Industrial Revolution to the present, having sufficient energy and using the available power most effectively and efficiently to obtain optimum output has become the main problem of economies. At this point, for countries that do not have sufficient energy resources, access to energy and economic output have become elements that follow each other in a vicious circle. Namely, countries that do not have enough energy resources need energy at an increasing rate to increase their industrial production, and they meet this energy need through imports. Therefore, countries should first turn to renewable energy sources together with energy sources and expand their consumption.

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