

# CHANGING APPROACHES TO RENEWABLE ENERGY AND ENERGY INTENSITY

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## ABSTRACT

The use of renewable energy is of great importance for sustainable development. The energy sector is one of the leading causes of greenhouse gas emissions in the atmosphere, which causes global warming. Greenhouse gases emitted during the use and extraction of fossil fuels to generate energy account for more than 25% of all greenhouse gases surrounding the world. Although renewable energy sources have become more popular in recent years, most of the world's energy needs are still met by fossil fuels. For this reason, countries need to increase their use of renewable energy and reduce their energy intensity. In the article, these issues were discussed and data were analyzed on the basis of countries.

**Keywords:** renewable energy, energy intensity energy consumption

## INTRODUCTION

The electrical energy sector is a sector that provides a large amount of input to other sectors of the economy. Accordingly, the energy sector is both affected by the development in other sectors and stimulates the development of other sectors. At the same time, the fact that the electrical energy supply required for economic growth is insufficient to meet the demand affects economic growth negatively. Despite the important advantages of electrical energy, it also has some disadvantages. The most important of these is that this resource is an energy resource that must be consumed as soon as it is produced, since the storage possibilities are very limited and very expensive [2, 4, 11]. As we know, the distribution of production factors on the basis of countries is not fair. While some countries have more resources such as capital, technology and knowledge, some countries have more resources such as fertile agricultural lands, mines and fossil fuel reserves [13-19]. In this case, the economies tend to use which factor of production they have more in the production process. However, economies need intense energy input in order to produce and maintain this production. Three conditions are necessary for take-off to lead to sustainable growth [15]:

- 1) An increase in the rate of productive investment, for example, a rise in national income above 5%.
- 2) Development of key manufacturing sectors with high growth rate.
- 3) The existence of a political, social and institutional structure that can use the development trends in the modern sector and the potential benefits of departure and sustain the development.

Today, energy is one of the most important production inputs. For this reason, ensuring energy efficiency is of great importance for today's countries.

### **Energy consumption and energy intensity**

Different factors affect the level of energy consumption. One of these factors is energy prices. The energy price has a serious impact on the energy consumption rate [20]. Apart from the energy price, the geographical features of the country, population density, distribution of the population between rural and urban areas, climatic conditions, GDP level and many other factors affect energy

consumption [6, 11]. In order to ensure energy consumption, the nature of the energy strategy of the countries today consists of the following approaches:

- To increase efficiency and savings in energy use,
- Ensuring energy security,
- Diversifying energy production with new technologies,
- To ensure a sustainable energy supply by increasing alternative energy sources, taking into account human and environmental health,
- Participating in the process of transferring energy resources to foreign markets.

A country's per capita energy consumption and energy intensity indicator can be seen as an indicator of the standard of living or well-being in that country. In other words, per capita energy consumption and energy density are two important energy indicators [3, 5-12].

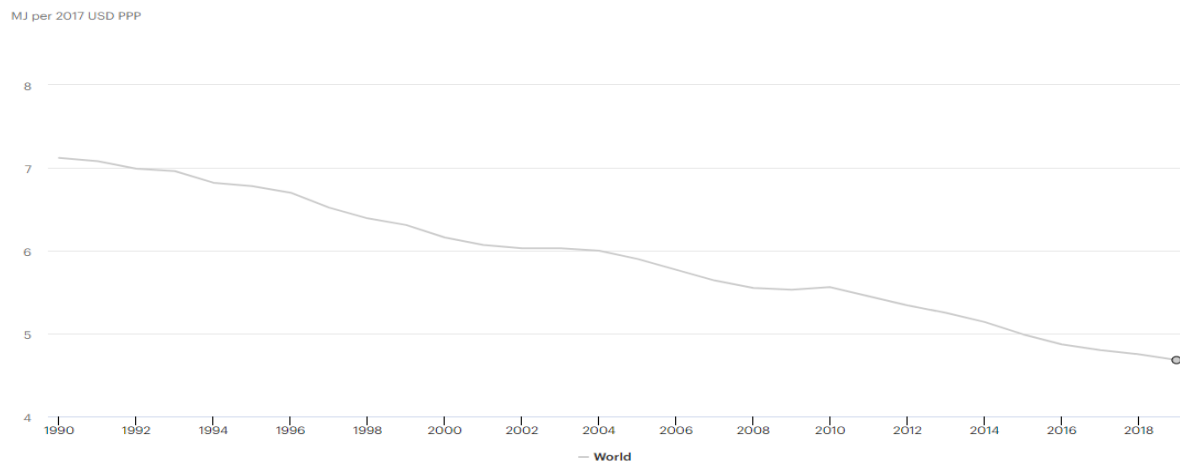
Energy intensity is defined as the amount of energy used to produce a given level of output or activity [21]. Using less energy to produce a product or provide a service result in lower energy intensity.

Countries with the lowest energy density are considered to be the most successful in energy efficiency. Energy intensity trend - affected by structural changes in the economy and industry, changes in energy consumption patterns, and efficiencies in the equipment and sectors used by end users [22]. In general, although it is considered as a reliable indicator, it is necessary to be careful when performing energy intensity analyzes in underdeveloped and developing countries where the rate of informal economy is high.

The pace of improvement in global primary energy intensity has slowed in recent years. Global energy intensity improvements accelerated earlier this decade, but the 1.5% improvement in the global economy's energy intensity in 2019 falls well short of the initial Sustainable Development Goal of 7.3 per year of 2.6%. The recent slowdown has been the result of weak energy efficiency policies in many major economies, as well as strong demand growth in more energy-intensive economies. Namely, current and planned policies modeled in the stated Policies Scenario are projected to improve average energy intensity by 2.2% per year until 2030 [8].

**Figure 1.**

### Energy intensity measured in terms of primary energy and GDP



**Source:** <https://www.iea.org/reports/sdg7-data-and-projections/energy-intensity>

As we know, the global primary energy intensity improvement rate is the indicator used to monitor progress in global energy efficiency. The main target is to achieve an annual reduction of 2.6% by 2030. However, the world has lagged behind this target, especially in recent years. Early projections for 2020 indicate a significant drop in improvement in intensity as a result of the Covid-19 crisis, while the outlook for 2021 shows a return to the average rate of recovery over the previous decade. However, that would be well below the 3.2% pace needed to meet SDG targets this decade, and the more than 4% pace needed to reach net zero emissions by 2050.

Figure 1 shows that energy intensity was 7,1 MJ in 1900, while in 2000 it was 60.2, 5.6 in 2010 and 4.7 in 2019. As we mentioned above, the most basic indicator in ensuring the efficient use of energy is the reduction of energy density. These data show that countries have generally been successful in ensuring efficient use of energy since 1990 [8].

Table 1 shows the values taken by some countries regarding energy consumption and energy intensity.

**Table 1.**

**Primary energy consumption per capita, Renewables consumption, Energy intensity**

Countries	Primary energy consumption per capita		Renewables consumption		Energy intensity	
	2011	2021	2011	2021	2011	2019
Canada	408.5	364.4	0.28	0.58	7.1	6.9
US	297.1	279.9	3.25	7.48	5.4	4.5
France	164.5	144.0	0.30	0.74	3.9	3.3
Germany	166.4	152.0	1.24	2.28	3.3	2.8
Italy	121.1	107.2	0.44	0.76	2.8	2.4
Türkiye	65.8	80.2	0.06	0.61	2.9	2.6
United Kingdom	133.9	106.9	0.36	1.24	3.0	2.3
Azerbaijan	57.2	64.6	-	less than 0.005	4.2	4.6
Russian Federation	202.4	214.5	0.01	0.06	8.4	8.1
Saudi Arabia	323.6	301.3	less than 0.005	0.01	5.8	5.6
China	81.9	109.1	1.16	11.32	0.4	0.5
India	19.1	25.4	0.49	1.79	5.3	4.3

Source: BP Statistical Review of World Energy 2022, p.11, 43, <https://www.iea.org/reports/sdg7-data-and-projections/energy-intensity>

Table 1 indagates that primary energy consumption per capita increased in some countries in 2021 compared to 2011, such as Turkey, Azerbaijan, Russia, China and India. As highlighted before, one way to reduce energy-related pressures on the environment is to use less energy as a result. This is possible by reducing energy consumption for energy-related activities, or by using energy more efficiently (using less energy per unit of demand), or by combining both. On the other hand, it is observed that indicators such as the rate of renewables consumption increased in 2021 in the

given countries. Since renewable energy sources are generally environmentally friendly, that is, they have much lower net CO<sub>2</sub> emission values per unit of energy produced, the increase in this rate shows that a trend is followed in line with the demands of the day. However, consumption rate of renewables is very low in Azerbaijan, Russia and some other countries.

In terms of energy intensity, China, the United Kingdom, Italy and many other countries have a good indicator. This shows that they are successful in ensuring efficient use of energy in those countries.

In general, it can be said that shifting the weight from traditional energy types to high-quality energy types such as electricity in the formation of energy policies due to the increasing use of electrical energy gains importance in terms of accelerating economic growth. Conservation policies (energy saving, energy taxes, energy price policies, etc.) to be implemented in the field of energy should serve economic growth.

Net zero is one of the most important targets for countries today. In the net zero target, it is aimed to equalize the amount of gases such as carbon dioxide, methane and nitrous oxide, which are released into the atmosphere due to human-induced activities and cause the greenhouse effect, with the amount of greenhouse gases naturally absorbed by the earth. In other words, net zero means not adding new emissions to the atmosphere. That is, the emission will continue, but this will be offset by absorbing an equivalent amount of gas from the atmosphere.

To achieve a net zero economy in the EU by 2050, all mitigation strategies need to be implemented to the maximum extent possible, but they alone will not be enough. In the agricultural sector, for example, there will always be some emissions (i.e. non-CO<sub>2</sub> emissions from livestock and fertilizer use), and the above strategies do not take into account many emissions in the industrial sector and parts of the transport sector (heavy-duty vehicles, aviation, waterborne transport) [17].

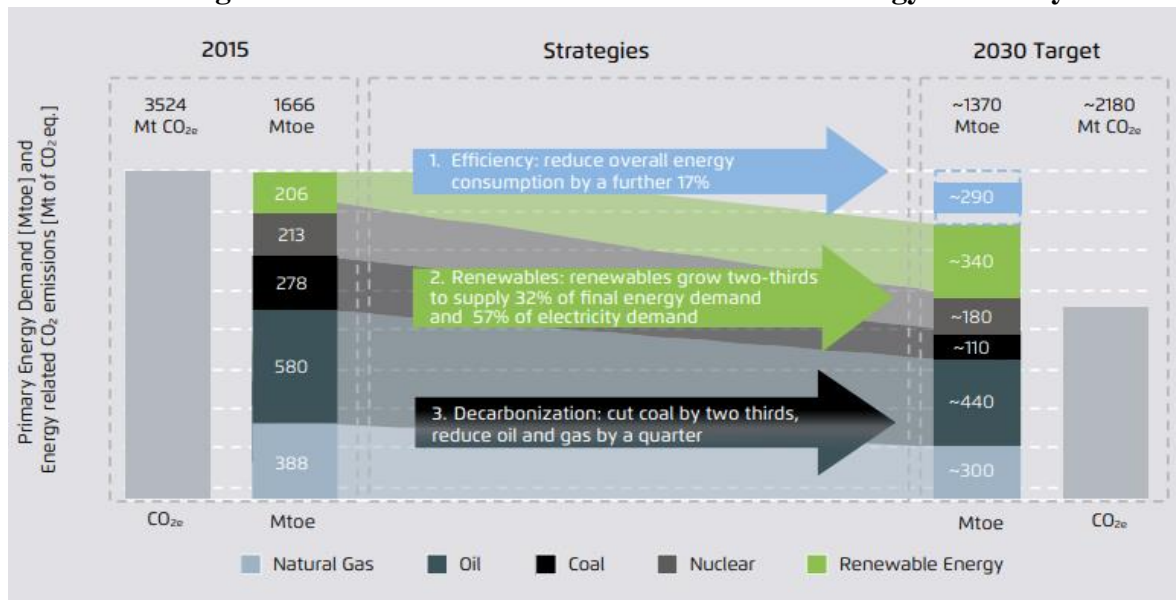
Reducing these emissions will require additional measures, including significant research and innovation, and most importantly, the introduction of new technologies. Only through such implementation can the necessary technologies and related infrastructure become commercially viable. In addition, to achieve net zero greenhouse gas emissions, residual emissions need to be balanced by the introduction of more removal (requiring afforestation and improved soil management) and negative emissions technologies (such as bioenergy combined with carbon capture and storage) to natural sinks. CCS is also required in some industries to reduce carbon emissions and in particular to reduce process emissions (such as cement production).

Reducing these emissions will require additional measures, including a significant research and innovation drive and, most importantly, the deployment of new technologies. Only through such deployment can the necessary technology and related infrastructure become commercially viable. Furthermore, in order to achieve net zero GHG emissions, the remaining emissions will need to be offset by greater absorption into natural sinks (requiring afforestation and improved soil management) and the deployment of negative emissions technologies (such as bioenergy combined with carbon capture and storage). CCS is also necessary for carbon reduction in certain industries, and particularly for cutting process emissions (in cement production, for example) [1].

In order to achieve the determined targets, it is of great importance to reduce energy costs. For this reason, strategies have been identified for the low-cost transformation of the energy sector in Europe by 2030.

**Figure 2.**

## Strategies for a cost-efficient transformation of the energy sectors by 2030



Source: Agora Energiewende (2019): *European Energy Transition 2030: The Big Picture. Ten Priorities for the next European Commission to meet the EU's 2030 targets and accelerate towards 2050*, p.29

As seen in Figure 2, the identified strategies have been determined as

- Efficiency: reduce overall energy consumption by a further 17%,
- Renewables: renewables grow two-thirds to supply 32% of final energy demand and 57% of electricity demand,
- Decarbonization: cut coal by two thirds, reduce oil and gas by a quarter.

## CONCLUSIONS

The right energy and economic growth policies to be followed by countries are important in terms of effective use of energy resources all over the world, reducing environmental pollution and achieving sustainable high economic growth. The efficient use of scarce resources in the world and the realization of economic growth by minimizing environmental pollution will benefit all humanity and future generations. Therefore, countries can take different actions. Mandatory policies, such as codes and standards, including minimum energy performance standards, fuel-economy standards, building energy codes and industry targets, continue to form the basis of energy efficiency policy. However, these measures are being complemented by fiscal and financial incentives, such as tax relief on building renovations and electric vehicle purchases, public financing and the use of market-based instruments. Technological change and advances in energy management in the industrial and buildings sectors are also delivering efficiency improvements.

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