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SUSTAINABLE CONSUMPTION AND ENERGY EFFICIENCY

Katarzyna WITCZYŃSKA

Wroclaw University, Institute of Economic Sciences; katarzyna.witczynska@uwr.edu.wroc.pl,
ORCID: 0000-0002-8021-3967

Purpose: The paper presents the issues related to the sustainable consumption and energy efficiency.
Design/methodology/approach: The study used world-bank reports from the University of Oxford publication Our World in Data and own research.
Findings: The main purpose of the article is to increase consumer awareness and demand for energy needs. It is worth emphasizing the important role played by sustainable energy expenditure in this area. They are an important element of sustainable consumption, because the way society uses energy has a significant impact on the environment, health and energy resources. Sustainable energy expenditure is a way of using energy that allows you to achieve a balance between the demand for energy and its consumption. Selected measures of energy efficiency show that economic development does not have to be equated with an increase in the consumption of energy resources.
Originality/value: The publication presents the results of research conducted on the basis the University of Oxford publication Our World in Data.

Keywords: sustainable consumption, energy efficiency, solar energy.

Category of the paper: Research paper.

1. Introduction

The Sustainable consumption is consumption that takes into account the impact on the environment and society. This means that consumers make purchasing choices that are more environmentally and socially friendly. In accordance with the idea of sustainable consumption, the priority is to meet the needs and increase the quality of life for everyone on a local and global scale, while respecting human and labor rights, taking into account the possibility of meeting the needs of future generations and preserving and restoring natural (natural) capital for them (Kurzak, 2016). Sustainable consumption aims to reduce the negative impact on the natural environment and society by reducing the amount of waste, energy and water consumption and choosing products that are consistent with social values. The effects of human

impact on the environment from consumption can be of two types: direct and indirect. Direct pressures include: emissions to air from the combustion of fuels in private cars or the burning of coal, gas and oil for heating purposes (heating the house, heating water, cooking) in households. Indirect pressure, on the other hand, is related to the consumption of goods and services whose production has an impact on the environment. This pressure is the most difficult to estimate due to the fact that the production of each good is associated with various impacts on people and the environment in the production phase (Jaros, 2014). In July 2008, the European Commission proposed a package of actions and proposals on sustainable consumption and sustainable industrial policy (COM(2008)0397).

2. Consumption and energy expenditure

The main objective of such activities was to increase consumer awareness and demand for sustainable goods and production technologies, promote innovation in EU industry and regulate international issues. It is worth emphasizing the important role played by sustainable energy expenditure in this area. They are an important element of sustainable consumption because the way society consumes energy has a significant impact on the environment, health and energy resources. Sustainable energy expenditure is a way of using energy that allows you to achieve a balance between the demand for energy and its consumption. This means that consumers make purchasing choices and use energy in a more environmentally friendly way, which also affects the "quality of life and social well-being", as the authors point out (Barwińska, Małajowicz, Knapkova, Szczotka, 2023). Energy expenditure is closely related to energy efficiency. It is difficult to give a universal definition of energy efficiency. After analyzing the existing literature on the subject, it can be assumed that it is the ratio of the obtained results, services, goods or energy to the energy input. Efficient use of energy aims to reduce the amount of energy needed to deliver products and services (Doms, Dunne, 1995). Definitions such as "resource efficiency, energy consumption reduction, energy services per unit, use of energy resources" are available. Energy efficiency therefore focuses on minimizing energy losses and waste through the optimal use of available resources and minimizing losses in the processes of energy transformation and supply. According to the directive of the European Parliament from 2012, energy efficiency is "one of the most important elements to ensure the sustainable use of energy resources". In other words, it is a series of activities aimed at reducing energy consumption in the economy.

3. Energetic efficiency

There are several energy efficiency measures that are used to assess and compare the energy performance of systems, equipment, buildings or sectors, as shown in table 1. It is worth noting that energy efficiency measures may vary depending on the sector, context and purpose of the assessment. It is also important to consider all aspects of energy consumption, such as fossil fuel consumption, electricity consumption and greenhouse gas emissions, in order to obtain a comprehensive energy efficiency assessment. The selected measures of energy efficiency show that economic development does not have to be equated with an increase in the consumption of energy resources (Gulczyński, 2009).

A certain dissonance between economic growth and energy consumption is permanent due to both the energy-saving direction of technology development and pro-innovation policy, as the authors note (Malko, 2012). From October 1, 2016, the Act of May 20, 2016 on energy efficiency (Journal of Laws of 2021, item 2166) has been in force, which introduces changes to the regulations that are beneficial both for the development of the economy and for every citizen. The purpose of the regulation is that anyone who meets certain requirements (energy efficiency audit for a specific investment) will receive a benefit in the form of property rights resulting from energy efficiency certificates (commonly referred to as white certificates). White certificates are issued by the President of the Energy Regulatory Office. The most popular investments for which white certificates are awarded include: thermal modernization, insulation, replacement of industrial equipment, replacement of lighting and energy recovery from industrial processes.

Table 1.
Energy efficiency measures

Indicator Characteristics	**Indicator Characteristics**
Energy Efficiency Ratio (EER) or Coefficient of Performance (COP)	These metrics are applied to HVAC (heating, ventilation, air conditioning) systems and help measure the ratio of energy delivered (e.g. cooling or heating) to energy consumed. The higher the EER or COP, the more energy efficient the system (lower operating costs).
Energy Consumption Index, ECI	They are used to measure energy consumption for a specific area, sector or device. They can be expressed as a ratio of energy used to other measures such as building area, industrial production or units of time.
Building Energy Efficiency Index (BEEI)	It is used to assess the energy efficiency of buildings. It measures the ratio of a building's total energy use to another parameter, such as floor space or energy intensity.
Energy Utilization Index (EUI)	It is used to compare the energy consumption of different buildings or sectors. It expresses the total energy consumption in relation to a unit of measurement, such as a square meter of building area or a unit of production.
Index of energy efficiency of industrial processes	Energy efficiency measures may include indicators such as the Energy Intensity of Production, which measures the ratio of energy used to a unit of GDP.

Source: own elaboration (https://www.ure.gov.pl/pl/efektywnosc-kogenerac/efektywnosc-energetyczn, https://www.iea.org/data-and-statistics/data-product/energy-efficiency-indicators).

In 2018, under the "Horizon 2030" directive, the goal was to reduce energy consumption by 32.5 percent. by 2030. In absolute terms, energy consumption is expected to be a maximum of 1,128 million tonnes of oil equivalent for primary energy and 846 million tonnes for final energy, measured on the basis of 2007 forecasts. It was also assumed that the average annual energy consumption would decrease by 4.4%. on Member States by requiring them to develop a 10-year national plan on how to meet the energy efficiency target. In order to maintain energy efficiency, the assumptions of the European Green Deal are implemented. According to its provisions, the European Union should achieve climate neutrality by 2050. Initially, by 2030, greenhouse gas emissions are to be reduced by at least 55%. compared to the data from 1990. The share of energy generated from RES is to be 40%. all energy producers, and emissions from delivery vehicles are to be reduced by 50%. This goal primarily means increasing the production of energy from renewable energy sources, which include: solar energy, wind energy, hydro energy, geothermal energy, biomass energy, including solid energy (e.g. wood, plants), liquid energy (biofuel), gas energy (biogas) (Barwińska, Małajowicz, Knapkova, Szczotka, 2023). The list of individual energy producers is presented in table 2. It shows that solar power plants operate with the highest efficiency for 24.9 percent of the time. time during the year, and wind farms by 35.4 percent. Geothermal power plants operate around the clock, which is a significant advantage over other unconventional sources such as solar, wind or water power plants. However, the ranking is won by obtaining energy from nuclear sources, as much as 92.5%.

Table 2.
Energy efficiency of individual energy sources

A type of energy	**%**
Nuclear energy	**92,5%**
Geothermal energy	74,3%
Gas	56,6%
Water energy	41,5%
Coal	40,2%
Wind	35.4%
Solar energy	24,9%

Source: own elaboration: (https://www.energy.gov/ne/articles/nuclear-power-most-reliable-energy-source-and-its-not-even-close)

However, the review of the literature shows that the importance of renewable energy, in particular energy obtained from photovoltaic sources and wind energy, is increasing. The development of the photovoltaic market in the EU-27 countries is very dynamic and its share in the energy market is increasing year by year (the increase compared to 2019 reached 18.8 GW). The chart below shows the annual production of electricity from the sun in the world, measured in terawatt hours. In 2022, it was approximately 1200 TWh. Thanks to its practical technology, solar energy is popular and more and more households decide to cover their roofs with photovoltaic panels, becoming prosumers. The prosumer concept aims to decentralize electricity production, allowing individuals and small businesses to participate in energy production and reducing dependence on traditional suppliers.

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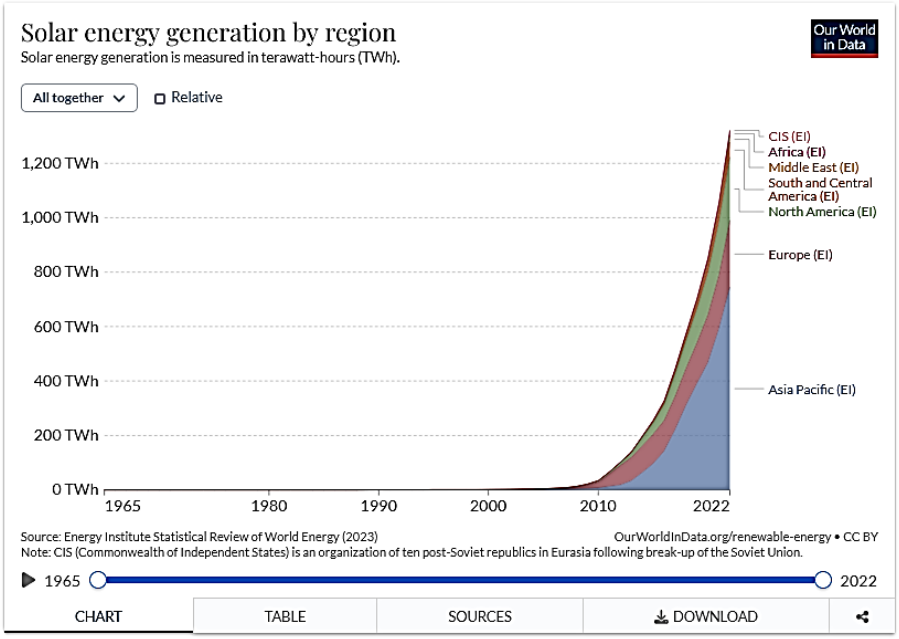

Figure 1. Solar energy production in the world.

According to the latest data provided by the Central Statistical Office (GUS), households in Poland had a significant share in the national energy consumption, not counting the consumption of engine fuels. In 2021, this indicator was 20.2 percent. Households consumed on average 24.6 GJ of energy per capita. For comparison, the European average was 24.5 GJ/capita. As much as 65.1 percent. of energy used by households was used for space heating. It is worth noting, however, that its share decreased by 3.7 percentage points. compared to 2012. Heat from the network (52.2%) and solid fuels (32.8%) were most often used for space heating - mostly hard coal and firewood. In addition to heating rooms, they were also used to heat water (22.5%) and cook meals (1.7%). Natural gas was used in 56.5 percent. households, but 30.8 percent recipients used it only for cooking meals, and only 14.6 percent. for residential heating only. In dwellings equipped with their own central heating boilers, the most common were double-function boilers (26.3%), which were also used to prepare hot water. Single-function boilers were less popular (15.1%), and fireplaces were even less common

(2.4%). Solar collectors were used by 1 in 38 households, and heat pumps by only 1 in 132 households. Electricity was used mainly for lighting and powering household appliances and electronics. The use of electricity for heating purposes was small (5.5%), e.g. due to high prices and the existence of cheaper substitutes. The heating network was most often used to obtain hot water (41.1% of households). Boilers or electric thermal baths also had a significant share (19.5%). Increasing energy efficiency in a household can contribute to reducing energy consumption, lowering energy bills and limiting the negative impact on the environment. Actions that households can take on their own to increase energy efficiency include: the use of thermal insulation, the use of energy-saving lighting, temperature control, the use of devices with a high energy efficiency class (e.g. marked A++ or A+++), which consume less energy, turning off unused devices, optimal use of natural light, economical use of water, reducing electricity consumption and others. Poland is not widely recognized as a country with high energy efficiency. There are some challenges that Poland has to face in the context of energy efficiency. For example, in Poland there are still many older buildings that have low energy efficiency and need modernisation. The district heating sector is also a challenge as many plants still use coal as their main fuel, which has a negative impact on the environment. Poland is still one of the largest emitters of greenhouse gases in the European Union. However, in recent years, Poland has been making efforts to improve energy efficiency and reduce emissions. Programs and initiatives are being implemented, such as co-financing programs for thermal modernization of buildings, support for renewable energy sources and energy efficiency programs in industry. Poland has also committed itself to meeting the European Union's climate and energy goals, which requires greater emphasis on energy efficiency.

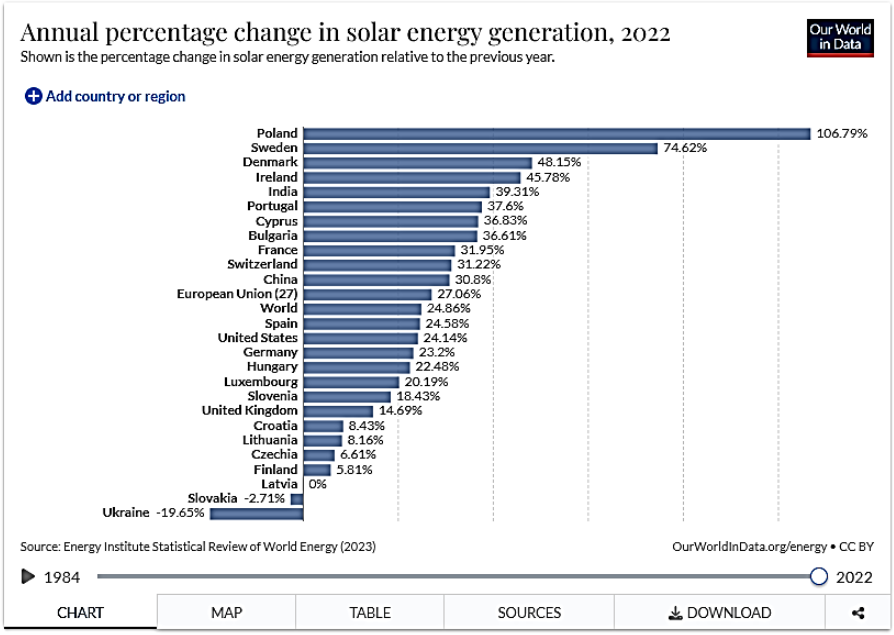

Figure 2. Annual percentage change in solar energy generation, 2022.

The chart above shows that in 2022 Poland recorded the largest jump in the use of solar energy. This is positive news, and at the same time a surprise that most photovoltaic analysts did not expect. The driving force for photovoltaics in Poland turned out to be the micro-installation segment, which enjoyed a favorable system of accounting for energy produced and collected from the grid. In the context of energy efficiency, energy security is also an important issue, which aims to ensure the energy stability of the country in uncertain times or in the event of unforeseen situations that have a negative impact on the flow of energy and a sudden increase in its price. The country should have enough energy to meet current and future energy needs. Easily available and cheap energy for society has an impact on the development of the economy, which needs to constantly produce more and more goods. Interruptions in energy supply pose a threat to human health, expose entrepreneurs and individuals to financial losses, and may contribute to destabilization. Energy security can be achieved e.g. thanks to the diversification of energy sources. In March 2022, after the start of Russia's invasion of Ukraine, for fear of Russia using fossil fuels as a weapon, for example by interrupting their supplies, changes were proposed under the "REPowerEU" program in the field of energy security and energy storage rules. An obligation was imposed to fill gas storage facilities to at least 80 percent until November 1 of the same year, and in subsequent years the limit was increased to 90 percent. On May 18, 2022, under the same program, the European Commission proposed a number of changes in energy efficiency, taking into account the Russian invasion of Ukraine. One of the most important of these is the European Union's independence from Russian fossil fuel supplies by diversifying supplies and saving energy and accelerating the clean energy transition.

4. Summary

With the growing emphasis on energy security and diversification of supplies, but also addressing climate change, it is crucial to develop a strategy for the transition from non-renewable energy sources to renewable ones. It is important that those in power increase subsidies for alternative energy sources, in particular photovoltaics, and introduce programs aimed at increasing public awareness of energy saving. Governments can use financial incentives for people using renewable energy sources, such as tax credits, to encourage them to use these sources.

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