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EVOLUTIONARY PERSPECTIVES ON ENERGY CONSUMPTION OF RAW MATERIALS TO ENSURE ENERGY PRODUCTION IN THE EU-28

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ABSTRACT

A clear analysis of the electricity production and consumption sector in the EU 28 offers firstly the possibility of knowing the final energy consumption for each segment (industry, households, trade, services and transports). The final energy consumption for the industrial sector decreased during the2001-2012 period, from 330872/1000 tons of oil equivalent to 282316/1000 tons of oil equivalent, while, if the transport sector is considered, an increase can be observed in consumption over the same period, from 348636/1000 tons of oil equivalent to 351080/1000 tons of oil equivalent. Although greenhouse gas emissions from energy used decreased during the analyzed period from 98.8 tons CO_2e to 91.4 tons CO_2e, a special attention must be paid to the energy production from unconventional sources. As regards the primary production of energy from renewable sources between 2001 and 2012, an increase was observed in solar power, from 16.4/1000 tons of oil equivalent to 5781/1000 tons of oil equivalent, and in wind energy, from 2296/1000 tons of oil equivalent to 17692/1000 tons of oil equivalent.

KEYWORDS: conventional energy, greenhouse gas, non-conventional energy

1. Introduction

To ensure a sustainable future in a constantly developing Europe it is particularly important to keep a balance between energy consumption and emissions of greenhouse gases. In 2010, the European Commission established five "themes" for 2020 ("Europe 2020, a European strategy for smart, sustainable and inclusive growth"): employment, research and innovation, climate change and energy, education and combating poverty. These targets require a number of steps and directions to obtain the established results.

2. The final energy consumption in different sectors

The "20/20/20" objectives regarding the climate/energy assumed by the EU first require a different approach to energy consumers regardless of their nature [1].

The final energy consumption in industry between 2001 and 2012 in the 28 member states of the EU decreased from 330872/1000 tons of oil equivalent (toe) to 282316/1000 toe. The lowest amount is 269814/1000 tons of oil equivalent in 2009, when the economic crisis strongly influenced all activities in the field. After this year, a slow, gradual rise can be observed. The average EU-28 final energy consumption in industry over the analyzed period was 313558/1000 toe, the three countries with the highest consumption being: Germany – 59222/1000 toe, Italy – 36018/1000 toe, and France – 34537/1000 toe [2].

Among the countries with the lowest power consumption are: Estonia – 650/1000 toe, Cyprus – 315/1000 toe, and Malta – 48/1000 toe [3]. In the 2001-2012 period, the average amount of energy consumed by Romania is 8858/1000 toe and it is observed from the annual progress analysis that the smallest amount consumed is that of 2009, only 6518/1000 toe, almost by 50% less than in the 2002-2005 period.

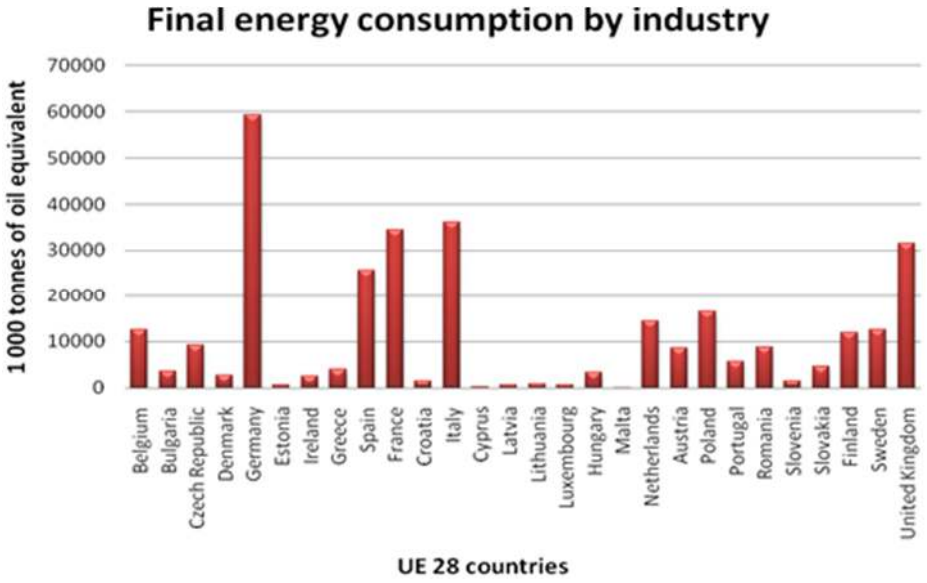

Fig. 1. *Final energy consumption by industry in EU-28*

Drastic measures are required for climate challenges and also for resource usage. The local and the central public administration should prepare a number of measures to reduce these impacts in the following period.

The heavy dependence on fossil fuels and the inefficient use of raw materials are found in their prices, affecting the economic security and simultaneously causing the increase of climate changes. The competition for natural resources and for improving the quality of life will be emphasized by the world population growth from 6 to 9 billion [4].

The final energy household consumption is influenced by the population of that country, the first ranked being: Germany, with a consumption of 95476/1000 toe, France – 72900/1000 toe and England – 61009/1000 toe [5]. The final energy trade and services consumption is also linked to population. Romania ranks 10 among the countries with the highest final energy consumption, with an average of 10084/1000 toe for the period 2001-2012.

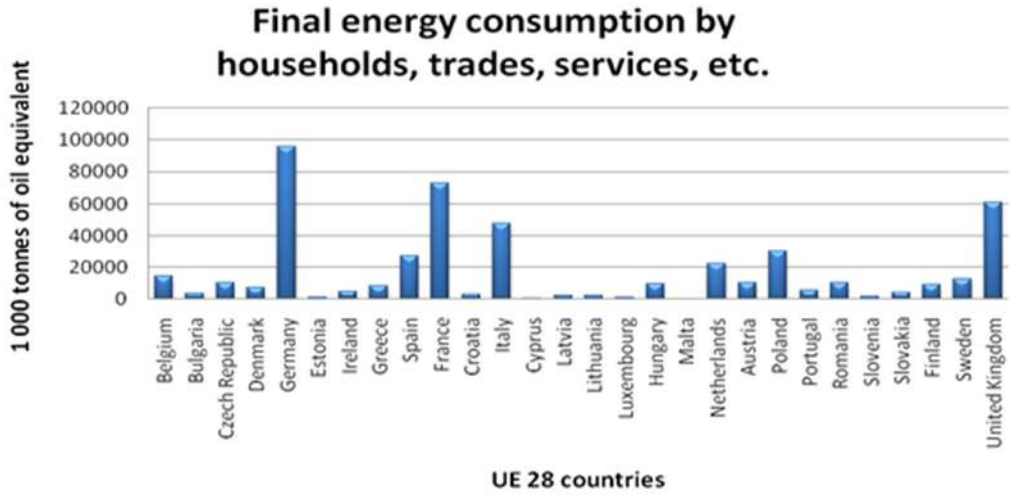

Fig. 2. *Final energy consumption by population, trade and services in EU-28*

A significant objective included in the 2020 strategy refers to the modernization of the transport sector and thereby the reduction of carbon dioxide emissions contributing to competitiveness [6].The local and central authorities will benefit from a number of facilities for a rapid development of the infrastructure of an electrical mobility network, efficient traffic management, more efficient transportation vehicles, the supervision of CO_2 emission reduction for road vehicles, aviation and naval sectors, etc. Simultaneously, the strategy aims to promote the use of European green cars, including electric and hybrid vehicles. This set of measures can be realized through the application of innovative technologies, through a series of support measures that include research, development and innovation, establishing common standards and the development of infrastructure required throughout the EU [7].

The urban dimension of transport is responsible fora large part of greenhouse gas emissions in the environment.

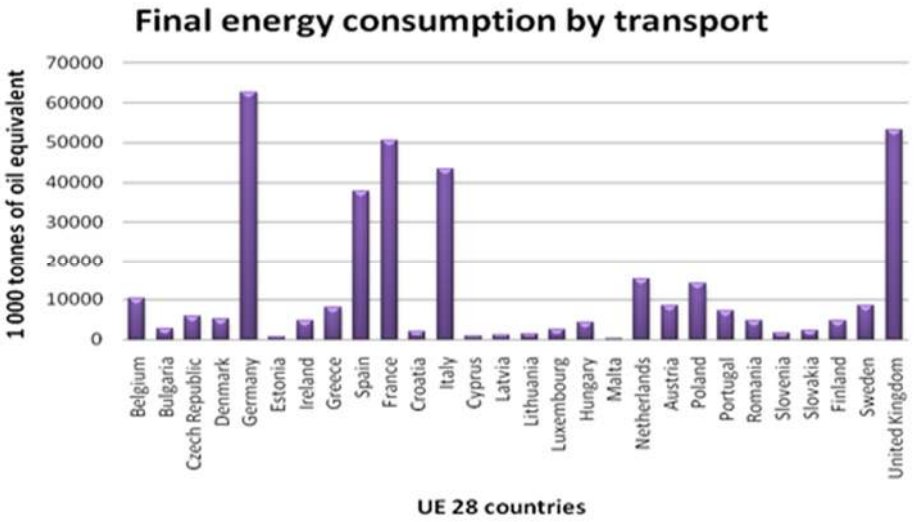

***Fig. 3**. Final energy consumption by transport in EU-28*

In the EU-28, from 2001 to 2012, the largest amount of power consumed by the transport sector was recorded in Germany – 62571/1000 toe, England – 53164/1000 toe, and France – 50536/1000 toe. The average consumption of Romania in that period was 4791/1000 toe, a value quite close to that of Ireland – 4832/1000 toe and of Finland – 4714/1000 toe. The smallest amount of energy used by the transportation sector is in: Cyprus – 989/1000 toe, Estonia – 768/1000 toe and Malta – 237/1000 toe [8].

The application of the strategy regarding the climate changes and energy production and consumption throughout the EU requires a number of investments in key-infrastructure by the cross-border energy and transport networks and also in the application of low-carbon technologies. It is extremely important, in the next period, to find a common solution in response to the challenges posed by the climate changes.

One of the major targets set out in the 2020 Strategy refers to the reduction of greenhouse gas emissions by at least 20% compared to 1990 levels or by 30%, increasing to 20% the share of renewable energy in the final consumption and a 20% increase in energy efficiency. By reaching the energy targets, according to the studies, the EU imports of oil and gas could fall by 60 billion € in 2020. Achieving the EU target, that 20% of the energy used to come from renewable sources, could allow for the creation of over 600 000 jobs in the EU and, if we add the objective of 20% energy efficiency, there are over 1 million new jobs. Additionally, the European energy market integration may result in a GDP growth of 0.6% -0.8% [9].

The EU-28 average intensity of greenhouse gas emissions from energy consumption for 2001-2012 was 95 tons of CO_2e. The highest average was: 103 tons of CO_2e in Bulgaria, 101 tons in Croatia and 100 tons in Malta. The value of our country was above the European average, 96 tons of CO_2e, but we have to point out that the trend is decreasing, with lower values in 2009-2011, followed by a slow growth in 2012. All these values reflect the degree of energy usage in various sectors and the ecological characteristics of machinery, equipment and vehicles.

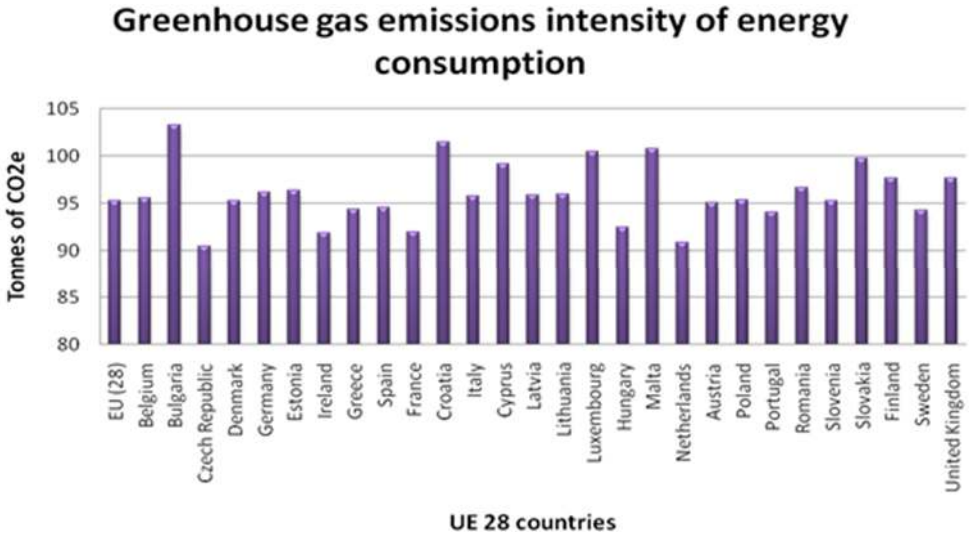

Fig. 4. *Intensity of greenhouse gas emissions from energy consumption in EU-28*

From the analyzed period it can be clearly seen that, as more investments were made in upgrading the equipment, the obtained values of greenhouse gas emissions were lower, and the clearest examples are the Czech Republic – 90 tons of CO_2e, Netherlands – 90 tons and Ireland – 91 tons [10].

Europe must achieve a higher efficiency in terms of resource usage by 2020 by supporting the transition to a low carbon economy and increasing the usage of renewable energy. All these measures will help decouple economic growth from the use of conventional resources.

3. Renewable and gross final energy consumption

During 2001–2012, the share of renewable energy in the gross final energy consumption in the EU-28 was 11%, with significant differences between the first and the last countries, and it has increased steadily since 2001. The highest percentage of energy from renewable sources is in Norway – 62%, Sweden – 45%, Latvia – 32%. Romania ranks 8 in the 28 EU Member States, with an average of 20% energy from renewable sources in the gross final energy consumption. Denmark has the same percentage, 20%.

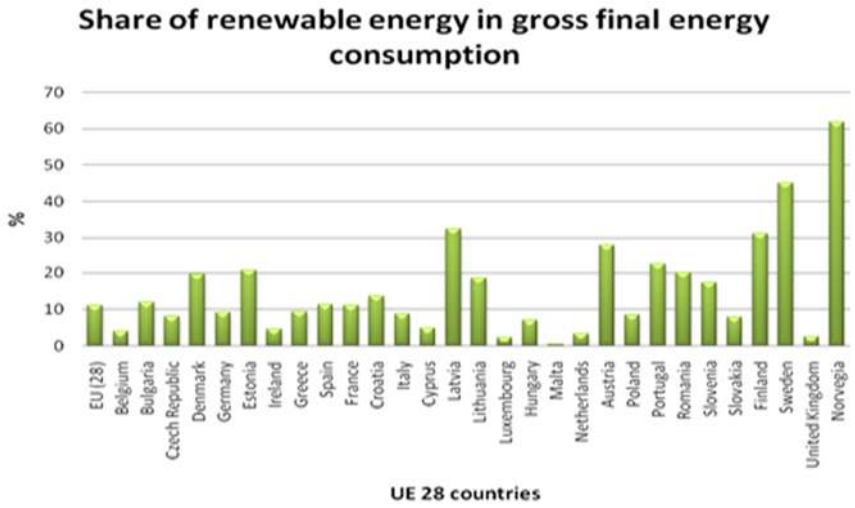

Fig. 5. *Share of renewable energy in the gross final energy consumption in EU-28*

In the share of renewable energy in final energy consumption, Hungary has only 7%, while Netherlands has only 3%. The last three places in this chapter are occupied by UK– 3%, Luxembourg – 2% and Malta – 1%. These values are proportional to the size and population of each country. The share of renewable energy in the final energy consumption varies between countries from 60% to 1 in some cases [11].

The European directives on renewable energy include, among others, the Directive on promoting the electricity from renewable energies and the Directive on promoting biofuels [12]. The number of policies adopted at national level increased after the adoption of the 2008 climate and energy package, which imposed a target of 20% of the total final energy consumption.

It has to be accepted that the application of renewable technologies depends largely on the geographical and socio-economic context situation of each Member State. EU Member States have the possibility to determine the measures that will be adopted in the electricity and heat field, to achieve the 20% of the objective.

Most of the renewable energy fields have experienced an accelerated growth since 2001. A major increase was recorded in photovoltaic solar energy in Germany, from 10/1000 toe in 2001 to 2268/1000 toe in 2012. The same extremely ascending trend was recorded in Italy, with an increase from 1/1000 toe to 1621/1000 toe, Spain – from 2/1000 toe to 704/1000 toe. For the Czech Republic, Belgium and Greece the proportion of primary production of photovoltaic energy has increased since 2008 from 1/1000 toe to about 180/1000 toe.

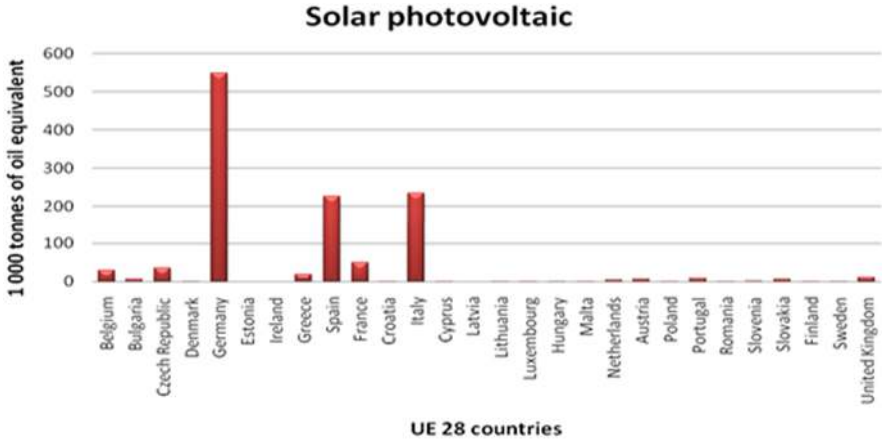

Fig. 6. *Renewable energy (solar photovoltaic technology) in EU-28*

In Romania a feeble growth can be seen starting with 2011, from 0.1/1000 toe photovoltaic primary production to 0.7/1000 toe photovoltaic primary production in 2012. Also, starting with 2011, a rise was observed in the percentage for Poland, Croatia and Lithuania, reaching, at the end of 2012, 0.1/1000 toe Estonia, Ireland and Latvia do not use solar photovoltaic energy.

The photovoltaic solar energy market is dependent on developments from Germany, which remains the world leader in the production of photovoltaic cells. In Germany this evolution is influenced by favorable policy framework, while Italy and Spain have seen this progress due to their favorable geographical context.

The evolution of primary production from wind power has seen a growth rate as upward as the wind energy in most EU-28 countries. During the period2001-2012 the primary production of wind energy varies from 2757/1000 toe to 0 in some cases. The most significant progress has been made by Germany, from 899/1000 toe to 4356/1000 toe, Spain – from 581/1000 toe to 4253/1000 toe and England – from 83/1000 toe to 1683/1000 toe.

In Romania and Bulgaria, the primary production of wind power was nonexistent until 2003, after which Bulgaria had an increase of 0.1/1000 toe to 105/1000 toe in 2012, and in the case of Romania between 2007 and2012, the amount of wind power increased from 0.3/1000 toe to 227/1000 toe. From the 28 countries, only Malta and Slovenia remain without primary production of wind energy. It is observed that most Member States have managed to increase their primary production of wind energy in response to new EU targets set for 2020 [13].

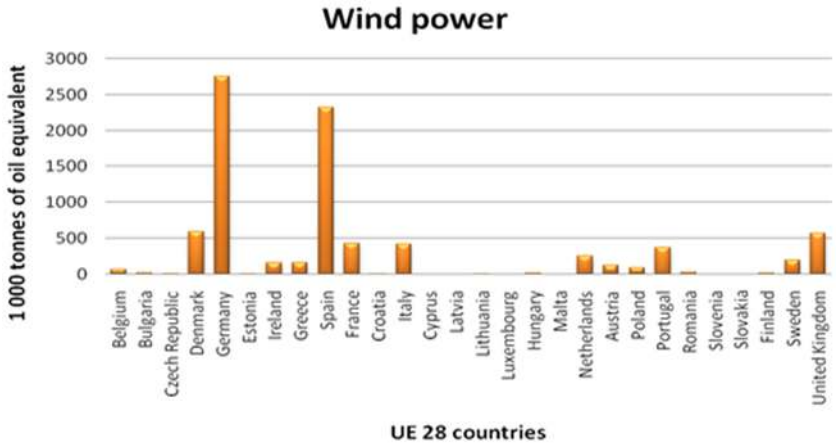

Fig. 7. *Renewable energy (wind power) in EU-28*

The renewable energy production is dominated by the large hydro plants (> 10 MW), which produced over two thirds of the EU-27's the renewable energy in the analyzed period. The greatest amount of hydroelectric power is produced in Sweden, 5779/1000 toe, on an average for the period 2001-2012.

During this period, in France and Italy, there have been decreases in hydro power production, from 6413/1000 toe to 5048/1000 toe in France and from 3829/1000 toe to 3438/1000 toe in Italy. Notable progress has been made by Bulgaria, from 149/1000 toe in 2001 to 277/1000 toe in 2012, and Estonia, which has increased the amount from 0.6/1000 toe to 3.6/1000 toe. Spain has halved the amount of energy, from 3515/1000 toe to 1766/1000 toe. In Romania the production decreased from 1283/1000 toe to 1037/1000 toe in 2012 [14].

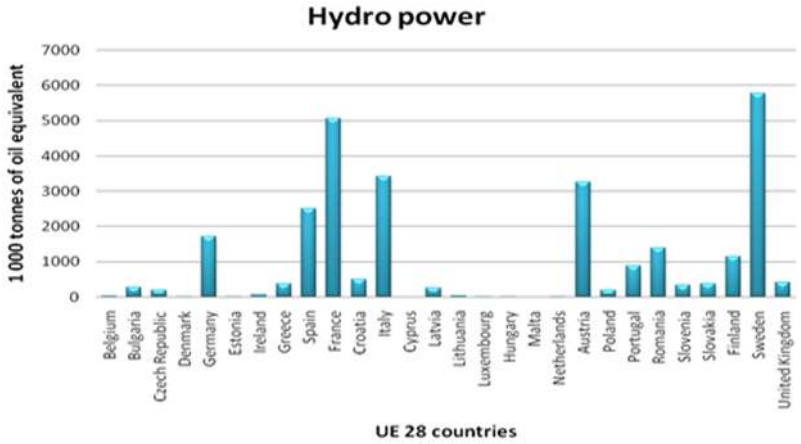

Fig. 8. *Renewable energy (hydropower) in EU-28*

The development of micro hydro power plants has been limited since 2006 by the constraints imposed by the Water Framework Directive. The fluctuations in hydropower production were mostly caused by the climate change, which led to low precipitation and prolonged droughts.

4. Conclusions

The rhythm of the exploitation of primary energy resources, the risk of their decreasing in a few decades, rising energy prices, also the increasing of the amount of imported energy resources and also a more significant climate change lead to the idea that renewable energy sources (solar, wind power, hydro-electricity) are the only real alternatives to fossil fuels.

In the near future, energy consumption will be particularly controlled and directed by carefully monitoring of the energy efficiency and through the diversification of primary energy sources. An increasing energy efficiency can be achieved by

reducing specific energy consumption for the same product, service or process, without affecting the quality of the product, service or process.

The reduction of environmental pollution, the maintenance of raw material and energy reserves are the main targets of energy efficiency analysis. A sustainable society is based primarily on an increase in the efficiency of energy usage, the increase of energy security by limiting the dependence on resources from outside the EU.

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