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HIGH-ENERGY INTENSITY PROBLEMS IN THE REPUBLIC OF SERBIA

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Abstract: *Energy efficiency is crucial to ensuring a safe, affordable, reliable and sustainable energy system and is an important component of all efforts to reduce greenhouse gas emissions (GGE). It is also the fastest and cheapest way to solve energy, environmental and economic problems and challenges. In the context of facing increasing demand for energy, unstable prices, energy supply disruptions and environmental issues, the European Union (EU) has set ambitious energy saving targets of 20% by 2020 and of 30% by 2030, by directing its energy efficiency measures towards those sectors where there is the greatest potential for savings. The energy sector is one of the areas of strategic importance for the future development of the Republic of Serbia (RS). Bearing in mind that Serbia is a candidate country for EU membership, the strategic direction of its energy sector development is largely determined by the undertaken international obligations, with a special emphasis on the Energy Community membership and the EU accession process. In this sense, the country has accepted the obligations related to increasing energy efficiency. The paper analyses the relative and absolute energy intensity trends in order to determine the general trend and dynamics of energy efficiency in Serbia in the period from 1990 to 2015. The paper points out that Serbia, in terms of energy intensity, is lagging behind many EU countries, as well as for some in the region, and gives recommendations for taking measures that would increase energy efficiency in the country.*

Keywords: *energy efficiency, energy intensity, gross inland energy consumption, Republic of Serbia, environment*

1. INTRODUCTION

Energy efficiency is crucial for providing a safe, affordable, reliable and sustainable energy system[International Energy Agency, 2018]. Improving energy efficiency of final consumption, i.e. energy efficiency of individuals, households and enterprises, is an important

element in efforts towards the reduction of greenhouse gas emissions (GGE). The argument for improving energy efficiency is based on the idea that energy-efficient technologies will in the run save end users' money and thus ensure cost-effective and free options for reducing harmful gas emissions in the atmosphere[Gerarden, et al. 2014, pp. 1].Such an approach to mitigate harmful gas emissions is feasible only in those countries whose governments activly undertake activities to address climate issues, along with the implementation of numerous energy efficiency policy measures.

Given that contemporary developed countries treat energy efficiency as an energy source that each country has in abundance, it is the quickest and most cost-effective way to solve energy security issues, as well as to tackle environmental and economic challenges. Although energy efficiency policies have become a crucial part of the global energy market, there remains a huge unexploited potential that points to the need for the implementation of more effective measures directed to reducing energy intensity of contemporary countries. In 2008, the International Energy Agency (IEA) developed a set of 25 Energy Efficiency Policy Recommendations that can be classified in the following seven priority areas[International Energy Agency, 2011, pp. 3]: a) the Cross-sectoral area, b) Construction, c) Appliances and equipment, d) Lighting, e) Transport, f) Industry and g) Energy utilities.

These recommendations cover a large set of policies that contemporary countries should consider in the context of their energy economies. These efforts include measures to cost-effectively increase the energy efficiency by establishing frameworks to motivate more effective activities, by accelerating the introduction of new technologies and by strengthening and implementing minimum energy performance standards (MEPS) for devices, lighting and equipment. They also involve the adoption of appropriate energy regulations. If these measures were to be applied globally without any delay, the IEA estimates that up to 2030, these proposed actions could save up to 7.6 gigatonnes (Gt) of carbon dioxide (CO_2) per year, which is almost 50% more than current CO_2 emissions in the United States[International Energy Agency, 2011, pp. 3].

The European Union (EU) is today faced with increasing energy demand, unstable prices and energy supply disruptions. In addition to these problems, the EU must also reduce the harmful influence of its energy sector on the environment. In order to solve these problems, there is a need for more decisive implementation of the EU energy strategy. The EU's energy policy has the following main three objectives [European Union, 2018]: a) security of supply, b) competitiveness and c) sustainability. As a part of its energy efficiency policy, the European Union first set the energy saving target by 20% up to 2020, which is approximately equal to the 400 power plants exclusion. Shortly afterwards, on November 30, 2016, the European Commission (EC) proposed the revised Energy Efficiency Directive that includes achieving a new energy efficiency target of 30% by 2030, as well as accompanying measures for its fulfilling[European Commission, 2018].The European Union starts from the fact that more efficient energy use will reduce the electricity bills, that it will reduce its dependence on external suppliers of oil and gas and that, in this way, it can help to support the environment protection. The EU also emphasizes that energy efficiency must be increased in all energy chain phases, from the electricity production to its final consumption. Therefore, the primary goal of EU's energy efficiency measures is to regulate those sectors where there are major saving potentials, such as construction.

The energy sector is also one of the strategic important areas for the future development of the Republic of Serbia (RS). Therefore, considerable attention has been devoted to this sector in the past few years. In 2005, the Government of the Republic of Serbia adopted the long-term Energy Sector Development Strategy until 2015. Given the changed circumstances in the country and in its environment, the overall goals of the Strategy raised from the intention to establish qualitatively new conditions for functioning and development of the energy production and consumption sectors that would stimulate the country's development and environmental protection, as well as accelerate accession of Serbia to the European Union[Janković, et al. 2015, pp. 3]. In this respect, the strategic direction of the energy sector development of the Republic of Serbia is largely determined with acceptance of international obligations, with a special emphasis on the membership in the Energy Community and the accession process to the EU. The Strategy envisaged, among other things, the adoption of measures to stimulate and support investments in new energy sources and technologies, as well as the use of more energy efficient devices and equipment. The Strategy also predicted the implementation of financial incentives for private investments in economically effective programs and energy efficiency projects, as well as the selective use of renewable energy sources[Službeniglasnik RS, 2005, pp. 16].By signing the Treaty establishing the Energy Community with the European Union (in 2006), Serbia has undertaken the obligation to apply EU energy regulations.

Nine years after the first one, the Serbian Government adopted the second long-term Energy Sector Development Strategy until 2025, which, in the form of increasing energy efficiency priorities, states[Vlada RS, 2014, pp. 48]: a) energy saving reconstructions of the building sector and b) the introduction of energy management system in the public sector. In addition to increasing energy efficiency in all consumption sectors, this Strategy specifically insists on the cogeneration (a combined electricity and heat generation in the industry), as well as on informing and educating the public about the need to improve the energy efficiency and the possibilities of using renewable energy sources. Finally, we should emphasize that Serbia also adopted the Law on Efficient Use of Energy in 2013. This Law has the aim to[Službeniglasnik, 2013]: a) increase the energy supply security and its efficient use, b) increase the competitiveness of the economy, c) reduce the energy sector negative impacts on the environment, and d) encourage an energy responsible behavior in the sectors of production, transmission, distribution and energy consumption. The Law refers to energy users from the industry, the trade and service sectors, the population, the public and construction sectors and other energy users. The Law enacts the introduction of Energy Management System (EMS), Energy Efficiency Labeling System (EELS), and Minimum Energy Efficiency Requirements (MEER) in the Production, Transmission and Distribution of Electricity and Heat, MEER in the Transport and Distribution of Natural Gas, and financing, encouraging and other energy efficiency measures.

2. RESEARCH METODOLOGY

Energy intensity measures the energy consumption of the observed country and its energy efficiency. Energy intensity is the ratio between Gross Inland Energy Consumption (GIEC) and Gross Domestic Product (GDP) calculated for each calendar year[European Environment Agency, 2018]. Variations of the energy intensity index reflect the influence of

various factors, such as energy efficiency improvements, but also structural changes in the economy, changes in the energy mix structure, in lifestyles (more devices, higher or lower indoor temperature, more cars, etc.), changes in climate factors such as colder winters and warmer summers, changes in transport patterns, preferences, etc. On the other hand, energy efficiency refers to an activity or product that can be produced with a certain amount of energy and it is inverse to energy intensity[Office of Energy Efficiency & Renewable Energy, 2018].

Gross Inland Energy Consumption (GIEC) is calculated as a sum of Gross Inland Consumption (GIC) of five energy types: solid fuels, oil, gas, nuclear and renewable energy sources[European Environment Agency, 2018]. This indicator reflects the amount of energy required to satisfy domestic consumption within the national territory boundaries. Data on GDP are in constant 2010 prices in order to avoid the impact of inflation. The tonne of oil equivalent (Toe) is a standardized unit that is defined on the basis of one tonne of oil with a net calorific value of 41,868 Gigajules (Gj). In other words, it is equivalent to the approximate amount of energy that can be extracted from one tonne of crude oil. This is an appropriate general measure used for summing different types of fuel, based on their energy content[Eurostat Statistics Explained, 2013]. Lower ranks contain less energy values.

This paper examines the Relative and Absolute energy intensity with the aim to determine the dynamics and the energy efficiency general trends in the Republic of Serbia. The base period is 2010 in order to perceive a relative decrease in the energy intensity level in the period from 1990 to 2015. The paper uses time series data to evaluate the rate of energy intensity growth. Relative energy intensity is the ratio between GIEC Index and GDP Index at constant prices. Absolute energy intensity is a ratio of GIEC and GDP at constant prices, using chain-linked volume data to eliminate the effects of inflation. The paper uses data from the Eurostat database and the National Statistical Office's energy balances.

3. THE ENERGY INTENSITY OF THE REPUBLIC OF SERBIA

Energy intensity in Serbia is not at satisfactory level. Unlike developed countries, which, even in the 1970s, began more actively to apply energy efficiency measures, Serbia has started systematically to take care about this area since 2004. Although the primary energy consumption per capita in the Republic of Serbia is not too high, there remains a problem of too high-energy intensity. Namely, the country, on this basis, lags behind the most developed countries, in some cases up to five times. For example, while Croatia has an energy efficiency index of 0.45, Bosnia and Herzegovina 0.6, Romania 0.4, Slovenia 0.3, Czech Republic 0.3, and Germany only 0.17, in Serbia this indicator stands at 0.8 (in industry 0.6) [Spalović, 2010].In addition to the aforementioned problems, it should take into account that the electricity price in Serbia is still quite low to stimulate above all consumers, as well as manufacturers to apply energy efficiency measures. Table 1 and Figure 1 show the trends of the Gross Inland Energy Consumption, Gross Domestic Product at constant prices and Relative and Absolute energy intensity indicators in the Republic of Serbia in the period from 1995 to 2015.

Table 1. Trends of Gross Inland Energy Consumption, Gross Domestic Product at constant prices and Relative and Absolute energy intensity indicators in the Republic of Serbia in the period from 1995 to 2015

Years	GIEC in millions of Toe	GIEC Index, 2010=100	GDP Index at constant prices, 2010=100	Relative energy intensity	GDP using the chain value method, in millions of euros, 2010=100	Absolute energy intensity
1990	19.6	125.64	-	-	-	-
1995	13.6	87.20	60.9	143.18	18.138,5	749.41
2000	13.7	87.82	64.9	135.32	19.310,2	709.94
2005	15.7	100.64	87.7	114.75	26.097,3	601.66
2010	15.6	100.0	100.0	100.00	29.766,3	523.81
2011	16.2	103.85	101.4	102.42	30.183,4	536.61
2012	14.5	92.95	100.4	92.58	29.877,0	486.88
2013	14.9	95.51	103.0	92.73	30.645,4	487.40
2014	13.3	85.26	101.1	84.33	30.084,2	441.88
2015	14.7	94.23	101.8	92.56	30.312,1	486.13

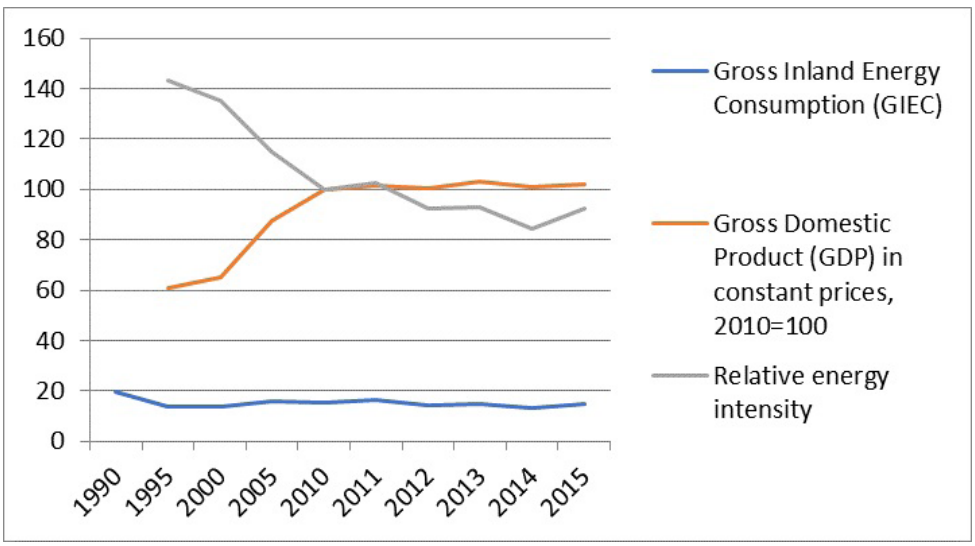

Fig. 1Trends in Gross Inland Energy Consumption, Gross Domestic Product and Relative energy intensity in the Republic of Serbia in the period from 1995 to 2015

The analysis clearly shows that in the Republic of Serbia Gross Inland Energy Consumption remained relatively stable in the period from 1990 to 2015, while the Relative energy intensity was decreasing in the observed period, first sharply, and then more moderately since 2005. In 2005, the Relative energy intensity was 114.75 (the Absolute energy intensity was as high as 601.66) and it was lower by as much as 28.43% compared to the 1995 level. In the same period there was a significant increase in Gross Domestic Product (in 2005, Serbia's GDP was 26.8% higher than its 1995 level). The aforementioned fall in Relative energy intensity can be explained above all by the low initial level of GDP, as well as by the dramatic consequences of sanctions form the 1990s, NATO bombing, hyperinflation, and by a large wave of privatization of public enterprises. These circumstances caused the phenomenon of a massive wave of enterprise bankruptcy, the production break down in many factories, and consequently the reduction of the country's economic activities and the Energy Intensity Index. However, in parallel with the deindustrialization of the country, since 2000, there has been an expansive growth in the service sector (Transport, Telecommunications, Banking, Trade and Catering), which can explain relatively stable indicators of GIEC and GDP. These structural changes in the economy could only indirectly determine the efficiency of energy consumption.

After the stagnation period of these indicators, follows the period of decoupling of the Relative energy intensity and the GDP. From 2011, follows a new trend of the Relative energy intensity falling that experienced its minimum in 2014 when it was 84.33. In that year the Relative energy intensity of the country was by 18.09% lower than in 2011 and even by 58.85% lower than its value from the beginning of this analysis's observation (1995). During this period, there was a very high inflow of foreign investments, as well as the trend of new production capacities opening, with more modern, more efficient and less energy intensive technologies that can explain this energy intensity trend. In addition, it should be noted that, in the past two decades, Serbia has been permanently facing a persistent poverty growth and a dramatic population emigration increase, which could also partially contribute to the GIEC reduction, and consequently to the decrease in energy intensity. Based on the presented facts, we can conclude that the Republic of Serbia has high-energy intensity volumes which, given the obsolete equipment that many of its industrial facilities still have, indicates a costly, inefficient and environmentally harmful production.

CONCLUSION

In June 2015, the Republic of Serbia adopted a preliminary National Emission Reduction Plan (NERP) with a program for the harmonization of pollutants' emissions into the air. According to this Plan, in Serbia in 2030, the GGE voluntary reduction should amount to 9.8% in relation to 1990 levels. However, despite of all the efforts so far undertaken in this sense, Serbia did not adopt the final NERP by the end of 2017[Agencija za energetiku Republike Srbije, 2018, pp. 54].Among other things, according to the preliminary Plan, and due to obsolete technology and high production and environmental costs, the Government is planning a successive closing of the oldest and most energy inefficient thermo- blocks by 2027. At the same time, it intends to continue the activities on revitalization and modernization of existing power plants that will enable the increase of energy efficiency in the country. Actions on the revitalization and modernization of many hydropower plants are

underway. In addition to influencing the energy intensity reduction, the consistent applying of this Plan would also influence the increase in the economy's resilience during natural disasters, it would accelerate its development towards the *green* and circular economy, and it would influence the provision of new jobs[Privredna komora Srbije, 2015].However, despite of allthese efforts, the energy intensity in Serbia, measured by total primary energy consumption per unit of GDP (in purchasing power parities), is at the level of the countries in the Western Balkans region, but it is 1.79 times higher than the European average[Agencija za energetiku Republike Srbije, 2018, pp. 6].Higher energy intensity occurs due to the inevitable technical losses in the lignite transformation process into electricity, but also because of irrationality, i.e. the law efficiency of consumption in households and industry, as well as obsolete technologies that various industrial sectors are still using.

For the sustainable development of Serbia's energy system, it is first necessary to introduce an adequate long-term price policy that would be predictable for all the relevant market actors, that is for customers, companies and investors. Such electricity prices and network services would enable the provision of the necessary funds for the investments of energy companies, they would stimulate the investors, and they would induce country's energy efficiency. In addition to increasing the electricity price that would boost consumption efficiency in the population sector, the efficiency of existing production capacities' use should be increased, as well as to introduce more energy efficient technologies in the industry. It is important to improve above all the industry segments, the segments of electricity transmission and distribution, as well as the production and distribution of heat energy. The Government should also encourage further investments in revitalization and modernization of production, transmission and distribution capacities, which would increase the reliability and efficiency of the electricity system operation. Due to necessary introduction of new and more efficient technologies, further economic developments and attracting foreign investors will play a crucial role in reducing energy intensity in Serbia. Likewise, the construction of power plants based on renewable energy sources, such as new hydropower plants, solar power plants, wind farms, and biomass-fired energy plants could significantly contribute to energy intensity reduction in the country.

The energy efficiency market in Serbia is still at an early stage of its development[Popović, 2018].With several realized projects related to energy performance contracting, awarded to private investors in the public lighting field (examples of the public-private partnership projects in the Ada and Žabalj municipalities) and several large cities' major projects that are in preparatory phase (in Belgrade and Novi Sad), this market is only in its infancy. It has not yet experienced the successful implementation of energy efficiency measures in many fields, especially in public buildings. Therefore, it is necessary to insist on a more consistent and persistent applying of the Law on Efficient Use of Energy and all of its foreseen and adopted measures, especially in the construction, transport and industry sectors. It is important to reduce the country's energy intensity indicators to make the economy more competitive, in order to increase the living standard, but also to make the environment cleaner.

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