ENERGY INTENSITY OF THE HOUSEHOLD SECTOR IN THE REPUBLIC OF SERBIA

Assistant Professor, Ph.D. Lidija MADZAR
Faculty of Finance, Banking and Auditing, "Alfa BK" University, Belgrade, Serbia
E-mail: lidi.madzar@gmail.com

Abstract: *Contemporary countries are increasingly aware of the need to change the way of energy consumption. For this reason, concern about energy security, the social and economic effects of high-energy prices, and the increased awareness of the climate change effects led to improvements in energy efficiency worldwide. The household sector can significantly contribute to the key goals of energy and climate policy achievement. It can contribute to reducing the energy intensity of the economy and the country's energy dependence, the greenhouse gas emissions, as well as meeting the climate goals. The paper analyses the basic aggregate indicators of the final energy consumption efficiency in Serbian household sector. Serbia's energy intensity is almost twice as high as the European average and it appears because of irrational energy consumption in households and industry and widespread obsolete technologies. The paper follows the trend of Total and Relative residential final energy consumption, Residential final energy consumption per capita and the correlation between Gross Domestic Product per capita and Final energy consumption of Serbian household sector. Although energy efficiency in this sector is lower than in the EU countries, residential energy consumption is nevertheless declining slightly and it is not conditioned by the country's economic development.*

Keywords: *energy efficiency, energy intensity, household sector, energy consumption in the Serbian household sector, energy consumption factors in the household sector.*
JEL Classification: *D10, O13, Q40.*

1. Introduction

Contemporary countries around the world are increasingly aware of the need to change the way of using energy. In this regard, the concern for energy security, the social and economic effects of high energy prices, as well as increased awareness of climate change effects are some of the factors that have led many countries to put more emphasis on their energy efficiency improvement policies and measures. Therefore, it has been increasingly recognized that energy efficiency improvement often represents the most economical, proven and the most accessible means for achieving these goals (International Energy Agency, 2014, p. 15). Today people use energy for various purposes such as transportation, space heating and cooling, water heating, electrical appliances' operations, cooking, lighting, manufacturing, entertainment, providing services, etc. The choices that they make in terms of energy use, such as purchasing fuel saving vehicles or the use of more energy efficient devices, greatly affect the environment and energy efficiency of the observed country. At the same time, there is a significant difference between energy efficiency and energy conservation (Campbell and Ryan, 2012, pp. 8-11). Energy efficiency refers to the use of technology that requires less energy to perform the same functions. For example, the use of Light Emitting Diode (LED) light bulbs or compact fluorescent lighting, which requires less energy consumption than traditional bulbs, is a good example of energy efficiency. On the other hand, energy conservation refers to any conscious behaviour that has a result in less energy use. In that sense, turning off the lights while leaving the room is a good example of saving energy.

The residential sector can make a significant contribution to the key energy and climate policy objectives achievement. More specifically, this sector may contribute to the reduction of the overall energy consumption and energy intensity of the economy, as well as decreasing the future energy dependence of the country. Investments in the energy efficiency of the household sector can also affect the reduction of greenhouse gas (GHG) emissions, as well as the climate change goals fulfilment (Organisation for Economic

Cooperation and Development, 2012, p. 7). This primarily relates to the launching of cost-effective and feasible initiatives to support the thermal insulation installation on energy-inefficient buildings, support to the installation of the automatic substations and radiator thermostats in buildings with the aim of better heat distribution, and to support the switching from coal to natural gas in the energy production for heating. These investments also include the encouragement of energy labelling for devices, equipment and buildings introduction. However, in order to succeed in the realization of such initiatives, it is necessary to establish an adequate political and regulatory framework with a clear set of incentives for energy efficiency investments. In addition, the potential lack of resources can jeopardize the implementation of such programs. This also refers to a number of political, regulatory and institutional factors that are beyond the direct control of program executives (OECD, 2012, p. 8). Such factors usually include poor price signals, inefficient structure of energy prices, weak enforcement of building codes, the lack of adequate measurement of actual heat consumption, lack of user's control over the use of heat (in the absence of thermostats), lack of energy labelling of devices, various investment barriers, etc.

The structure and intensity of households' energy consumption vary greatly from country to country, primarily depending on climate conditions, building stocks, living standards and the lifestyle of the population. Therefore, for each country, it is extremely important to understand the structure, drivers and energy consumption factors. This is particularly true for developing countries that will probably experience a significant increase in future energy use. On the other hand, in developed countries, household energy consumption has experienced its saturation, so there will probably be no major changes in this area (Nakagami, Murakoshi and Yumiko, 2008, p. 222). In the light of expectations of the future residential energy consumption growth at the global level, the question arises whether there is and where the room is for energy efficiency improvements. Household energy consumption depends on the number of structural factors such as housing forms and types of households, the degree of electrification, types of used equipment and devices and the rate of gasification. Furthermore, this factors usually also include wealth and standard of living, overall energy efficiency of the country, responsible and/or irresponsible attitude of the population towards energy consumption, quality of energy infrastructure, etc.

2. The Economic and Energy Profile of the Republic of Serbia

The Republic of Serbia (RS) currently has the candidate country status for the membership of the European Union (EU). Although Serbia is a market economy in transition, the public sector remains important in certain areas. Serbia has slightly less than 7.1 million inhabitants, a Gross Domestic Product (GDP) of 37.7 billion US dollars (at current prices) and a GDP per capita of $ 5,340 at current prices (World Bank, 2018). The country's economy relies on production, services and exports and it is largely driven by foreign investments. International economic sanctions, civil war and NATO bombing from 1999 significantly damaged the infrastructure and downgraded the country's economy, so in 2015 Serbia's GDP was 27.5% lower than its 1999 level (Index Mundi, 2018). Serbia is currently implementing stabilization measures and market reforms, achieving some progress in trade liberalization, as well as in the restructuring and privatization of state-owned enterprises. Nevertheless, many companies (thermal power plants, telecommunication companies, natural gas distribution companies, utility companies, etc.) remained state-owned. The global financial crisis revealed structural weaknesses of Serbia's economic growth model and induced the need for financial consolidation and acceleration of an unfinished transition into a market economy. In this regard, the

Government of the Republic of Serbia has shown some progress in the implementation of economic reforms such as fiscal consolidation, privatization and public spending reduction. However, high unemployment rates and relatively low household incomes continue to be a significant political and economic problem.

The country has made some progress towards EU membership and has so far opened 16 of the 35 negotiating chapters, of which two has temporarily closed (Science and Research and Education and Culture) (Stevanovic, 2018). Serbia is slowly implementing its structural economic reforms. Although the country reduced its budget deficit to 1.4% of GDP in 2016, and its public debt to 71% of GDP in 2017, the public debt remains as one of the main problems, as it has more than doubled in the period from 2008 to 2015 (Index Mundi, 2018). The main economic challenges that the country will continue to face in the future include high unemployment, the need for creation of new jobs in the private sector, the implementation of state-owned enterprise reforms, attracting new foreign direct investments (FDI) that add value, inefficient judicial system, aging and emigration of the population, and others.

Primary energy consumption in the Republic of Serbia (without the Autonomous Province of Kosovo and Metohija) in 2016 was 15.9 million tonnes of oil equivalent (Mtoe). A high share of coal, predominantly low calorie lignite, is dominating over the production of total primary energy in Serbia (with about 51%). In comparison with other countries, such a large share of lignite enables relatively high-energy independence and electricity production with relatively lower and stable costs. On the other hand, such use of this resource in electricity generation endangers the environment and enhances the risk of increase in GHG emissions. In the comparison with the EU countries, GDP at purchasing power parity (PPP) was at the level of 36% in 2015, total primary energy consumption per capita was 65%, final electricity consumption was 71%, while carbon dioxide (CO_2) emissions per capita were at the level of 88% (Agencija za energetiku Republike Srbije, 2018, p. 5).

Energy intensity, measured by the total primary energy consumption per unit of GDP (at PPP) is at the level of the countries of the region, but is 1.79 times higher than the European average (Madzar, 2018, p. 123). Higher energy intensity is primarily due to irrationality, i.e. low efficiency of energy consumption in households and industry, as well as obsolete technologies that are still widely used in various industrial branches. A significant difference in the final energy consumption structure in Serbia in relation to the EU countries is the higher share of final energy consumption in the residential sector (by 10%), but also the lower share of this indicator in transport sector (by 8%) (Republicki zavod za statistiku Republike Srbije, 2017, p. 27 and Eurostat Statistics Explained, 2017). In addition, these differences also arise because of the fact that industrial production in Serbia is significantly lower today than it was in the 1980s.

3. Research Methodology

The research methodology applied in this paper is largely limited by the availability of data. The paper uses the methodology of the International Energy Agency (IEA) for calculating the energy efficiency indicators of final energy consumption in the household sector. The paper first analyses the development of Total and Relative final energy consumption in the Serbian residential sector. The IEA and the European Environment Agency (EEA) define the final energy consumption as the overall energy delivered to end-users for all energy uses (EEA, 2015). In practice, it is usually disaggregated into the final end-use sectors, such as industry, transport, households, services, agriculture and forestry and fisheries. Total final consumption in absolute terms is usually measured in kilo tonnes of oil equivalent (Ktoe). Residual relative final energy consumption is the ratio between

Final energy consumption of households and the Total final energy consumption in the observed country. This indicator is usually expressed as a percentage.

After that, the paper investigates Final energy consumption per capita trends. This indicator shows how much energy each person uses in the observed country or region. Although this indicator cannot be identified with energy efficiency indicators, it does allow rough comparison of a large number of countries, as well as monitoring its general trends over time (International Energy Agency, 2014b, p. 44). Further, the paper observes the Residential final energy consumption indices with base year 2000 (as the initial year of this analysis) with the aim of more precise monitoring of final energy consumption in the Serbian residential sector.

In order to determine the nature of the relationship between GDP per capita and final energy consumption in the Serbian residential sector, Pearson's correlation coefficient is applied where GDP per capita is taken as an explanatory variable (X), while Residential final energy consumption is taken as response variable (Y). To calculate Pearson's correlation coefficient, there is a need to count three different sums of squares (SS): the sum of the X variable squares, the sum of the Y variable squares, and the sum of cross products of the X deviations with the Y deviations (Ivanovic, 1966, pp. 173-177).

The sum of the X variable squares is the sum of squared deviations of the X observed values:

$$SS_{XX} = \sum_{i=1}^{n} (X_i - \bar{X})^2 \quad (1)$$

Where the average value of the variable X is equal to:

$$\bar{X} = \frac{1}{n} \sum_{i=1}^{n} X_i \quad (2)$$

The sum of the Y variable squares is the sum of squared deviations of the Y observed values:

$$SS_{YY} = \sum_{i=1}^{n} (Y_i - \bar{Y})^2 \quad (3)$$

Where the average value of the variable Y is equal to:

$$\bar{Y} = \frac{1}{n} \sum_{i=1}^{n} Y_i \quad (4)$$

The X and Y variables' sum of products is equal to the sum of cross products of the X deviations with the Y deviations:

$$SS_{XY} = \sum_{i=1}^{n} (X_i - \bar{X})(Y_i - \bar{Y}) \quad (5)$$

The Pearson's correlation coefficient is the measure of the strength of the linear relation between the X and Y variables and it is calculated on the basis on the following formula:

$$r = \frac{SS_{XY}}{\sqrt{SS_{XX} \times SS_{YY}}} \quad (6)$$

The value of Pearson's coefficient of correlation ranges from +1 (the perfect positive correlation) to -1 (the perfect negative correlation).

The paper uses data from the Eurostat's database, the results of the Population and Households Census of Serbia from 1991, 2002 and 2011, as well as data from the Serbian Energy balances and various publications of the Serbian National Statistical Office. It should be noted here that because in Serbia and in the EU countries the collection of more

detailed data on end-use final energy consumption in households became mandatory only since 2015, at this moment we still do not have the required data for more detailed monitoring of this phenomenon. As already mentioned above, the indicators observed in this paper are not always closely related to energy efficiency and energy intensity indicators, but due to the lack of more detailed data, they are often the only ones, which we can build up. The IEA also considers the Residential energy consumption per household as one of the best indicators for the entire household sector (IEA, 2014b, p. 45).

4. The Relative and Total Final Energy Consumption in the Serbian Household Sector

This paper is devoted to the calculation of the generally accepted aggregate energy efficiency indicators of the Serbian household sector. The residential sector includes those activities that are closely related to private dwellings. More precisely, this sector covers all activities that involve the use of energy in flats and houses, such as space and water heating, space cooling, lighting, cooking and using devices, including the use of large appliances and small plug loads (IEA, 2014a, p. 25). The final energy consumption trends in the household sector and various forms of its end-use are influenced by the wide spectrum of factors such as overall energy efficiency improvements, demographic change, available energy mix, urbanization rates and internal migration. Other factors that can affect these trends are the number of occupied dwellings, number of household members, size and type of dwellings, buildings' characteristics and their age profile, income level and economic growth, preferences and behaviour of consumers, energy availability, climate conditions, devices' penetration rate, adopted energy standards, etc.

Devices and households can also be considered as an energy-using system that in turn provides some services (Ortiz-Santana and Bernstein, 1999, p. 4). For the household sector, there are standard methods for measuring energy consumption and energy efficiency. If the household is perceived as a system of devices and people who consume energy, the most common methods to measure energy efficiency in the household sector is to calculate the Total annual energy consumption by fuel, Total annual final energy consumption by end-use and the Total annual energy cost.

The IEA estimates that in 2011 around 23% of global final energy consumption has been recorded in the household sector. Whereas in the period from 1990 to 2011, the share of the household sector in the total final energy consumption remained relatively stable, total energy consumption in the household sector in absolute terms however grew by 35% because of the influence of the large number of factors. These factors include the number of occupied dwellings' and the population growth, changes in the apartments' size, more devices and the growth of wealth. The relative importance of energy consumption in the residential sector, as well as of energy sources used to meet energy demand varies considerably between countries and regions. Electricity and natural gas are the main energy products used in the OECD countries, where the electricity use is growing rapidly mainly due to increased penetration of small devices and wider dislocation of space and water heating pumps. On the other hand, in non-OECD countries, renewable energy sources (mainly traditional biomass) continue to be the dominant energy commodity, with the use of electricity that grew rapidly in the observed period, even by 270% (IEA, 2014a, p. 27). In the EU countries in 2016, the household sector accounted for 25.4% of final energy consumption or 17.4% of gross inland energy consumption. Most of the final energy consumption in the EU household sector derives from the use of natural gas (37.1%) and electricity (24.5%), followed by renewable energy resources with 16.0%, petroleum products (11.7%), derived heat with 7.5%, and coal products with 3.3% (Eurostat Statistics Explained, 2018).

The dynamics of Total final energy consumption in Serbia, Residential final energy consumption, Relative final energy consumption in the Serbian household sector, and the Residential final energy consumption per capita in the observed period is presented in the following table (Table no. 1).

Table no. 1. Some Aggregated Indicators of Energy Consumption in the Serbian Household Sector for the Period from 2000 to 2016

Year	Total final energy consumption (in Ktoe)	Residential final energy consumption (in Ktoe)	Relative residential final energy consumption (in %)	Population	Residential final energy consumption per capita (in Toe)
2000	6,941	3,127	45.0511	7,527,952	0.4154
2001	7,995	3,159	39.5122	7,504,739	0.4209
2002	8,657	3,209	37.0683	7,502,126	0.4277
2003	9,144	3,252	35.5643	7,490,918	0.4341
2004	10,330	3,121	30.2130	7,470,263	0.4178
2005	9,572	3,114	32.5324	7,456,050	0.4176
2006	9,706	2,838	29.2396	7,425,487	0.3822
2007	10,188	3,247	31.8708	7,397,651	0.4389
2008	9,478	2,911	30.7132	7,365,507	0.3952
2009	8,482	3,054	36.0056	7,334,937	0.4163
2010	8,997	3,091	34.3559	7,306,677	0.4230
2011	9,247	3,147	34.0326	7,251,549	0.4339
2012	8,486	3,135	36.9432	7,216,649	0.4344
2013	8,320	2,860	34.3750	7,181,505	0.3982
2014	7,831	2,760	35.2445	7,146,759	0.3862
2015	8,156	2,832	34.7229	7,114,393	0.3981
2016	8,603	2,941	34.1857	7,076,372	0.4156

Source: Energy balances of Serbia and population data from the Eurostat's database, author's calculation

Unlike the situation in the rest of the world and the EU countries, in Serbia the share of the household sector in total final energy consumption is still quite high (in 2016 this indicator was 34.18%). The Relative final energy consumption in the Serbian household sector gradually declined from 2000 to 2006 when it experienced its minimum. Thereafter it started to grow from 2006, achieving its two peak values of 36% in 2009 and almost 37% in 2012 (Fig. no. 1).

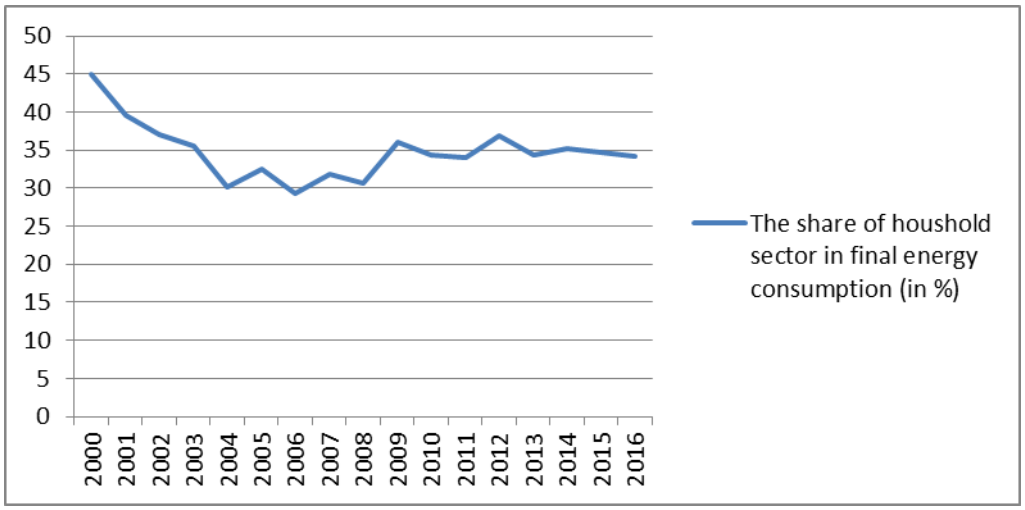

Figure no. 1. Relative Final Energy Consumption in the Serbian Household Sector in the Period from 2000 to 2016 (in %)

Although in the period from 2000 to 2016 there was a significant decrease of this indicator by around 24%, energy consumption in the Serbian residential sector is still extremely high, primarily due to the relatively low electricity price for households in comparison to the countries of the Western Balkans region and the EU (Agencija za energetiku Republike Srbije, 2018, p. 36). This is also due to the low overall energy efficiency in the country. Other factors contributing to this problem include the insufficient distribution of district heating and gasification, the domination of old, thermally non-insulated and energy-inefficient buildings in the country's total building stock, an outdated heat consumption charging system per floor area of heating space and the established practice of the population to waste energy. In addition, in urban areas, electricity is still the most dominant source of energy supply. In spite of all this, in the observed period, however, a slight decrease in Residential final energy consumption by 5.95% was recorded (Fig. no. 2). This trend can be partly explained by the poverty growth and the decline in real income, to a certain extent by the negative birth rate and increased internal migrations of the population to cities, and to a certain extent by the population emigration from Serbia due to economic and social insecurity and poor living standards.

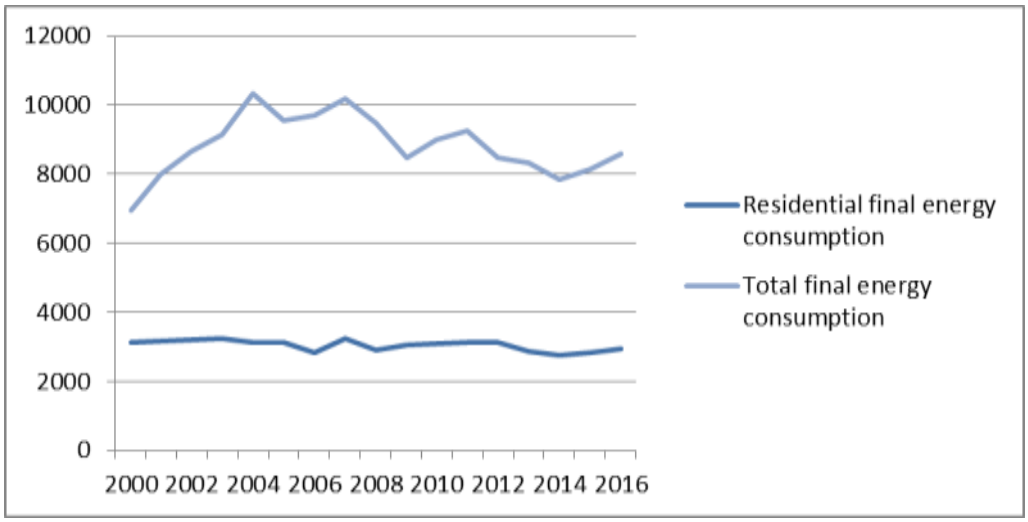

Figure no. 2. Total Final Energy Consumption and the Total Residential Final Energy Consumption Trends in the Period from 2000 to 2016 (in Ktoe)

5. Final Energy Consumption per capita in the Household Sector of Serbia

One of the most important energy intensity indicators of the residential sector is Final energy consumption per capita, and it is the most widely used and the most available indicator for the household sector. Although this indicator does not have an overly large informative character and does not talk much about the structure and drivers of household energy consumption, it is, however, useful because it provides an interesting insight into the general trends in energy consumption.

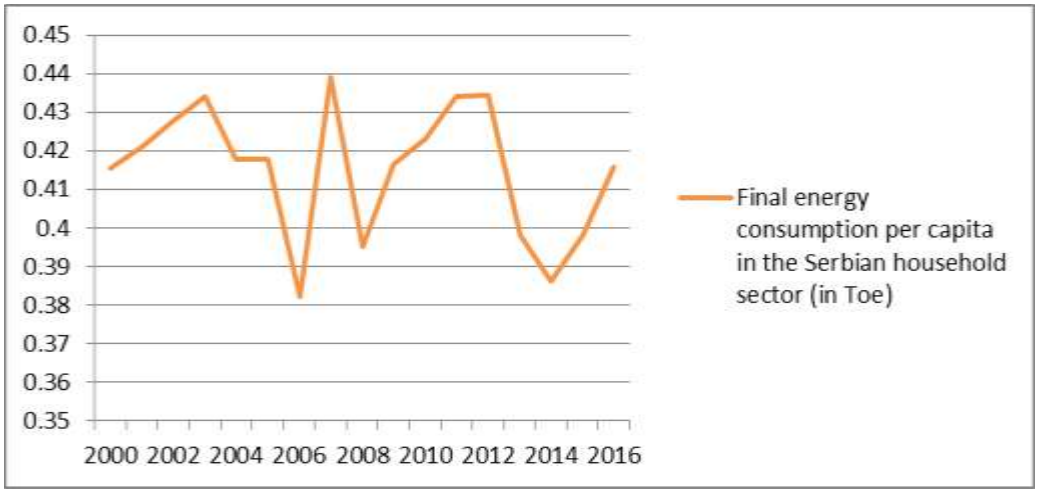

Figure no. 3. Final Energy Consumption per capita in the Serbian Household Sector in the Period from 2000 to 2016

As can be seen from Table no. 1 and Figure no. 3, in Serbia, from 2000 to 2016, Final energy consumption per capita in the residential sector varied considerably in the range from 0.38 tonnes of oil equivalent (Toe), i.e. 380 kilograms of oil equivalent in 2006 to around 0.44 Toe per inhabitant as it was just one year later. This indicator, first, grew by 2003, and after that, it experienced its sharp decline to the level of 0.38 Toe in 2006. After that, it continued with its sharp fluctuations up and down twice more, so that in 2016 it reached a value of about 0.42 Toe per inhabitant, which represents almost the same consumption from the beginning of the considered period.

The picture of the final energy consumption in the Serbian residential sector can also be supplemented with the monitoring of the index, i.e. consumption changes in relation to the base year 2000. Figure no. 4 suggests that the rate of change in final energy consumption in the household sector first declined by 9.24% by 2006, and then in 2007 it increased significantly and sharply by as much as 14.41% in comparison to the previous year. After its 2007 maximum value, in 2008, when the last economic and financial crisis began, this rate again experienced its severe fall by 10.35% compared to the previous year, achieving one of the lower values of energy consumption in the observed period. After that, this indicator continued with its slight growth until 2011, when it began to decline again, at first slightly, and later ever sharper. In 2014, the rate experienced its lowest value when the recorded energy consumption was 11.74% less than the 2000 consumption as the initial year of this analysis. Figure no. 4 clearly shows that at the end of the observed period, Final energy consumption in the household sector was significantly lower than at the beginning of its consideration, and that the negative rates of change of this indicator were higher than in the initial years of this analysis.

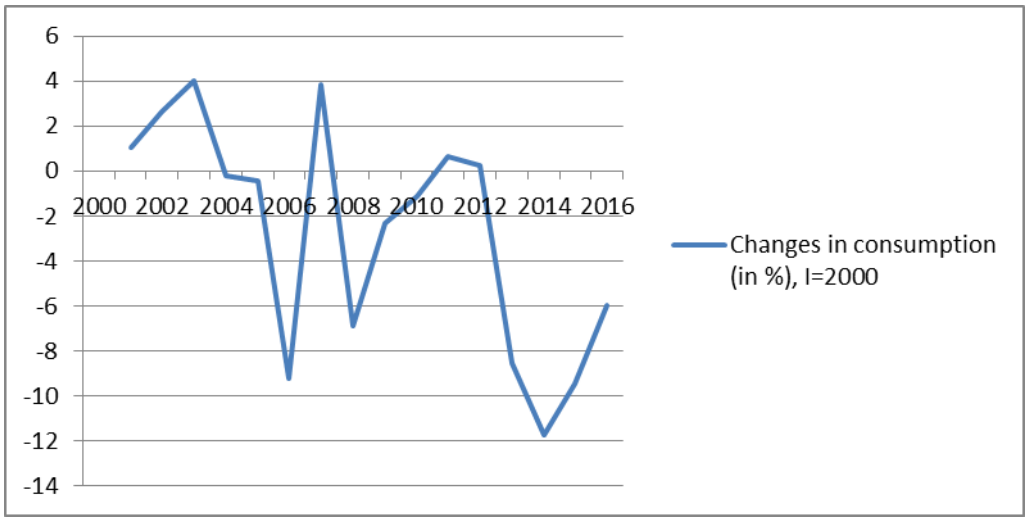

Figure no. 4. Base Indices of Final Energy Consumption in the Serbian Household Sector in the Period from 2000 to 2016 (in %, I=2000)

6. Correlation between GDP per capita and Final Energy Consumption of the Serbian Household Sector

Figure no. 5 shows the relationship between final energy consumption in absolute terms in the Serbian household sector and GDP per capita. The Pearson's correlation coefficient of these variables amounts r = -0.569, which means that this is a negative and not so strong correlation relationship. Overall, with the GDP per capita growth, the population consumption remained relatively stable. This phenomenon occurs primarily because of poverty and poor living standards, but also the still relatively low penetration rate of electrical devices. Other factors contributing to this trend include the great reliance on traditional biomass that is predominantly used in rural areas for space and water heating and cooking, as well as the decline in the households' number, the negative birth rate and emigration of the population from Serbia due to poor economic and social conditions.

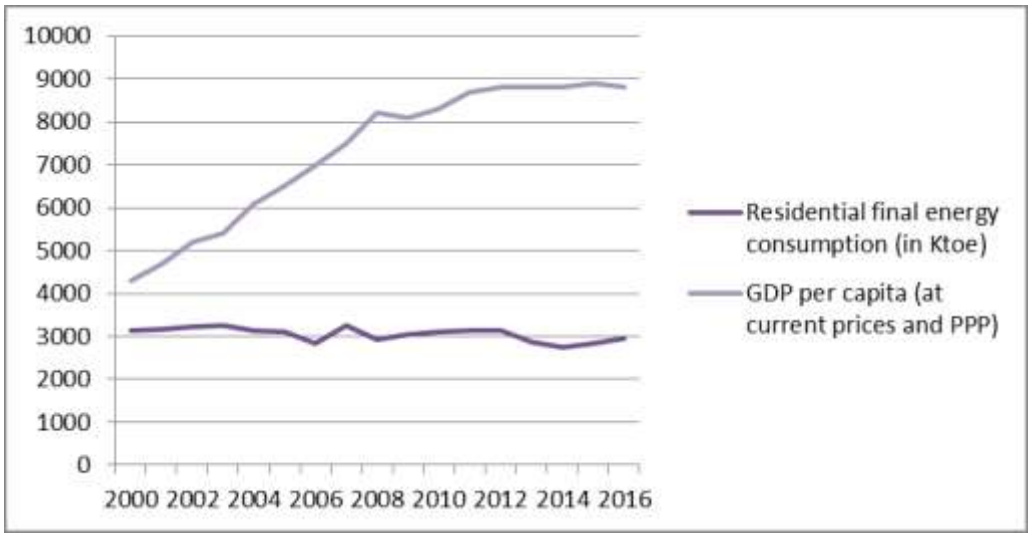

Figure no. 5. The Relationship between Final Energy Consumption in the Serbian Household Sector and GDP per capita, from 2000 to 2016 (in Toe, at current prices and PPP)

The mutual relationship between these two variables is presented in the scatterplot, where it is clearly seen that the cross section points are not completely grouped around the

regression line (Fig. no. 6). The dispersion of the points indicates a weak negative correlation.

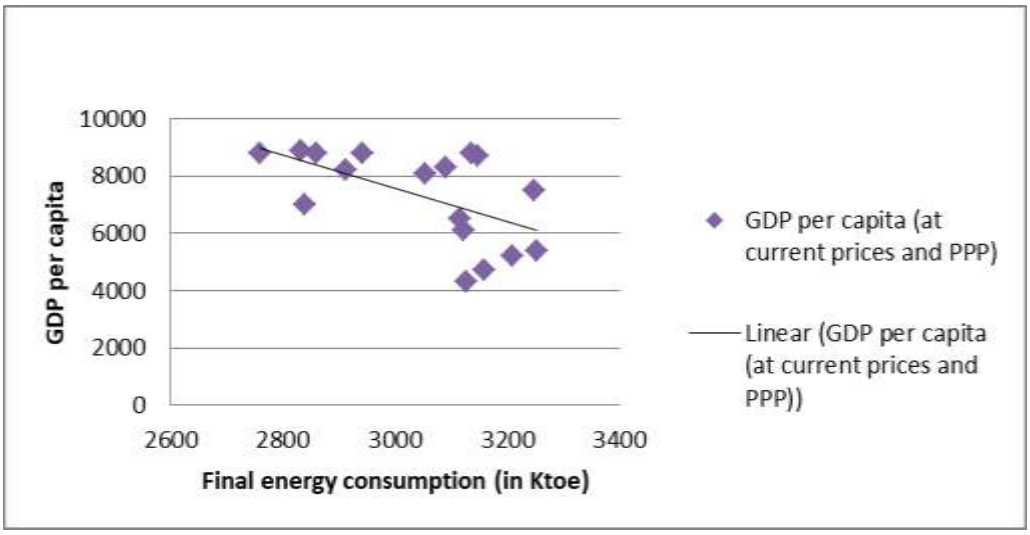

Figure no. 6. Scatter Diagram – The Relation between GDP per capita and Residential Final Energy Consumption in Serbia between 2000 and 2016

7. Conclusion

Given that energy consumption per capita in Serbia is 40% higher than the European average, the country is at the very bottom of European countries when it is about the energy efficiency of the economy and the household sector. In Serbia most of the energy is wasted in industrial plants and in the building sector, while inefficient use of energy mostly occurs because of poor planning, old and inefficient building stock, inadequate characteristics of work processes, poor maintenance and utilization of equipment, etc. In Serbia, there are also large GHG emissions, as well as between 300,000 and 400,000 residential buildings that do not have adequate thermal insulation, due to which energy is unnecessarily wasted on heating (Tanjug, 2014). Although energy efficiency in the Serbian household sector is considerably lower than in the EU countries, the figures from the paper clearly show that residential energy consumption in Serbia still decreases slightly, primarily due to poverty and poor living standards, high traditional dependences on biomass, declining households, negative birth rate and the population emigration due to poor economic and social conditions. More precisely, in the observed period there was a gradual and insignificant decrease in energy consumption of this sector. This conclusion is also supported by the fact that the trend of residential energy consumption is not in correlation with the trend of GDP per capita.

Recognizing these problems in its Development Energy Strategy of the Republic of Serbia until 2025, the Serbian Government defined energy efficiency as one of the priorities of rational use of energy sources, as well as it recognised the need for more intensive use of renewable energy resources. The Strategy also emphasizes that energy-efficient and environmentally friendly behaviour in energetics requires non-selective endorsement of laws and non-discriminatory practice (Vlada Republike Srbije, 2014, p. 3). In this respect, it is important to develop an energy and ecologically friendly culture, as well as to prompt changes in the costumers' and energy producers' behaviour that would emerge from information campaigns and knowledge dispersion as key development factors of contemporary economy. The Strategy defined following goals as priorities for efficient use of energy (Vlada Republike Srbije, 2014, p. 48): a) energy reconstructions in the building sector, and b) the introduction of energy management system into the public

sector. Acknowledging the fact that the existing energy intensity indicators of the country have values that are close to the countries of the region, but significantly above average values of the EU countries, the Strategy insists on more intensive use of measures and procedures for increasing energy efficiency, with the strong state support.

Serbia adopted The Law on Efficient Use of Energy in 2013, which should contribute to increasing of the energy supply security and its efficient use, as well as the reducing of country's dependency on energy imports, increasing the competitiveness of the economy and citizens' standards of living and to reducing the energy sector negative impact on the environment. The overall aim of the Law (Sluzbeni glasnik Republike Srbije, 2013) is to encourage responsible behaviour towards energy. This Law, among other things, foresaw the introduction of mandatory energy efficiency labelling system for certain types of products (refrigerators, televisions, air conditioners, washing machines and dishwashers, electric ovens and bulbs), as well as the dynamics of its introduction. The Law also envisages the harmonization of products with the requirements of eco-design, as well as their adequate labelling as a precondition for their market positioning. When it comes to the energy efficiency and energy properties of buildings, the Law on Planning and Construction from 2009, as well as its by-laws more precisely regulate this area. This Law (Sluzbeni glasnik Republike Srbije, 2009) is the basis for the adoption of buildings' energy certification regulations. There are special regulations that enact the energy characteristics used in calculating the buildings' thermal properties and the energy requirements for new and existing buildings. These codes also regulate more closely the conditions, content and the ways of issuing energy passports. However, in Serbia, the implementation of these regulations is still in its infancy. Thus, for example, until March 2016, only 970 energy passports for newly build buildings were issued, whereby there is also an initiative to assign these certificates for existing buildings (Privredna komora Srbije, 2016).

Beside the introduction of energy efficient products, processes and technologies, it is necessary to inform end-users adequately about the energy properties of household appliances, but also to specify the responsibility of producers, suppliers and distributors, as well as additional conditions related to eco-design. More precisely, there is a need to educate the public, as well as to launch information campaigns on the possibilities of more efficient use of renewable energy sources, devices and technologies. It is important to create awareness in the society about the value of energy and the need for its rationale use. All this should contribute to the end-users buying more energy efficient products and thus to the achievement of the defined goals. Also, in construction of new and reconstruction of existing buildings, the Law on Planning and Construction and its accompanying regulations should be applied more consistently. This is particularly true for areas of permitted buildings' energy characteristics determination and energy certificates issuance. In this way, remarkable energy savings (around 16% of final energy consumption) could be achieved during the building new facilities or reconstructing the existing ones (Vlada Republike Srbije, 2014, p. 49). It should also raise the price of electricity for households, because it is important for the price to reach a level that would be disincentive to its irrational spending, especially when it is about space heating. However, the elementary prerequisite for changing the electricity price for households is the increase in the number of protected, socially vulnerable customers, which was, in 2017, several times lower than it should be according to the evidence of the competent institutions (Agencija za energetiku Republike Srbije, 2018, pp. 1-2). In addition to the above, the billing system per actual heat consumption should be introduced, with the possibility of regulating heat energy. All this could lead to its more rational consumption in the Serbian household sector.

References

1. Agencija za energetiku Republike Srbije, 2018. *Izveštaj o radu Agencije za energetiku za 2017. godinu*. Beograd: AERS.
2. Campbell, N. and Ryan, L., 2012. *Spreading the Net: the Multiple Benefits of Energy Efficiency Improvemens,* 2nd ed.[pdf] Paris: OECD/IEA. Available at: < http://www.ourenergypolicy.org/wp-content/uploads/2014/04/Spreading_the_Net.pdf> [Accessed 2 January 2019].
3. European Environment Agency, 2017. *Final energy consumption – outlook from IEA*. Copenhagen: EEA. [online] Available at: <https://www.eea.europa.eu/data-and-maps/indicators/final-energy-consumption-outlook-from-iea/final-energy-consumption-outlook-from> [Accessed 23 August 2018].
4. Eurostat, 2018. *Energy Balances*. [online] Available at: <http://ec.europa.eu/eurostat/web/energy/data/energy-balances> [Accessed 18 August 2018].
5. Eurostat, 2018. *Main GDP aggregates per capita*. [online] Available at: <http://ec.europa.eu/eurostat/web/products-datasets/-/nama_10_pc> [Accessed 21 August 2018].
6. Eurostat, 2018. *Population on 1 January by age and sex*. [online] Available at: <http://ec.europa.eu/eurostat/web/population-demography-migration-projections/population-data/database> [Accessed 20 August 2018].
7. Eurostat Statistics Explained, 2017. *Final energy consumption, EU-28, 2015 (% of total, based on tonnes of oil equivalent)*. [online] Available at: <http://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Final_energy_consumption,_EU-28,_2015_(%25_of_total,_based_on_tonnes_of_oil_equivalent)_YB17.png> [Accessed 2 July 2018].
8. Eurostat Statistics Explained, 2018. *Energy consumption in households*. [online] Available at: <http://ec.europa.eu/eurostat/statistics-explained/index.php/Energy_consumption_in_households#Energy_consumption_in_households_by_type_of_end-use> [Accessed 22 August 2018].
9. Index Mundi, 2018. *Serbia Economy – overview*. [online] Available at: <https://www.indexmundi.com/serbia/economy_overview.html> [Accessed 23 August 2018].
10. International Energy Agency, 2014a. *Energy Efficiency Indicators: Essentials for Policy Making*. Paris: IEA.
11. International Energy Agency, 2014b. *Energy Efficiency Indicators: Fundamentals on Statistics*. Paris: IEA.
12. Ivanovic, B., 1966. *Teorijska statistika*. Beograd: Jugoslovenski institut za ekonomska istraživanja.
13. Madzar, L., 2018. High-Energy Intensity Problems in the Republic of Serbia. *International Journal of Economics and Law*, 8(23), pp. 117-125.
14. Nakagami, H., Murakoshi, C. and Iwafune, Y., 2008. International Comparison of Hausehold Energy Consumption and Its Indicator. *ACEEE Summer Study on Energy Efficieny in Buildings*. Washington, D.C.: American Council for an Energy-Efficient Economy. [online] Available at: <http://aceee.org/files/proceedings/2008/data/papers/8_24.pdf> [Accessed 20 August 2018].

15. Organisation for Economic Cooperation and Development, 2012. *Promoting Energy Efficiency in the Residential Sector in Kazakhstan: Designing a Public Investment Programme*. Paris: OECD.
16. Ortiz-Santana, D. and Bernstein, M. A., 1999. *Measures of residential energy consumption and their relationships to DOE policy*. Washington, D. C.: Rand & Science and Technology Policy Institute.
17. Privredna komora Srbije, 2016. U Srbiji 970 zgrada ima energetski pasoš. [online] (Last updated 4 March 2016) Available at: <http://zelenaenergija.pks.rs/ZelenaEnergija.aspx?id=14&p=6> [Accessed 6 August 2018].
18. Republicki zavod za statistiku, 2016. *Osnovni podaci Popisa 2011*. [online] Available at: <http://popis2011.stat.rs/> [Accessed 22 August 2018].
19. Republicki zavod za statistiku, 2017. *Domaćinstva prema broju članova*. [online] Available at: <http://data.stat.gov.rs/Home/Result/3102020101?languageCode=sr-Cyrl> [Accessed 21 August 2018].
20. Republicki zavod za statistiku Republike Srbije, 2017. *Energetski bilansi, 2015*. Bilten no. 622, Beograd: RZS.
21. Sluzbeni glasnik Republike Srbije, 2009. *Zakon o planiranju i izgradnji*. no. 72/2009, Beograd: Sluzbeni glasnik RS.
22. Sluzbeni glasnik Republike Srbije, 2013. *Zakon o efikasnom korišćenju energije*. no. 25/2013, Beograd: Službeni glasnik RS.
23. Stevanovic, K., 2018. Srbija i EU: Otvorena dva nova poglavlja. *BBS News na srpskom*. [online] (Last updated 10 December 2018) Available at: <https://www.bbc.com/serbian/lat/svet-46506886> [Accessed 4 January 2019].
24. Tanjug, 2014. Naprednim tehnologijama do uštede energije. [online] (Last updated 16 April 2014), Available at: <http://mondo.rs/a682920/Info/Ekonomija/Naprednim-tehnologijama-stedimo-i-do-40-odsto-energije.html> [Accessed 24 August 2018].
25. Vlada Republike Srbije, 2014. *Predlog strategije razvoja energetike Republike Srbije do 2025. godine sa projekcijama do 2030. godine*. [online] Available at: <http://www.parlament.gov.rs/upload/archive/files/lat/pdf/akta_procedura/2014/113-14Lat.pdf> [Accessed 24 August 2018].
26. World Bank, 2018. *The World Bank in Serbia – Overview*. [online] Available at: <http://www.worldbank.org/en/country/serbia/overview> [Accessed 23 August 2018].