

# Energy Inefficiency of the Republic of Serbia as a Barrier to Future Energy Development

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**Abstract** — Modern trends in the area of energy efficiency have opened a number of issues, as whether developing countries (the Republic of Serbia being one of them) are ready to enter into this process of transformation and the new industrial era. In order to answer that question, we formulated the goal of the research which is reflected in the analysis of the energy potential of the Republic of Serbia, its utilization and efficiency levels. A detailed and systematic analysis of various theoretical frames and industrial reports identified the reasons for the low energy efficiency of Serbia at macro and micro levels, which represents a key barrier to securing energy and ecologically sustainable environment of our country. The lack of government initiatives or financial instruments for encouraging renewable energy, as well as accumulated and unresolved political and economic problems are just some of the barriers at macro level, while on micro level a large number of organizations in Serbia have problems with: high costs of heating and electricity, old plants, boilers that are not working at their full capacities and a range of other problems. Despite the current unfavorable energy balance, a small number of organizations is opting for change, because change itself is unknown, it carries a great risk and financial investments.

With regard to the situation identified in this field and considering the awareness of our society, process of energy efficiency growth and switching to renewable sources would be time consuming, followed by the need to implement radical and systemic changes at the state level and organizational system level, which would produce effects in the future. Measures in the shortest possible time frame are suggested in order to minimize the negative effects due to poor energy efficiency and primary use of conventional sources of energy, taking into account the existing situation and constraints, so this could yield positive effects and ensure environmental protection.

**Key words:** energy inefficiency, barriers, eco technology

## I. INTRODUCTION

One of the most important global topics in scientific, political and business circles is providing energy efficiency in order to achieve the same or even greater benefit while using less energy and simultaneously ensuring economic, social and environmental sustainability. The growing demand for energy, which a large number of countries encounter, and taking into account economic and environmental effects, focuses on defining the measures of stimulating growth of country's energy efficiency, along with adhering to the concept of sustainable development and environmental protection. All this leads to formation of a post-fossil energy age that

promotes finding new sources of power and new efficiencies with breakthrough technologies.

As we are witnessing it today, the energy market is facing much more challenges: limitation of fossil fuel reserves, increase in population, dearth of energy security, economic and urbanization growth [1]. Increasing research in that area point to a rapid downward trend of world reserves of conventional sources of energy and the need to go towards larger exploitation of renewable energy sources. It is believed that natural resources scarcity will lead to an increase in price of non-renewable resources, which will place renewable resources progressively on the business agenda of industries [2], enabling long term sustainability through realization of set of benefits shown on Fig. 1.

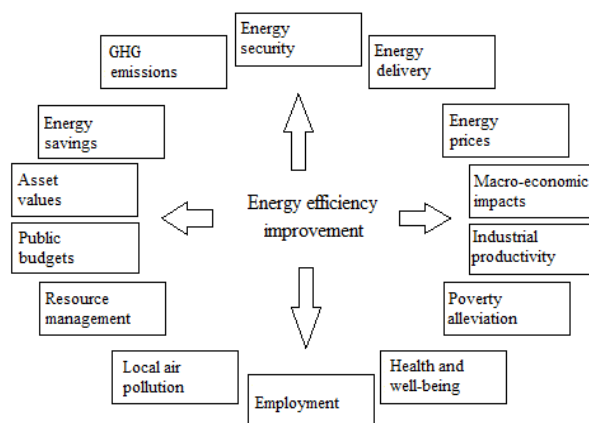


Figure 1. The multiple benefits of energy efficiency improvements [3]

In order to realize multiple benefits of energy efficiency, there is growing attention on the new sources of power and new efficiencies with breakthrough technologies that need to be found to step into the so-called post-fossil energy age. That would include lower cost of production, distribution and continuous operation, as well as smooth transition from nuclear energy, natural gas and biomass to solar, wind, and hydropower [4]. Although many are unprepared to handle the transformation, in the coming years there will be a new marketplace environment and fresh challenges in the form of transforming the entire industry [5]. Particularly in developing countries, where our country is listed, there is a gap between theoretical aims and objectives in this field on the one hand and practical realization of the same on the other. Despite present focus on increasing

investment into renewable energy while promoting new strategies for energy efficiency, in practice there is lack of implementation of the same, which leads to the conclusion that this industry is still characterized by focus on the planning phase with minimal involvement in implementation phase and the absence of practical benefits. On the territory of the Republic of Serbia situation in this area is very unfavorable because the percentage of utilization of renewable energy sources is at low level, with modest prospects for future improvement.

Global trends in energy efficiency and current situation in our country in this field have influenced the formulation of the basic objective of this paper that is aimed at identifying the reasons of economic inefficiency as present barrier to greater use of renewable energy sources. We have focused on two stages in this research; first, literature reviews from reputed academic journals and industry articles, and second, qualitative research used to identify various sources of energy inefficiency in the Republic of Serbia.

The paper is organized as follows: the second section describes energy situation and its utilization at the territory of the Republic of Serbia, the third section discusses and elaborates reasons of energy inefficiency in our country, the fourth identifies measures for establishing ecologically healthier environment, while the last one is the conclusion.

## II. ENERGY SITUATION AND ITS UTILIZATION IN THE TERRITORY OF THE REPUBLIC OF SERBIA

“Serbia is rich in sources of “clean” energy from nature, solar energy, wind, rivers, geothermal sources and biomass, of which it currently uses 33% of the available technical potential for achieving the estimated objective for 2020.” [6]. The greatest potential of renewable energy sources is biomass 49%, in large hydroelectric power plants 27%, solar energy 13%, wind energy 4%, geothermal energy 4% and 3% in small hydroelectric power plants [7]. The potentials of Serbia in renewable energy sources are amounted to about 4 million tonnes of oil equivalent (toe), of which biomass takes 2.68 million toe, solar energy has a potential of 640 000 toe, small hydropower plants of 440 000 toe, geothermal energy 185 000 toe and wind energy 160 000 toe. However, there is insufficient use of the potential that Serbia has, particularly in the field of hydropotential and biomass.

Currently, the aforementioned energy potential from renewable sources in the territory of the Republic of Serbia is not sufficiently utilized, and from the future's viewpoint it cannot be used effectively unless there is a clear political vision in this area, along with scientific and technological support. Political instability and a series of economic problems in domestic market that require state intervention slowed down the development of an adequate institutional framework in the field of renewable energy sources and raising awareness about the importance of using them. In order to overcome negative effects of political and economic developments in our country, which also have bad influence on energy efficiency, it is necessary to place an accent on harmonization of external and internal factors affecting this area in the future. One of the vital external forces for growth and development of renewable energy are

governments' regulatory and budgetary support in consistent manner, while the internal forces refer to those inside the industry that are formulated by business strategy, technology adoption, skilled workers etc. [8, p. 1369]. From the perspective of energy efficiency in renewable sources, it is of utmost urgency to identify the steps aimed at establishment of enabling external and internal environment, so we could keep the pace with the global trends and requirements.

## III. REASONS FOR ENERGY INEFFICIENCY OF THE REPUBLIC OF SERBIA – BARRIERS AT MACRO AND MICRO LEVEL

The main obstacle for creation of an energy efficient environment of our country is low awareness of both the state and its population about the importance and the treatment of such environment as a concept of negligible economic importance, which is inconsistent with the understanding of prominent economists worldwide. Unsustainable use of energy, together with limited supply of energy leads to slow economic growth and even negative levels of economic indicators [9]. Our energy intensity and energy productivity are far below the average values of these indicators in the EU [10], which indicates to the need for the Republic of Serbia to encourage changes in the energy use primarily at macro level and also at micro level. The need for change in this area at macro level is indispensable, as evidenced by the data of the International Energy Agency [3, p. 19], which indicates that 2/3 of the energy resources will remain unutilized until 2037 if policies and procedures in this field do not change.

There are numerous reasons of energy inefficiency in the Republic of Serbia:

- mentioned political issues and public policy that allows subsidizing the industry by taxpayers through provision of cheap energy with minimal investments and instruments to help in the use of renewable energy sources;
- social factors;
- industrial sector with lack of attention paid to energy efficiency investment opportunities by stakeholders in both private and government sectors, causing a growing technological gap in the territory of the Republic of Serbia from the perspective of poor application of energy efficient technologies.

Insufficient state incentives for investment into purchase of new energy-efficient plants caused utilization of the old ones that still use lignite as a fuel. On the other hand, the European Union's objective is to provide 20 % of its energy consumption from renewable energy sources [11], along with reducing fossil energy consumption and the consequent emission of green house gases [12]. Despite initiatives at the European Union level, Serbia has a high level of greenhouse gases emission, as evidenced by the fact that from the perspective of carbon dioxide emission per capita in 2013 Serbia was ranked fifth out of 36 countries in Europe. Another reason for the high CO<sub>2</sub> emissions in our country is underrepresentation of the need to control emissions of CO<sub>2</sub> in political circles and the absence of government subsidies for green energy [13, p. 4]. According to the "Doha Amendment to the Kyoto Protocol" to the United Nations Framework Convention to Climate Change, it commits

countries to 18% reduction (from 1990. levels) of green house gases by 2020 [14]. Globally, there is a growing concern about emissions of Green House Gas and consequent climate change, therefore renewable energy sources have become more attractive options for power generation [15, p. 763], while in the territory of the Republic of Serbia even in 2015 the situation has not been better from the perspective of utilization of renewable energy, because it lacked about 1,000 megawatts of electricity, which was again produced from lignite. All this is caused by high consumption of primary energy per unit of GDP in Serbia, which is 15 percent higher than the world average and nearly twice as high compared to the European members of the OECD [16]. As Wilkins summarises it, such increase in energy demand in developing countries highlights and emphasizes the urgent need for renewable, sustainable, affordable and environmentally sound energy systems [17].

Another reason that leads to the energy inefficiency of our country is the fact that the price of electricity is at a very low level, because it is on average 6 to 7 times cheaper than in the countries of the European Union, which leads to a small interest of both businesses and individuals for investing in more energy-efficient forms of energy. From their point, savings from using renewable energy sources are minimal compared to today's way of using electricity as a final energy, while from the perspective of economists it is evident that releasing some of the resources that are spent on energy could increase the disposable income that can continue to be invested into industrial sector. Social factors play a significant role, in terms of lack of population's awareness about the limitations and negative consequences of non-renewable energy resources, as well as distrust of both citizens and businesses in renewable energy sources, since investments in renewable energy require large costs in the present for greater and invaluable future benefit. Many potential customers are giving more importance to keep the initial low costs rather than to minimize the operating costs. Population's indifference towards the use of renewable energy stems from lack of knowledge and exposure to renewable energy in rural areas, and lack of easy access to information on the latest technologies, which results in uncertainty about the quality of new technologies [19]. Based on that, for the developing countries those technologies (which had not been used in their context before) had been more expensive and also presented more risk than the existing technologies [20]. Advocating the preceding viewpoint may lead to difficulties in business expansion in this area in the near future and so financial investment in the renewable energy business and its growth in the future may also be affected [8]. In order to minimize the probability of occurrence of the previous scenario, some of the proposed measures are to be implemented, namely: the development of knowledge management processes, either internal or external information sharing to sort out the problems of talent shortages and the lack of societal awareness [8, p. 1370]. Furthermore, education and information dissemination related to renewable energy must include everything, from resource studies and education about various renewable technologies to training and information about

available government incentives and support systems [15, p. 766].

At present, there is a lack of sufficient government incentive schemes as well as financing mechanisms to promote the adoption of renewable and sustainable energy technologies by businesses and industries [18]. Our country needs to formulate and promote a legal framework which will foster the creation of so-called green environment and induce the organizations to act accordingly. The need for such measures is necessary because the current uncertainties that the entrepreneurs involved perceive will greatly affect their innovation decisions and can prevent them from engaging in innovation projects aimed at developing and implementing emerging renewable energy technologies [8, p. 1378]. There should be emphasis on providing a set of financial incentives of different forms (subsidy, tax exemption, low interest loan, long-term credit, and specific funds for grid connected projects in rural/mountainous areas) [15, p. 766].

In addition to initiatives at macro level, it is necessary to encourage the initiative at micro level through development and application of new energy-efficient technologies that can be seen as a form of green or eco-innovation at the level of our organization, which is of great importance, representing a vision of sustainable innovation. Together with the aforementioned types of innovation application by large, financially strong and market-dominant organizational systems, it is necessary to encourage small and medium-sized organizations that want to keep up with the green way of doing business in cooperation and connection to large organizations with possibilities of joint investments in renewable energy and green technology. In this way the essential flow of information and knowledge at the organization level would be provided, which should also be encouraged at the state-organization level, science-economy level and vice versa. The current situation in our organizations reflects a low level of expertise in the field of energy efficiency and renewables, due to the lack of adequate guidance and technical support for operators [21] as well as poor 'information flow and communication', which are some of the greatest barriers to technology transfer experienced in industry [15, p. 766].

#### IV. MEASURES FOR ESTABLISHING ENVIRONMENTALLY HEALTHIER ENVIRONMENT

Inefficient use of energy sources, ongoing reliance on conventional energy sources and minimal use of renewable energy sources has led to poor environmental situation in our country, which points to the need for proposing measures with the aim of overcoming the same.

One of the greatest threats to disrupted ecological environment in our country is transport sector, which is responsible for 30% of CO<sub>2</sub> emissions, and given the average age of cars, namely 13 years, the average fuel consumption per 100 kilometers is 10 liters. Since the European Commission carried out an initiative to reduce greenhouse gas emissions within the transport sector, emphasis is placed on using biofuels and bio liquids which will provide GHG emission reduction of at least 35%. Looking at the trend of using biofuels in the period from 2007 to 2013, there is a significant progress that has

led to three times higher production in 2013 compared to 2007. However, comparing to neighboring EU member states, biofuels consumption in Serbia is significantly lower here than in Hungary, Romania and Bulgaria, while it is higher than in Croatia (Table 1.).

TABLE I.  
BIOFUEL CONSUMPTION IN ROAD TRANSPORT PER COUNTRY, 2007–2013 (IN TJ) [11]

Country	2007	2008	2009	2010	2011	2012	2013
Bulgaria	0,147	0,147	0,221	0,846	0,699	3,496	3,496
Croatia	0,110	0,147	0,328	0,110	0,164	1,526	1,526
Hungary	1,2	6,892	7,079	7,317	6,934	6,531	6,062
Romania	1,693	2,061	1,690	4,753	7,761	9,126	9,126
Serbia	0,980	1,961	2,941	2,941	2,941	2,941	2,941

At the national level it is necessary to encourage the use of biofuels and bio liquids in parallel with prescribed sustainability criteria while sourcing, producing and using biofuels and bio liquids in accordance with the Renewable Energy Directive (2009/28/EC). Making such procedure will enable financial support from the EU to the organizations that adhere to these procedures, as well as the ability to export the same to the EU market. One needs to go a step further by promoting the use of methodology for calculating the reduction of GHG emissions due to utilization of biofuels in transport, which would allow savings of GHG emissions in January 2017 at the amount of 50%, while for January 2018 expected savings could rise to 60%. State's commitment is inevitable at macro level for environmental protection with minimal GHG emissions and promotion of utilizing renewable energy sources, which will encourage formation of green or eco-industry, one of the most dynamic sectors in the European Union with a strong tendency of growth. However, positive effects of the proposed measures at macro level will fail if the companies in this and other sectors do not recognize the need for more energy-efficient way of doing business.

At the organization level, the need for more energy-efficient and environmentally responsible business should be carried out by potentiating green innovation as the vision of sustainable innovation with the aim of diagnosis, monitoring, reduction or prevention of environmental problems [22]. In the future, transformation of traditional business should be ensured towards green business which would lead to minimization of technology gap that exists in the territory of the Republic of Serbia due to utilization of energy-inefficient technologies. This transformation is important because organizations are one of the major participants whose current way of doing business led to poor environmental situation. Application of green business concept would make organizations become more environmentally responsible, and in the new era of green economy they would be more likely to achieve competitive advantage. Deteriorating ecological image in the world is caused by global warming, major environmental pollution, excessive waste, lack of natural resources, and it stimulates the development and utilization of green technologies which should enable implementation of sustainable development and thus protect the environment and solve accumulated environmental problems. Countries around the world should encourage investment into research and development of these types

of technologies, which represent the innovation trend. So far, countries that invest the most into the development of green technology are Japan, the United States and Germany [23]. Today, most organizations in the world tend towards implementation of green technologies, application of green materials in order to create the so-called green profile of their products [24], which directly provides new market opportunities. Organizations that implement green innovation invent new techniques, methods and processes in order to eliminate negative environmental impacts. Some economists believe that organizations that invest in green business concept and application of green technologies lead to positive social effects, but that the financial effect of that action is absent. For these reasons, although the green innovations together with green technologies represent an innovative trend to be pursued, a large number of organizations is not motivated to invest into research and development of green innovation due to absence of income. The above mentioned situation occurs also in the industrial sector of Serbia, because this kind of technology is still considered to be financially ineffective. However, a number of economists believe that its use does not lack financial effects, but tends to increase competitiveness of an organization, and therefore secures better financial position. They believe that green technologies are leading to a win-win situation with economic and environmental benefits [25, p. 422]. Organizations that find themselves in a win-win position lead to positive effects for directly or indirectly involved parties in the process of doing business. In addition to the positive effects that an organization has at micro level, there is realization of positive effects on macro level through benefits for all members of society.

Given the whole society's benefit from the development and application of green innovation, both in the field of management and technology, organizations in our country should work together on their research and development in order to achieve greater effects. The need for joint action stems from two reasons. Primarily, today's organizations are still inexperienced in coping with environmental problems, because there are no organizations that possess the ability to develop and implement eco-innovation processes and products [25, p. 423]. On the other hand, common development and application of eco-innovation solves environmental problems. Organizations in the field of green business need to establish cooperation with the government, intellectual institutions, suppliers, customers, competitors' organizations and industry associations [26, p. 413], in order to achieve a synergetic effect in the context of environmental protection. Interaction and coordination of all participants is indispensable in order to achieve the desired effects of application of the concept of eco-innovation and green business, as their implementation alone does not lead to a win-win situation and prosperity of the market.

## V. CONCLUSION

Various barriers to adopting energy efficiency and sustainable energy technologies in Serbia have been identified from the literature review and expert opinions in detail. The main obstacle for creation of an energy efficient environment in our country is poor awareness of both the state and its population of the importance and the

treatment of this concept as the one that has negligible economic importance. From the aspect of the country, there is a lack of sufficient government incentives schemes or financing mechanisms to promote the adoption of renewable or sustainable energy technologies. From the perspective of the population, there is insufficient awareness of their limitations and negative consequences of non-renewable energy resources, as well as distrust of both citizens and businesses about renewable energy sources, since investments into renewable energy requires large costs at present for a higher and invaluable benefit in the future. Previously mentioned barriers of energy efficiency lead to a bad situation in Serbia, caused by frequent false directing of Serbia towards investment in unsustainable systems which will lead to major negative effects on the environment, climate change and long-term development of the country. Therefore, this paper may play an important role in understanding various barriers and help in better utilization of energy potential of the Republic of Serbia, as well as removal of the mentioned barriers in order to adopt sustainable energy technologies more effectively and efficiently.

Currently underutilized renewable energy potential of the Republic of Serbia directs political public to formulate a clear vision in the field of energy efficiency, through setting up an adequate institutional framework that will allow the alignment of external and internal factors affecting this area and their positive effects in practice. It is necessary to implement planning in the field of energy efficiency, where an important role is played by the scientific community which should point to the world trends in this area, as well as the state that sets the energy development strategy, desired objectives and the proposed actions in the function of achieving global benchmarks. Synthesis of the planning phase and implementation phase is indispensable in order to ensure the transformation of the desired goals into practical results as soon as possible by establishing cooperation with the business sector of our country at the levels: Knowledge Management Process, Intellectual Capital Maintenance and Performance Measurement. In this way, essential flow of information and knowledge would be provided at the levels organization-organization, organization-state, science-economy and vice versa. In the business sector the emphasis should be placed on transition from traditional to green business that supports the use of new energy efficient technologies, minimizes emission of CO<sub>2</sub> and allows application of concept of sustainable development. If the state promotes energy and environmentally responsible behaviour of its population and such activities of all participants in its economy, there will be a synergy effect of positive benefits in this area, and a win-win situation for all participants, both at present and in the future.

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