

APPLICATION OF RENEWABLE ENERGY SOURCES IN TERMS OF ECONOMIC, ENVIRONMENTAL AND SOCIAL SUSTAINABILITY

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Abstract:

We are witnesses of everyday changes, which can bring the world into the question of survival. On the other hand, the progress and the speed of changes are the keys of success. What is important is that we have to change the human being's life, due to the concept of the sustainable development, which includes three dimensions: ecology, economy and social aspect. This paper gives the analysis of using the renewable energy, through the production of the electricity, including the sustainable development.

Through research, attention was paid to analyzing the growth in the share of renewable energy in electricity production, as well as incentives to use renewable energy sources, in the area of Republic of Srpska.

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1. INTRODUCTION

Modern life style means much more energy, with the goal to achieve higher effectiveness and comfort. Nowadays, most energy needs are settled using extremely harmful fossil fuels, which, in the future, should be replaced with cleaner energy resources, like renewables or nuclear energy.

Sustainable development is a dominant philosophy which must be respected by every human in a global world, if he/she wants to settle nowadays needs without compromising the ability of future generations to meet theirs [1].

Also, sustainable development means maintaining a balance between use, saving and restoring all resources, and understanding that the generations who are coming will largely depend on our present actions [2].

The paper's topic is very current due to the fact that the development of the renewable energy sources is a major challenge for the future of the whole world.

2. RENEWABLE ENERGY SOURCES

Renewable or inexhaustible sources of energy are those on the Earth, which are available in unlimited quantities. Although, the process of conversion and transformation temporarily spends their quantities, i.e. they can always be restored. Also, they are called alternative energy sources [3].

Renewable energy sources can be divided into several groups, based on similarities, which illustrates Fig.1 [3]:

- solar energy,
- wind energy,
- hydropower,
- earth energy,
- energy from biomass and
- other renewable energy.

Knowledge of the relative limitations and exhaustion of conventional, non-renewable energy resources and limited capacity of energy supply from renewable energy sources, have an impact on

energy and economic development, forcing all users to rationality and maximum savings [3].

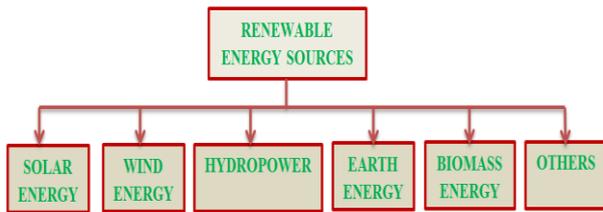


Fig.1. Renewable energy sources

Energy of the future, but not only it, completely should turn to renewable energy sources, which will stop any unreasonable and irreversible exploitation of non-renewable fossil fuels. It is, for sure, Solar energy, created millions of years ago, which humanity consumes in the most unreasonable and the most possible damaging way, often destroying their own environment, which is increasingly becoming a prerequisite for the survival of the civilization. Non-renewable energy sources, such as coal, oil and nuclear energy, by the end of the 21st century will have been replaced with new, renewable, environmentally clean, natural energy sources, especially Solar, wind, water, biomass and geothermal energy [4].

Solar energy can be used actively and passively. The active use of energy means the conversion of solar radiation, directly, into heat or electricity. On the other hand, passive use of energy refers to energy efficiency, in the use of Solar energy, for heating homes and other buildings [3].

Like most of the renewables, wind energy is also derived from solar radiation. Wind energy occurs like a circumstance of a complex process of weather, various soil heating and evaporation of weather, which leads to differences in atmospheric pressure, at different geographical position and movements of air masses from a higher to a lower pressure position [3].

Hydropower plants are plants in which the potential energy of water is first converted into kinetic energy of its flow, then into mechanical energy of the rotation of the turbine shaft and finally into electrical energy, in the generator [5].

Geothermal energy, in a narrow sense, includes only that part of the energy from the ground, which in the form of hot or warm geothermal media (water or steam) passes through the surface of the earth and is suitable for utilization in the original format (for bathing, treatments, etc.) or conversion to other forms (electricity, heat in thermal systems, etc) [5].

Biomass is a biodegradable part of product, waste product from agriculture, forestry and forest industry, plant and animal origin, which use of energy is allowed in accordance with the regulations of environmental protection [6].

In the world, there are attempts to beneficial use of other renewable energy sources. This mainly refers to the energy of seas and oceans [3].

3. SUSTAINABLE DEVELOPMENT

Establishing a balance between economic development and higher standards of living, with the population growth and depletion of natural resources, creates a conceptual basis for an entirely new approach to the development of humanity - sustainable development [1].

According to one of the most commonly used definitions, sustainable development is one that meets the needs of humanity in the present, taking care not to jeopardize meeting the needs of those who will live in the future [2].

Sustainable development implies a balance between meeting basic needs and achieving a certain standard of living, with the available natural resources and preservation of the environment. In essence, sustainable development is a process in which there is a harmony between the exploitation of resources, direction of investments, orientation of technological development and institutional change, in order to improve the potential for the satisfaction of human needs, both now and in the future [2].

Many researchers agree that the terms sustainability and sustainable development could be described together as an improving of the life quality, in terms of a healthy environment, i.e. improving the social, economic and environmental conditions, for current and future generations [2].

Vollenbroek argued that sustainable development is the balance between available technologies, innovative strategies and laws, passed by the Government of the country. Sustainable development is a challenge, on one hand there is a meeting of the growing needs of humanity to natural resources, energy, food, transport and waste management and on the other hand there are conservation and protection of the environment and basic resources, for the life of future generations and their development. This concept includes the view that in the long run human needs can not be met, without preserving the physical, chemical and biological systems on the planet [2].

Sustainable development encompasses three aspects, which are commonly referred to as pillars viability [2]:

- the economic aspect,
- aspect of the environment and
- social aspect.

Previous illustrates the next Fig.2.



Fig.2. Sustainable development [7]

For the economic aspect it is necessary to ensure economic growth, in order to improve the life quality. The economy is therefore essential for long-term survival of the community. When we talk about sustainability, it is often associated with the aspect of the environment business practices, energy efficiency and sustainable business [2].

For the environmental aspect it is necessary to reduce to a minimum damage of the environment, pollution and exploitation of natural resources. Environmental issues make up the core of sustainable development and they are inextricably linked with the economic and sociological component. Community cohesion with its environment is complex and involves the exploitation of resources and consumption which acts to a local and also global eco-region [2].

For the social aspect it is necessary to ensure fairness in the resource distribution between the rich and poor. Social equality, in terms of sustainability, is usually considered as intergenerational, because the activities taken today affect the life of the community in the future.

Sustainable development is aimed at improving the living standards of individuals, with short, medium and long-term preservation of the environment. Its goal is threefold; development which is based on economic efficiency, social justice and sustainable environmental protection. Discussion of the concept of the sustainable development in particular contribute the challenges

that come with the vulnerability of the environment. Some of these challenges are: global warming, ozone layer depletion, the greenhouse effect, deforestation, the phenomenon of acid rain, the extinction of plant and animal species and the climate change, as the biggest and the most complex challenge that human society faces today [2].

3.1. Main aspects of the sustainability of the power system

The electricity system consists of generation, transmission, distribution and consumption of the electricity. The main task of this system is a reliable and quality supply of the consumers. This is the largest, most influential, the most necessary and the most widely used technical system, and it is, therefore, the most expensive.

Once the electricity is produced in power plants it is handed over to customers. The settlements, cities and finally the whole country are interwoven with power lines that transmit electricity [8].

The electricity system is the most widely used, which follows from its size. The only system which could be compared to the power system is the Internet. But, even comparing it to the Internet, we can say that the power system is more widespread than the Internet because there are places where the electricity is available, but the Internet isn't. As well, to connect to the Internet, in most cases, it is necessary to have the electricity infrastructure.

Nowadays, there is a number of 30 main energetic indicators of the sustainable development which are classified according to the three dimensions of the sustainable development [8]:

- economic dimension (16 indicators),
- dimension of the environment (10 indicators),
- social dimension (4 indicators).

Taken together, these indicators can give a picture of the whole energy system, including interconnections and exchanges between the different dimensions of sustainable development, as well as the long-term consequences of the current decisions and behavior. Changes in the indicators, over the time, show the progress or its absence in relation to the sustainable development.

The next tables 1, 2 and 3 show mentioned indicators.

Table 1. Energy indicators for sustainable development - economic aspect [8]

ECO 1	The use of energy per capita.
ECO 2	The use of energy per unit of GDP.
ECO 3	The efficiency of the energy conversion and the distribution of energy.
ECO 4	The ratio of the energy reserves and production.
ECO 5	The ratio of natural resources and production.
ECO 6	The energy intensity in the industry.
ECO 7	The energy intensity in the agriculture.
ECO 8	Services/energy intensity in the store.
ECO 9	The energy intensity in the households.
ECO 10	The energy intensity of the traffic.
ECO 11	The fuels shares in the electricity and energy.
ECO 12	The energy shares that does not contain carbon in the power generation and energy.
ECO 13	The renewable energy shares in the electricity generation and energy.
ECO 14	The energy prices for end users by sectors and by fuels.
ECO 15	The dependence on energy imports.
ECO 16	The inventories of missing fuels at an appropriate consumption.

Table 2. Energy indicators for sustainable development - environmental aspect [8]

ENV 1	The emissions of greenhouse gases due to the energy production and use per capita and per unit of GDP.
ENV 2	The concentration of the air pollutants in urban areas.
ENV 3	The emissions of air pollutants from the energy system.
ENV 4	The discharge of the contaminated substances in the fluids, from the energy system, including the discharge of oil.
ENV 5	The land where acid rains exceed the allowable limits.
ENV 6	The ratio of the deforestation and the use of energy.
ENV 7	The production of solid waste per unit of produced energy.
ENV 8	The ratio of the correctly deflected solid waste and the total quantity of produced waste.
ENV 9	The solid radioactive waste per unit of produced energy.
ENV 10	The ratio of the solid radioactive waste, which is waiting to be removed, and total produced solid radioactive waste.

Table 3. Energy indicators for sustainable development - sociological aspect [8]

SOC 1	The share of the households without electricity or commercial energy, high dependence on non-commercial energy.
SOC 2	The share of the households income on fuel or electricity.
SOC 3	The energy use in households for each income group and corresponding fuel combination.
SOC 4	The number of accidents and injuries of the produced energy in the chain of the energy production.

4. THE GREEN ENERGY - THE ENERGY OF THE FUTURE

The role of the energy is to encourage the growth and the economic development of the Republic of Srpska, taking into account environmental protection. The development of the energy sector will be achieved by technological development, strengthening of the domestic companies, increasing of the investment and competitiveness of the economy of the Republic of Srpska.

In the Republic of Srpska, the most important renewable energy sources are the energy of the watercourse (in large hydro power plants) and wood (for heating in households). The potential for hydropower development is significant and largely untapped, but in the terms of renewable energy here is emphasis on the smaller streams, i.e. the construction of small hydropower plants. Also, there is a significant potential for using wind, solar, agricultural biomass and geothermal energy, but unfortunately, now they are particularly not used [9].

In the Republic of Srpska, producers of electricity from the renewable energy sources are entitled to incentives. Right at the instigation of electricity, produced from the renewable energy sources and efficient cogeneration, based on the Agreement on mandatory purchase of electricity for the production from the renewables at the guaranteed purchase price for electricity which is delivered to the network, currently achieve 52 companies [9].

The right to an incentive is realized by companies that own hydroelectric power, solar power, biomass or biogas. It is interesting that, at the moment, there are no wind turbines or power plants that utilize the energy of the Earth, during the electricity production, even though the objective conditions exist. Percentage share of various energy plants

that are entitled to incentives is shown in the following Fig.3.

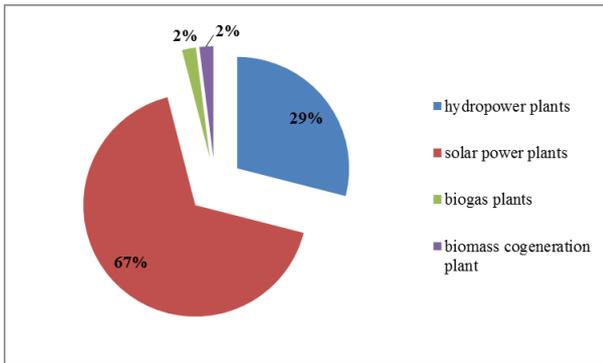


Fig.3. Percentage share of various energy plants that are entitled to incentives

Fig.4 provides information about the total amount of the mentioned power plants.

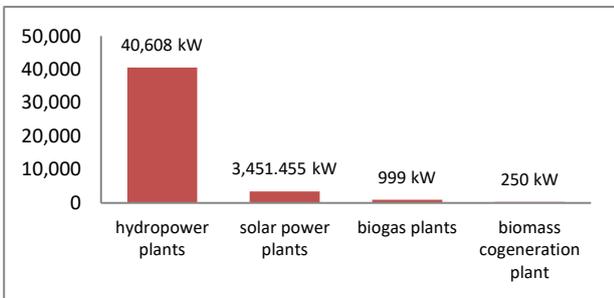


Fig.4. Total amount of the power plants

Although the percentage share of hydro power plants is lower than the solar plants, the total planned production of the electricity by hydro power plants is about 35 times higher than the solar plants. Also, the total planned electricity production of a biogas plant is about 2 times higher than the total planned production of all 35 solar power plants, although the solar power plants overall strength is much higher than the power of the biogas plant. Above said is shown in the Fig.5.

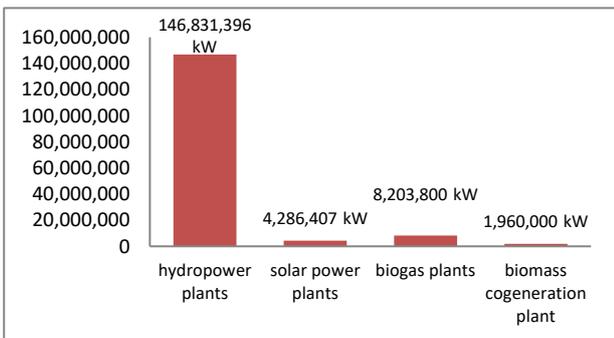


Fig.5. The total planned electricity production of the power plants

Period, which is analyzed is the time interval of 4 years, from 2012 to 2016. The following Fig.6 shows how varied the number of companies that have received the right to incentives, during the said period.

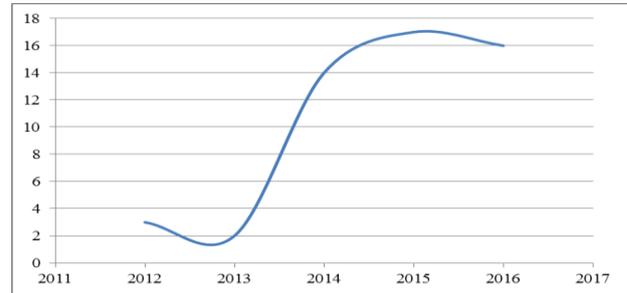


Fig.6. Curve of the companies that have received incentives during the period 2012-2016

Since 2012, the share of renewable energy is steadily increasing, due to their enormous benefits. Table 4 shows the share of renewable energy in the system of incentives in the total consumption of the electricity in the Republic of Srpska and the Fig.7 displays it graphically.

Table 4. The share of renewable energy in the system of incentives in total consumption of the electricity in the Republic of Srpska [9]

	UNIT	YEAR				
		2012.	2013.	2014.	2015.	2016.
Total gross of the electricity production	kWh	3.670.321.440	3.693.716.900	3.682.021.225	3.821.051.340	4.002.584.204
The total electricity production from renewables	kWh	5.049.206	24.650.412	42.095.078	45.143.269	112.902.081
Participation of the renewables in total consumption	%	0,14	0,67	1,14	1,18	2,82

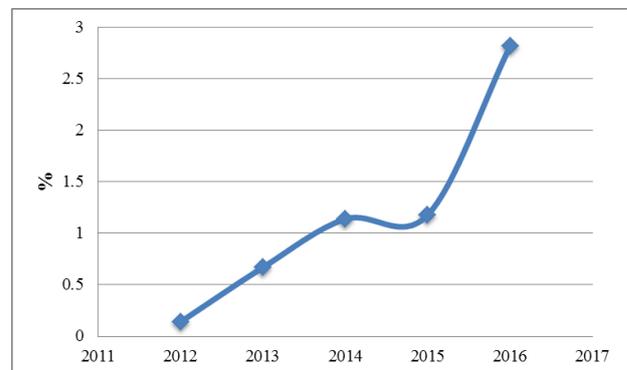


Fig.7. The growth of the renewable energy sources in the system of incentives in the total consumption of the electricity in the Republic of Srpska

5. CONCLUSION

Humanity today faces great problems in the energy sector. There are growing energy needs of mankind, which is every day more and more increasing. Limited reserves of non-renewable energy sources with its emissions exhaust gases and particulates significantly affect climate change in the world.

Currently, as an environmentally friendly solution there are renewable energy sources. Like all new technologies, at this stage of development, the exploitation of renewable energy economically is not, yet, fully viable. As a result, many countries, with their various measures of incentives are affecting the development and the use of renewable energy sources, including the Republic of Srpska. Republic of Srpska with these measures seeks to increase the spread of so-called application of the green energy.

Interconnection of economic and socio-cultural development, with the state of the environment, the need for the necessary natural balance, processes and global living conditions, today have become the part of the economic, political, normative-institutional and cultural reality of the modern humanity.

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