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OVERVIEW OF RENEWABLE ENERGY SOURCES IN SERBIA AND IN THE WORLD

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Abstract: We are at the end of one epoch when fossil fuels, conventional or non-renewable energy sources can not be the basis for our future development planning. Consequently, since all of these resources are exhausted, it is necessary to look for and bring in some new sources of energy in usage, and it is the moment when a person turns to nature or to renewable energy sources. Renewable energy sources are inexhaustible energy sources that are obtained from nature and are renewed at a certain interval of time. This paper presents the comparison of some different types of renewable energy sources that are used in Serbia, opposed to those that are used in the world. The paper also presents some regions on the territory of Serbia which has a good potential for some different types of the RES.

Key words: Renewable energy sources (RES), potential, thermal, Serbia, world.

INTRODUCION

Renewable energy sources have significant potential for improving the development of humanity. Energy from renewable sources - water, wind, sun and biomass, among others - can facilitated access to clean and safe energy for millions of people. It can provide an incentive for social and economic development, helping to cope with environmental challenges, and has a key role in successfully dealing with climate change. First of all, we need to define what renewable energy sources are. Renewable energy sources are inexhaustible energy sources of nature that are renewed at a certain time interval, in whole or in part. These energy sources are used for the production of electrical, thermal and mechanical energy, and their significant sustainability is environmental harmony, with reduced or reducing CO₂ emissions in the process of energy production. The usage of this elements are now the most important thing for us because we exhausted some of existing sources of energy, [1,2].

Renewable energy sources can be divided into two categories, [3]:

- Traditional renewable energy sources like: biomass and energy of large hydropower plants and
- „ New renewable energy sources“ such as energy of Sun, wind energy, geothermal energy, ect.

The development of renewable energy sources, especially from wind, water, sun and biomass, is important for several reasons, [3]:

- These energy sources play a very important role in reducing carbon dioxide (CO₂) emissions into the atmosphere. This is also an important part of the European Union's policy.
- Increasing the contribution of renewable energy sources we increase the energy sustainability of a country's system. At the same time it helps to improve the security of energy delivery and thus reduces the dependence on imports of energy raw materials as well as electricity,
- Renewable energy sources are expected to become economically competitive with conventional energy sources in due course.

Today, new energy sources produce only a small part of the world's total energy. This share in the future should increase considerably as non-renewable energy sources are getting smaller and their reserves are on the brink, and their detrimental impact is more and more pronounced in the last few years. The Sun, without whom there is no life on our planet, gives Earth several thousand times more energy than mankind is able to spend at the current stage of development. Everything is in favor of the fact that renewable sources can and must start to be better exploited and that if we do wisely, we do not have to worry about energy after fossil fuels.

OVERVIEW OF RENEWABLE ENERGY SOURCES IN SERBIA

Renewable energy sources are the main backbone of Serbia's energy independence in the future. The total potential of energy from renewable sources can satisfy a quarter of the annual needs of Serbia. The total technically available potential of renewable energy sources in the Republic of Serbia is estimated at 5.65 million ten for the year. Of this potential, 1.054 million ten of biomass (mainly firewood) and 909 thousand ten of hydroelectric power plants. As we said before, biomass present a huge energetical potential for Serbia, [4,5].

The potential of biomass is estimated at 3.448 million ten and in the total potential of RES accounts for 61%. Of this potential, the greatest part is the potential of wood biomass - 1.53 million ten and the potential of agricultural biomass - 1.67 million ten (residues in farming, livestock breeding, fruit growing, viticulture and primary fruit processing), while the potential of biodegradable municipal waste is estimated at 205 thousands of ten. Biodegradable waste (excluding municipal waste) consists of waste edible oils and animal waste (waste slaughterhouse waste) in the total amount of 0.043 million ten / year. Wood biomass is mainly in the area of central Serbia, and agricultural biomass in the area of Vojvodina. However, while the degree of utilization of potential is wood (forest) biomass is relatively high (66.7%), the potential of agricultural biomass is slightly used (~ 2%), while the potential of biodegradable municipal waste is not used at all, [4,5].

The total theoretically available hydropower potential of the waters that flow on the territory of the Republic of Serbia is around 25000 GWh / year. The largest part of the hydro-potential (over 70%) is concentrated only on several watercourses with a potential above 1000 GWh / year: Danube, Drina, Velika Morava, Lim and Ibar. On the other hand, on several rivers in the Republic of Serbia, hydro power potential will only be able to be partially used, due to the priority of water management of water, because some rivers are planned as sources of regional water supply systems: Toplica, Crni Timok, Rasina, Studenica, Veliki Rzav, Mlava, Lepenac, etc. The technically usable potential in the Republic of Serbia is around 19.5 TWh / year, of which about 17.7 TWh / year at facilities greater than 10 MW. So far 16 hydropower plants have been built and produced on average about 10.5 TWh per year. The total technical potential of hydroelectric power plants up to 10 MW is estimated at around 1800 GWh per year.

Wind energy in the Republic of Serbia can be used in the area of the Kosavsko area, southern Banat, the area of eastern Serbia, the eastern side of Kopaonik, the area of Zlatibor and Pester and on the location of mountain-crossings that have elevation above 800 m. For the clearer understanding of the potential, it is necessary to continue to devote wind measurements (started in southern Banat and eastern Serbia) in order to produce wind atlas, as one of the conditions for investing in wind power generation capacities. The technically usable wind potential is determined on the basis of the existing technical possibilities of the electric power system to take this energy. Additional assumptions in determining the potential are that the maximum variation of wind power generation will not coincide with the maximum variations in the production of electricity from solar power plants and that the maximum variation will not exceed 90% of the total installed capacity. This means that in the installed capacities it is possible to have 500 MW with the current size of the tertiary power reserve, which can be provided in thermal power plants and accumulation hydroelectric power plants. Considering the maximum possible production of wind farms with this installed power, they

can count on their maximum technically usable potential of 1200 GWh / year (0.103 Mtoe / year), [4,5].

Energy of the Sun represents the energetic potential of the Republic of Serbia, which can be used for the production of heat or electrical energy. The huge part of the territory of the Republic of Serbia, the number of hours of solar radiation is significantly higher than in many European countries (between 1500 and 2200 hours per year). The average intensity of solar radiation in the territory of the Republic of Serbia ranges from 1.1 kWh / m² / day in the north to 1.7 kWh / m² / day in the south - during January, and from 5.9 to 6.6 kWh / m² / day - during July. Annually, the average value of the energy of radiation is 1200 kWh / m² / year in northwestern Serbia, up to 1550 kWh / m² / year in southeastern Serbia, while in the central part it is about 1400 kWh / m² / year. The technically usable energy potential for the conversion of solar energy into heat energy (for the preparation of hot water and other purposes) is estimated at 0.194 million ten yearly, assuming the use of solar thermal collectors in 50% of available facilities in the country, [4,5].

The Republic of Serbia is located in the zone of favorable geothermal potentials and resources. Geothermal energy implies petrothermal and hydrogeothermal energy resources that the Republic of Serbia has abundantly used. The use of geothermal energy for heating and other energy purposes in the Republic of Serbia is at an early stage and very modest in terms of potential and resources. The geothermal potential of the Republic of Serbia clearly shows the existence of a large number of spas and natural springs with water temperatures greater than 30°C, and a different degree of natural diversity. Based on the existing measurements, the heat flux is above the average for Europe (60 mW / m²), or ranges from 80 to 120 mW / m². Natural and artificial sources of thermal water have been identified in the territory of more than 60 municipalities. The water temperature is usually in the range of 40°C, and only in the territory of six cities / municipalities (Vranje, Sabac, Kuršumljija, Raska, Medveđa, Apatin) the water temperature is over 60°C. Average water flows from existing sources and wells are on average up to 20 l / s. At several locations, the flow of water exceeds 50 l / s (Bogatic, Kuršumljija, Pribojska Banja, Niška Banja), and only at one location the flow of water exceeds 100 l / s (Banja Koviljača). The total thermal power that could be obtained by utilizing all existing thermal water sources is about 216 MW_t, with the production of thermal energy of 180 thousand ten. Significant but unimaginable geothermal potential lies in the use of negative and sedimented oil and gas wells in Vojvodina, where the exploitation is completed, [4,5].

These are all the most recent facts related to the RES in Serbia, but to see that Serbia had progression on this way, on Figure 1. we would show the facts related to the RES from 2012.

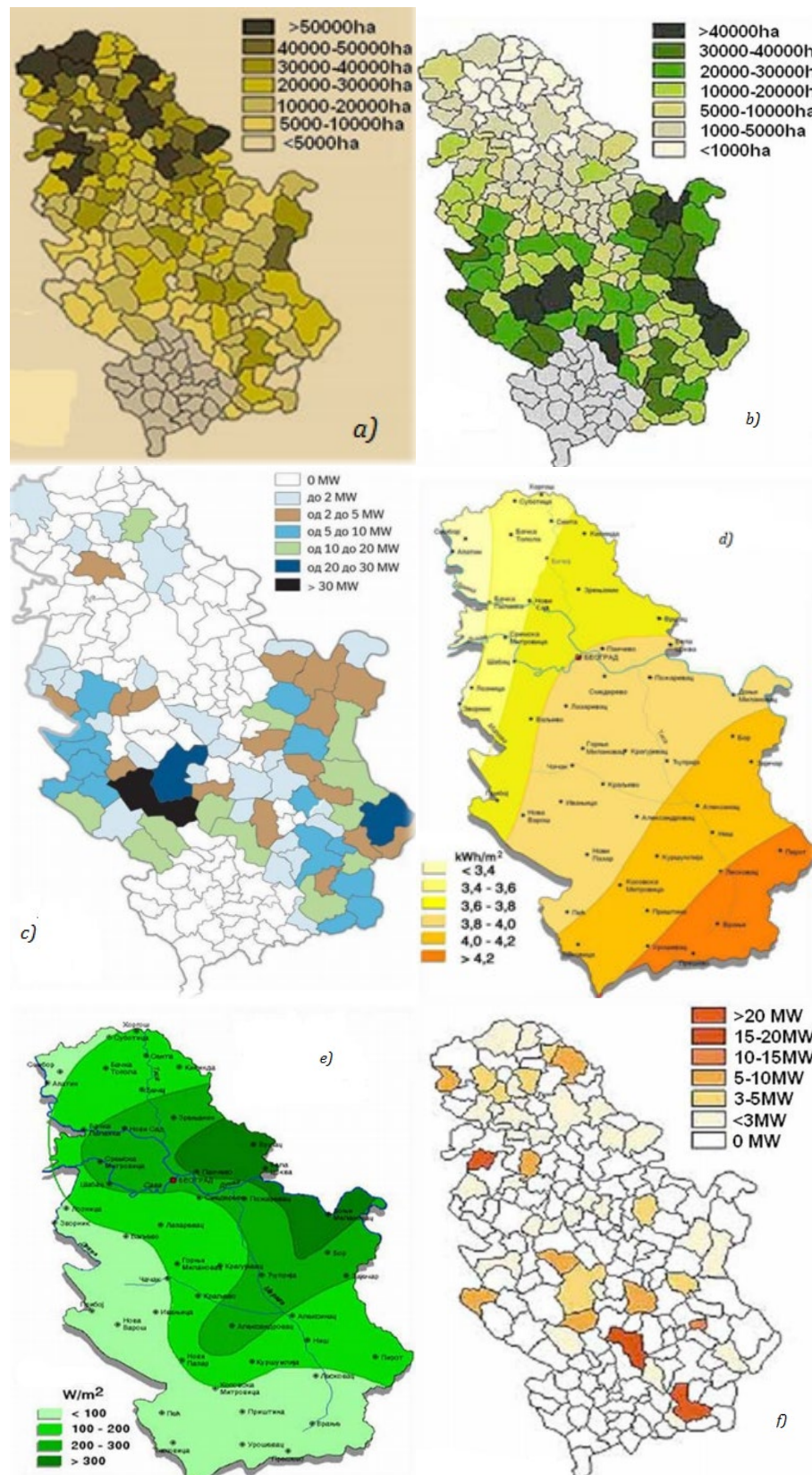


Fig. 1. Potential for some parts of Serbia for using the RES and the numbered datas from 2012.
 a) sources of biomass – arable lands, b) sources of biomass – surface with the forests, c) hidroenergy - total power of small hydropower plans, d) areas with a large number of sunny hour – annual average of the daily energy of global radiation on the horizontal surface, e) wind energy – average annual wind power at 100 m, f) geothermal energy – total power from geothermal sources, [1].

OVERVIEW OF RENEWABLE ENERGY SOURCES IN THE WORLD

Renewable technologies include hydropower, solar, wind, geothermal and modern biofuel production (including modern forms of waste-to-biomass conversion). The change & mix of modern renewable consumption over the last 50 years is shown in the Figure 2. below. This is measured in terawatt-hours per year and can be viewed across a range of countries and regions. Globally, the world produced approximately 5.9 TWh of modern renewable energy in 2016. This represents a 5 to 6-fold increase since the 1960. Here we see that hydropower remains the dominant form of modern renewables consumption, accounting for almost 70 percent. Despite absolute growth in production, hydropower's share is, however, declining as other renewable technologies grow, [6,7].

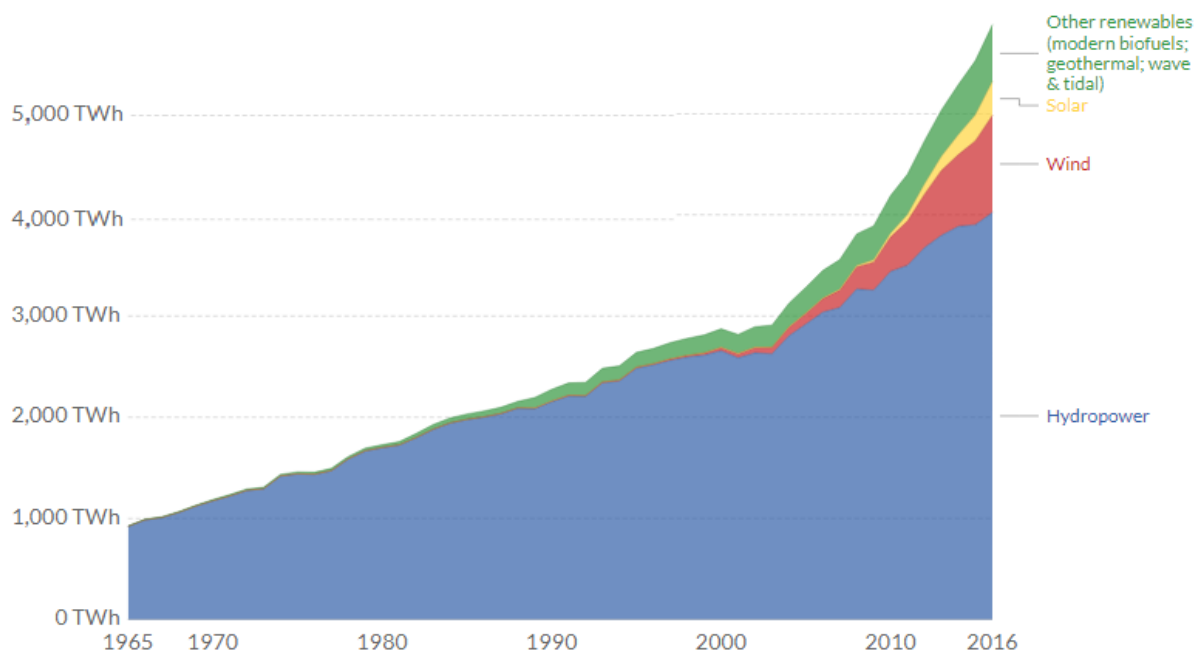


Fig. 2. Modern renewable energy consumption over the last 50 years in the world, [6].

Renewable energy sources represent the future of every country that wants to sustain development and represents the general field that needs to be invested in the great powers. It is important to note what are the leading world countries that are at the top of the use of renewable energy sources. These countries are shown in Figure 3.

	1	2	3	4	5
Investment in renewable power and fuels (not including hydro over 50 MW)	China	United States	Japan	India	Germany
Investment in renewable power and fuels per unit GDP ¹	Marshall Islands	Rwanda	Solomon Islands	Guinea-Bissau	Serbia
Geothermal power capacity	Indonesia	Turkey	Chile	Iceland	Honduras
Hydropower capacity	China	Brazil	India	Angola	Turkey
Solar PV capacity	China	United States	India	Japan	Turkey
Concentrating solar thermal power (CSP) capacity ²	South Africa	-	-	-	-
Wind power capacity	China	United States	Germany	United Kingdom	India
Solar water heating capacity	China	Turkey	India	Brazil	United States
Biodiesel production	United States	Brazil	Germany	Argentina	Indonesia
Ethanol production	United States	Brazil	China	Canada	Thailand

Fig. 3. Top five countries for annual investments, net capacity and for production based on using the RES in 2017, [8].

CONCLUSION

As we said renewable energy sources have significant potential for improving the development of humanity. Energy from renewable sources - water, wind, sun and biomass, among others - can facilitated access to clean and safe energy for millions of people. It can provide an incentive for social and economic development, helping to cope with environmental challenges, and has a key role in successfully dealing with climate change. The use of RES in the world has seen a significant increase in all sectors and global investments in RES set new record. And this trend is striving to grow even more. Serbia has significant energy potential in this area, but resources are underused in relation to the rest of the world.

Energy from renewable sources, such as the sun and wind, is approximately equally distributed in the countries of the world, and no one owns that energy.

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