POTENTIALS AND PROSPECTS FOR IMPLEMENTATION OF RENEWABLE ENERGY SOURCES IN SERBIA

by

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Serbia is dependent on imports of crude-oil and natural gas, but is endowed by reserves of lignite and the potential of renewable energy sources. Serbia has a strategy to reduce greenhouse gas emissions in the energy sector and to increase the share of renewable in gross final energy production 27% by 2020. Serbia's total estimated technically usable potential of renewable energy sources is 5.65 Mtoe per year. Biomass has the highest potential for use in Serbia (3.448 Mtoe), followed by hydro power (1.679 Mtoe), solar energy (0.240 Mtoe), geothermal energy (0.180 Mtoe), and wind energy (0.103 Mtoe). This paper presents the potential of renewable energy sources available in Serbia, with current status of their use and prospects for further exploitation.

Key words: *renewable energy, potential, utilization, sustainability, strategies*

Introduction

There are global problems with pollution, GHG emissions, rising energy demand and dependency on energy imports. Energy resources have been classified into non-renewable (fossil fuels, uranium, nuclear*, etc.*) and renewable resources (solar, wind, biomass, geothermal, *etc.*). Limitations in the production of crude-oil, price changes, environmental pollution and unstable situation in the oil-exporting countries result in an ever growing interest to use RES.

Renewable energy is at the center of the transition a less carbon-intensive and more sustainable energy system. Renewables have grown rapidly in recent years, accompanied by sharp cost reductions for solar photovoltaics (PV) and wind power in particular. The electricity sector remains the brightest spot for renewables with the exponential growth of solar PV and wind in recent years, and building on the significant contribution of hydro power generation. But, electricity accounts for only a fifth of global energy consumption, and the role of renewables in the transportation and heating sectors remains critical to the energy transition.

The RES can be defined as resources available over the long term at a reasonable cost that can be used without negative effects on the environment. In Serbia, RES utilization is currently limited to hydro power plants and non-commercial use of biomass and geothermal energy. A hydro energy source is the most utilized RES for electricity generation and registered in the official Serbian Energy Balance. In particular, despite the country's large dependence to import of liquid and gaseous fuels (about 90%), the adjustments in the regulatory frameworks enables Serbia to develop its other renewable energies and considerably increase the share of RES in the primary energy balance, [1].

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The national renewable energy action plan (NREAP) sets the targets for the use of RES in Serbia until 2020 in line with the EU energy and climate policy objectives included in the Directive on the promotion of the use of energy from renewable sources [2]. The targets set for the share of renewable energy in the gross final energy use in 2020 are 36.6% in electricity supply, 30% in heating and cooling and 10% in transportation, resulting to 27% in the overall energy mix in 2020 [3]. In order to achieve these goals, the governmental support is provided, as it is found inevitable.

The data about technical potential of RES in Serbia enable estimating the economic and social benefits of investing in capacities that can reduce pollution and energy import. It is possible to estimate the real potential for utilization of RES in Serbia using these data and other relevant facts attributed to the use of biomass, hydro, wind, solar, geothermal, and other renewable sources. In this paper RES are analyzed with the focus on their technical energy potential, while their economically viable potential is out of its scope because of a possibility to be distorted by the current subsidies offered by the government to attract the investors. Future prospects for RES in Serbia are discussed as well.

Renewable energy sources in Serbia

Overall technically usable potential

The RES are expected to play an important role in the future development of the energy sector in Serbia. The total technically usable potential of RES in Serbia is estimated to be 5.65 Mtoe per year, of which only a third (34.83%) is already used. Biomass appears to be the largest part (61%) of it, followed by hydro (29.7%), solar (4.25%), geothermal (3.19%), and wind energy (1.82%) [3]. Table 1 shows the potential of RES by type in total, used and unused amounts.

Table 1. Overview of technical usable potential of RES, 2012 [4]

RES type	Available technical potential [Mtoe/year]		
	Used	Unused	Total
Biomass	1.054	2.394	3.448
Agricultural biomass	0.033	1.637	1.670
Liquid manure	–	0.042	0.042
Wood (forest) biomass	1.021	0.509	1.530
Biodegradable waste	0	0.248	0.248
Hydro energy	0.909	0.770	1.679
Installed capacities up to 10MW	0.004	0.151	0.155
Installed capacities from 10MW to 30MW	0.020	0.102	0.122
Installed capacities over 30MW	0.885	0.517	1.402
Wind energy	≈0	0.103	0.103
Solar energy	≈0	0.240	0.240
Electricity generation	≈0	0.046	0.046
Production of heat energy	≈0	0.194	0.194
Geothermal	0.005	0.175	0.180
Electricity generation	≈0	≈0	≈0
Production of heat energy	0.005	0.175	0.180
Total from RES	1.968	3.682	5.65

Biomass potential

Biomass is the biggest renewable source which Serbia possesses. Total biomass energy potential in the Republic of Serbia is estimated at 3.448 Mtoe and comprises the remains or waste in forestry and wood industry, in farming, livestock raising, fruit growing, vine growing, and primary processing of fruits. It is estimated that the potential of biomass in wood mass is 1.53 Mtoe, agricultural biomass is 1.67 Mtoe, and 0.25 Mtoe in biodegradable wastes [3]. Wood biomass is mainly available in the central part of Serbia with the usage level of 66.7%, and agricultural biomass in the Province of Vojvodina with the potential use of around 2% [5].

Biomass is mainly used for the production of heat and very little to produce electricity. About 55% of the territory of Serbia is arable land which covers 45000 km² fig.1(a), and about 30% of territory are forests occupying 24000 km², fig. 1(b) [6]. The energy of biomass is estimated at 115000 TJ per year, of which 65000 TJ comes from agricultural biomass, and 50000 TJ from forest mass after forest exploitation [7].

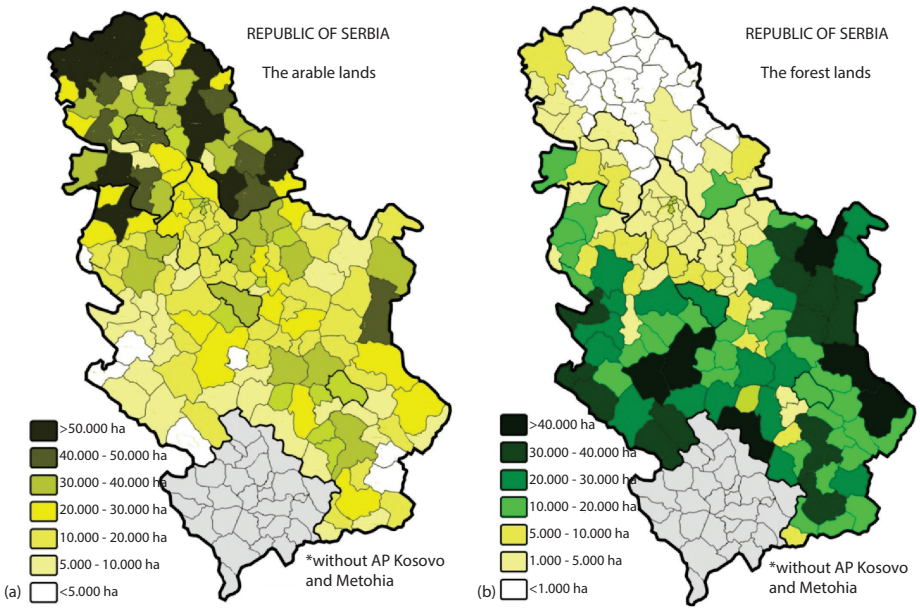

Figure 1. The arable lands; (a) and forest lands, (b) on the territory of Serbia

Hydro power potential in Serbia

Technically usable potential of hydro energy is estimated to be 1.679 Mtoe, of which a large portion is already used. The total theoretical potential of water streams which flow on the territory of the Republic of Serbia is about 30,000GWh per year, while technically usable is less than 20000 GWh per year. The largest part of the hydro power potential, of over 70%, is concentrated in the streams of the Danube, the Drina, the Velika Morava, the Lim, and the Ibar with over 10000G Wh per year [8]. The corresponding locations for the construction with the power of over 10 MW and the annual production of about 5200 GWh are in the Morava River basin (2300 GWh), the Drina and Lim Rivers (1900 GWh), and the Danube River (1000 GWh). Currently, 16 large hydro power plants produce more than 10 TWh per year (32% of Serbia's total annual electricity production) [6, 9].

According to theoretical estimates, Serbia could build several hundreds of Small Hydro Power Plants (SHPP), whose installed capacity was estimated to be 500 MW, and the annual production of about 1600 GWh per year [10]. Their construction would save about 400000 m^3 of gas and 2.3 millions of lignite per year, [6]. With only 39 SHPP operating in Serbia in 2007 (with a total installed capacity of up to 49 MW [11]), the potential of SHPP continues to be used under state subsidies.

Figure 2(a) shows the hydrogeology of Serbia, and fig. 2(b) distribution of the SHPP in different parts of Serbia. One of the latest installed SHPP in Serbia is Crna Trava (South-East Serbia) on the river Vlasina in 2012, with the power of 2.5 MWh per year and production capacity of 10 GW per hour of electricity. Also, in Crna Trava, SHPP Jabukovik began work in 2013, with the power of 1.6 MWh and annual production of 4.8 GWh of electricity [6, 11]. Recently, a number of SHPP was built on small river flows and distorted natural environment (even in the protected areas), that even provoked public protests.

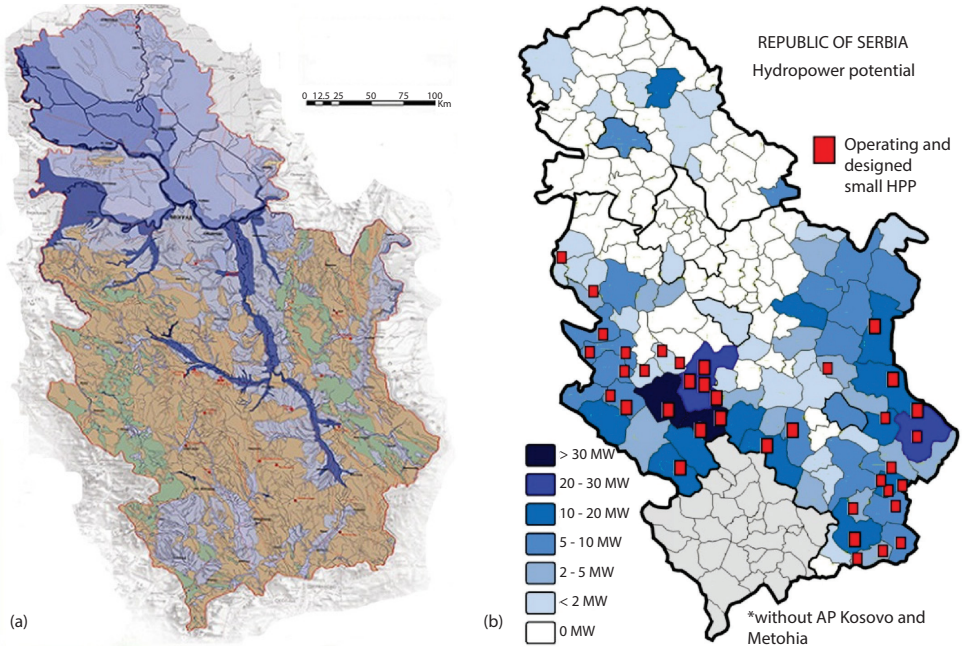

Figure 2. Overview of hydrology; (a) and map of small hydro power plants, (b) in Serbia

The overall technically usable hydro potential in Serbia is about 20 TWh per year, of which less than 1.5 TWh in SHPP. If all used, it is possible to produce only 4.2-4.7% of the current total electricity produced in Serbia (about 35 TWh per year) and around 15% of the current electricity produced in hydro-electric power stations (10.9 TWh per year) [6, 9]. But many negative impacts limit their use.

Solar energy potential

Solar radiation reaches the Earth with energy of 1000 W/m^2 where the useful radiation energy per unit area depends on the orientation and inclination of the surface of the structure and energy characteristics of the receiver of solar energy, time of day, time of year, time of insolation, atmospheric conditions, *etc.*, [12]. The average solar radiation in Serbia is about

40% greater than the European average. The total technical potential of the solar radiation is 0.240 Mtoe, which is 16.7% of the total useful potential of RES in Serbia [13]. The average intensity of solar radiation on the territory of Serbia is between 1.1 kWh/m² per day in the north and 1.7 kWh/m² per day in the south (in July reaches 5.9 kWh/m² per day to 6.6 kWh/m² per day). The average value of the solar radiation energy is 1200 kWh/m² per year in the northwestern part of Serbia, in the central part of Serbia is about 1400 kWh/m² per year, while it is up to 1550 kWh/m² per year in southeastern part of Serbia [6, 13].

However, the quota for governmental subsidies provided by the NAP for RES by the year 2020 was limited to 10 MW only, of which a half for the roof top based PV installations and rest for the land based ones. With the exception of a few roof-top plants that operate off-grid, all other installations are supplying their generated energy to the national power grid under the power purchase agreements (PPA) with the Electric Power Industry of Serbia (EPS) and receive payment according to the Feed-in Tariffs scheme defined by the governmental Decree on subsidies. Figure 3(a) presents distribution of global horizontal irradiation in Serbia, and fig. 3(b) an overview of PV plants (in use, designed or planned) [6, 14]. The total installed capacity of roof top PV rose from 2176 kWp in 2013 to above 5 MW now. A land based PV solar power plant with 2 MW capacity began production of electricity in Velesnica (Kladovo) in 2014. Another PV solar PV plant with 1 MW total capacity was commissioned in Beocin.

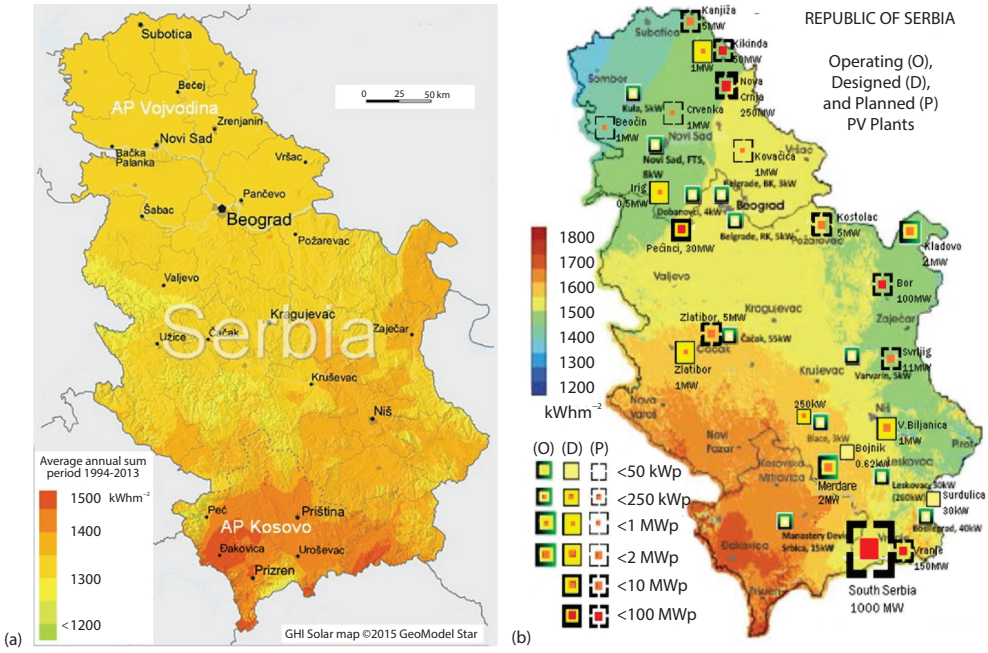

Figure 3. Solar radiation; (a) and location with PV plants, (b) in Serbia

Based on the currently available capacities of electric power system of the Republic of Serbia, for the provision of tertiary reserves it was adopted that maximum technically usable capacity of solar plants is 450 MW, *i. e.* their technically usable potential is 540 GWh per year (0.046 Mtoe per year) [15]. Technically usable energy potential for the conversion of solar energy into heat (preparation of hot water) is estimated to be 0.194 Mtoe per year.

Wind energy

The estimated technically usable potential of wind in Serbia is 0.103 Mtoe. Some estimates of the on shore wind energy potential go up to 10000 MW [6, 16]. However, even with wind capacities about 1.3 GW (close to 15% of the total energy capacity) implemented into the electricity system of Serbia, it would require additional storage measures to ensure the stability of the system operation.

The continental-mediterranean climate creates significant winds in the eastern part of Serbia. Particularly interesting are the parts of Vojvodina as well as the mountain areas of Southern and Eastern Serbia, mostly 100-1500 m above sea level. Major areas with high wind power potential are on the mountains such as Jastrebac, Stara planina, Kopaonik (east part), Juhor, Suva planina, Tupiznica, Krepoljin, Ozren, Vlasina, the areas with the elevation above 800 m. Figure 4(a) shows the average annual wind speed and average annual wind power, fig. 4(b) in different parts of Serbia [6, 13].

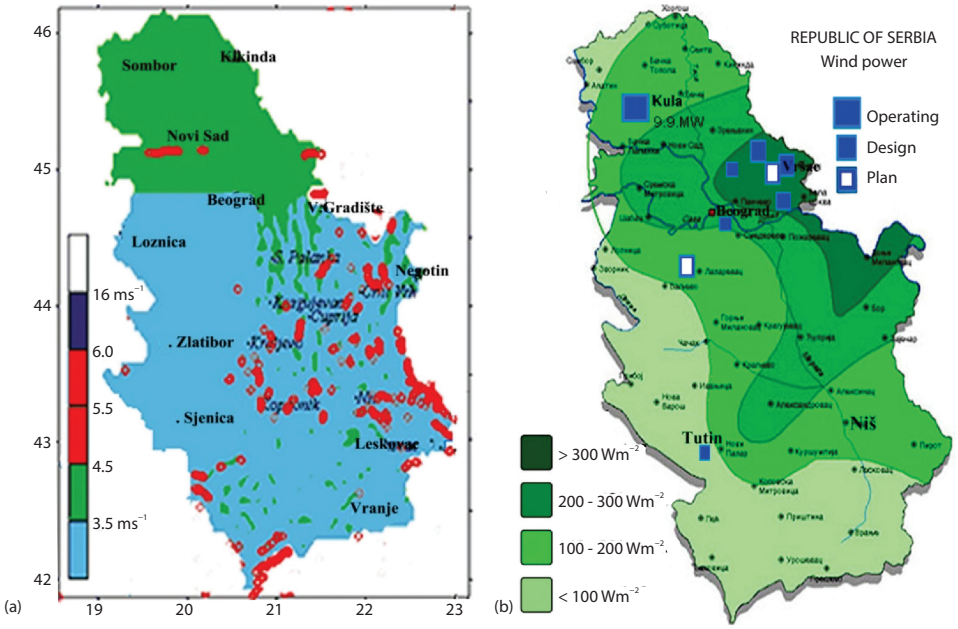

Figure 4. Average annual wind speed; (a) and wind power, (b) in Serbia

Serbia plans to build 500 MW wind power plants by 2020 [3]. The first wind generator in Serbia was set up near Belgrade in 2003 with a power of only 21 kW [17]. The first wind farm in Serbia with respectable capacity was opened in November 2015 near the town of Kula with the installed power of 9.9 MW capable of generating 27 GWh of green energy annually which is enough for nearly 8 thousand households. In 2016 completed were two 6.6 MW windmills near city of Vrsac. In 2018, the Malibunar wind plant was launched with the installed capacity of 8 MW, and the Alibunar wind plant with a power of 42 MW. They both will provide enough energy for 43000 households and annually reduce carbon dioxide emissions in an amount of 130000 tons.

Petroleum Industry of Serbia (NIS) has started the construction of 34 wind power generation units with a total capacity of 102 MW in Plandiste [18]. This wind power plant will produce at least 212 GW per hours of electric energy per year, which is enough to meet the an-

nual needs of 42 thousand households. Currently, wind parks are operating at several locations such as: Tutin (0.5 MW), Kula (9.9 MW), Vrsac (6.6 MW), Malibunar (8 MW), and Alibunar (42 MW). There are also expectations to be completed by the year of 2019 the plants in Kovacica (104.5 MW), Plandiste (102 MW), Kovin (158 MW), and Vrsac (68 MW). A boom of new wind power generating capacities was recorded in 2018 when 356 MW was commissioned, so that 374 MW was operating at the year end [19]. Construction of the wind farm Kostolac with a capacity of 66 MW is planned at the site of the old surface mine, while additional 250 MW in wind power will be commissioned in 2019 [15]. New wind farm projects (Bašaid, and several others) are under development as well.

Geothermal energy

Technically usable potential of geothermal energy in Serbia is estimated to be 0.180 Mtoe. The Republic of Serbia has a significant geothermal potential, with high density, fig. 5(a), of the geothermal heat flow in Vojvodina, Central Serbia and the south of Serbia of over 100 mW/m², while the European average is 60 mW/m² [6, 20]. Geothermal potential of the Republic of Serbia is clearly indicated by the existence of many spas and natural springs. Besides from the geothermal waters, the heat pump can use the heat from the ground, which, at the depth of several meters, remains at a fairly constant temperature, between 11 °C and 12 °C, all year round. By the use of heat pumps the *free* geothermal energy can replace two thirds or more of the conventional heat energy, usually generated by fossil fuels [21].

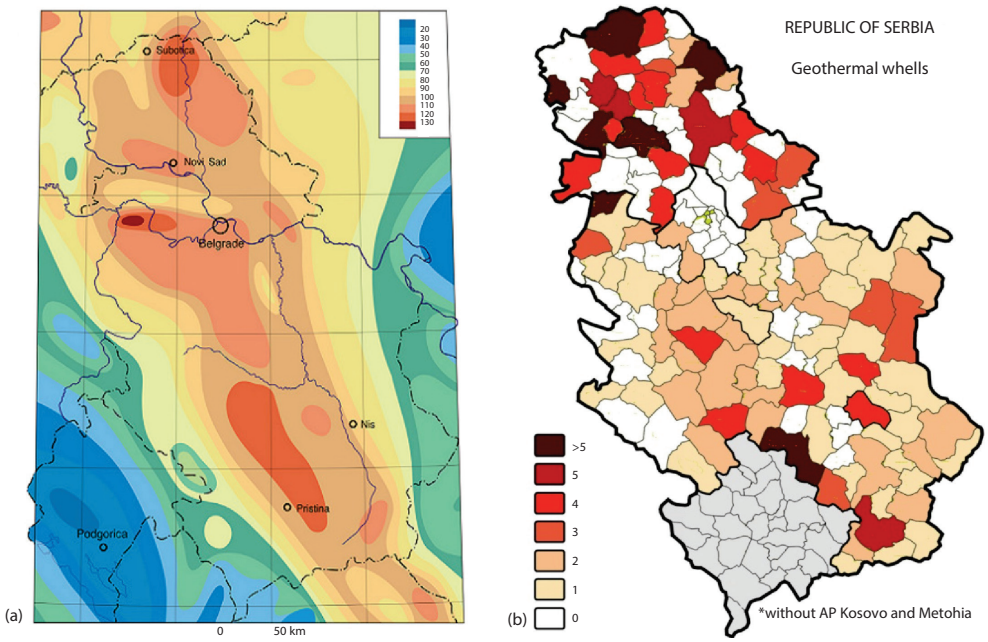

Figure 5. Ground heat flow map; (a) and geothermal wells location, (b) in Serbia

The use of geothermal energy and its resources in Serbia is low compared to its potential. The total thermal heat power capacity built in Serbia is 100.8 MWt, where the majority for balneology and recreation (39.8 MWt), direct space heating (20.9 MWt), heating with heat pumps (9.9 MWt), greenhouses (18.5 MWt), fisheries and animal husbandry (6.4 MWt), industry (4.6 MWt) and for agricultural drying (0.7 MWt) [22].

Prospects for development of RES in Serbia

Despite the energy status that is one-third hydro power, Serbia's large environmental footprint remains a serious challenge. Out of the total available technical potential of RES, the Republic of Serbia already uses 35% from the total value (0.91 Mtoe of used hydro-potential and 1.06 Mtoe of used biomass and geothermal potential) [3]. In the planned structure of primary energy production in Serbia for 2014, for instance, renewable energy participated with 1819 Mtoe, which was about 17% of domestic primary energy production. In the same time, the highest share went to solid biomass 58%, hydro potential with 41%, while biogas, wind, solar and geothermal accounted for less than 1% [23].

The use of RES in Serbia is supported by a system of measures like regulatory, financial and administrative ones. By 2020 Serbia aims to significantly enhance the use of RES and increase the amount of biofuels consumed in the transport sector [24]. The first step in developing the renewable energy sector in Serbia was enacted in 2009 when the Government of Serbia adopted a decree that introduced a stimulating feed-in-tariff system for energy produced from renewable sources in power plants. The Republic of Serbia has declared a feed-in-tariff, renewable energy targets and public investments like state measurements, with duration of stimulation measurements [25]. In addition the establishment of a legislative framework, there are more than 30 small power plant projects being developed in Serbia [15].

In line with the energy balance for 2018, tab. 2, it is planned to increase the production of primary energy from the RES (wind, solar and biogas) and reduce the hydro potential utilization, in relation 2017. The total planned primary energy production from RES in 2018 was 1925 Mtoe, which was 3% more than the estimate in 2017. In the structure of the planned total domestic primary energy production for 2018, the RES annual share was 18.33% or 2.75% more than in 2017. The most part was from solid biomass with 57%, hydro potential 39%, and biogas, wind, solar and geothermal energy are less than 4%. The planned production of solid biomass in 2018 was 1110 Mtoe, where a small part was spent in heating plants (0,002 Mtoe). The planned final consumption of biomass was 1041 Mtoe, where the industry participates with 13%, households with 84% and others with 3% [26].

Table 2. Final energy balance in Serbia for 2018 [26]

Energy	Units	Realized 2016		Estimation 2017		Plan 2018	
		Quantity	Mtoe	Quantity	Mtoe	Quantity	Mtoe
Total final energy			10.845		10.511		10.558
Hydro	GWh	10787	928	8676	746	8811	758
Geothermal	TJ	215	5	215	5	215	5
Biomass	TJ	46169	1103	46405	1108	46475	1110
Biogas	TJ	307	7	494	12	935	22
Solar	GWh	12	1	13	1	15	1
Wind	GWh	26	2	44	4	456	39
Landfill gas	TJ	-	-	-	-	20	0

The planned capacity of the plant for landfill and sewage gas for electricity production was 1 MW, biomass plants was 5 MW and for plants on biogas it is 18 MW. In 2018, it was planned to use hydro potential of large water flows (0.827 Mtoe) with a 3% increase in relation the 2017 year estimate; electricity production of small hydroelectric power plants (0.024 Mtoe) with a 25% increase; and, the use of sun energy (15 GWh) with a 17% increase. The biogas plan for the production of electricity and thermal energy in 2018 was 0.012 Mtoe or more than twice

comparing to the year of 2017. The wind energy plan was 456 GWh or 10 times more than the previous year's estimate. Finally, the planned production of geothermal energy was the same, that is 0.005 Mtoe. This is not surprising because this energy source is mostly used for heating in households [26].

According to the NREAP, Serbia should have installed 1092 MW from renewable energy by 2020, tab. 3 [3]. The Energy sector development strategy by 2025 with projections to 2030 predicts the installed capacity from RES to increase, approximately, up to 1300 MW and 1700 MW, by 2025 and 2030, respectively [4].

Table 3. Production of electricity by 2020 from RES in Serbia [3]

Type of RES	[MW]	Share [%]
Total	1,092	100%
Hydro (above 10 MW)	250	30.3%
SHPP (to 10 MW)	188	16.2%
Wind power	500	27.4%
Solar Photo-voltaic (PV)	10	1.0%
Biomass – CHP plants	100	9.0%
Biogas – CHP plants	30	3.0%
Geothermal energy	1	0.1%
Waste plants	3	0.3%
Landfill gas	10	1.0%

The prescribed quota of the Government of the Republic of Serbia by the end of 2020 for wind power is 500 MW, 250 MW for hydro power, 188 for SHPP. For biomass power plants the quota is 100 MW, 30 MW for biogas, 10 MW for landfill gas, 3 MW for waste plants. The prescribed quota for 10 MW of solar energy is covered by: solar power plant facilities in the amount of 4 MW (2 MW are planned for small solar power plants up to 30 kW, and 2 MW for solar power plants from 30-500 kW) and for (free standing) solar power plants in the amount of 6 MW. The prescribed quota for geothermal power is 1 MW by the end of 2020. Therefore, the total electricity production from new capacities should be increased by 4427 GWh [4].

Strategic goals of the Republic of Serbia in the area of RES are directed towards increasing of energy production from RES which is important for the reduction of import dependency, increase of energy security and reduce environmental pollution. This energy transition is in line with the obligations of Serbia as a signatory country of the Treaty establishing Energy Community in the South Easren Europe. In its effort to reach the goal of 27% from RES in the gross final energy consumption by 2020, Serbia has built the new facilities for power production including SHPP, PV solar power plants, wind power plants, biomass and MW from 5 biogas plants. The new wind projects dominate in installed capacity as listed in tab. 4 [6].

Table 4. List of wind power generation facilities in the strategy implementation program

Power plant	Expected on grid	Capacity	Annual production
Wind farm Alibunar	February 2018	42.0 MW	100.8 GWh per year
Wind F farm Malibunar	April 2018	8.0 MW	19.2 GWh per year
Wind farm Plandište 1	November 2018	102.0 MW	244.8 GWh per year
Wind farm Kovačica	November 2018	104.5 MW	250.8 GWh per year
Wind farm Čibuk	November 2018	158.5 MW	380.3 GWh per year
Wind farm Košava	April 2019	68.0 MW	163.2 GWh per year
Wind farm Kostolac	During 2020	66.0 MW	145.0 GWh per year

*The annual production of all wind farms is estimated based on an installed (maximum) powerand the estimated equivalent of effective annual operation time of 2400 hours

The total energy-related emissions of GHG are estimated at 45 million tonnes of CO_{2eq}. Table 5 shows to what extent they can be reduced by the year 2020 by increasing the share of RES in gross final energy use to 27%, as well as the share of RES in transportation 10% [27].

Table 5. Indicators related to the reduction of GHG emissions by use of RES

Participation of RES in total gross final energy consumption in Serbia [%)]	27
Participation of RES in gross final consumption in transport in Serbia [%]	10
Net reduction of GHG emission by using RES [t CO_{2eq}]	19333.265
Net reduction of GHG emission by using RES in transport [t CO_{2eq}]	726684

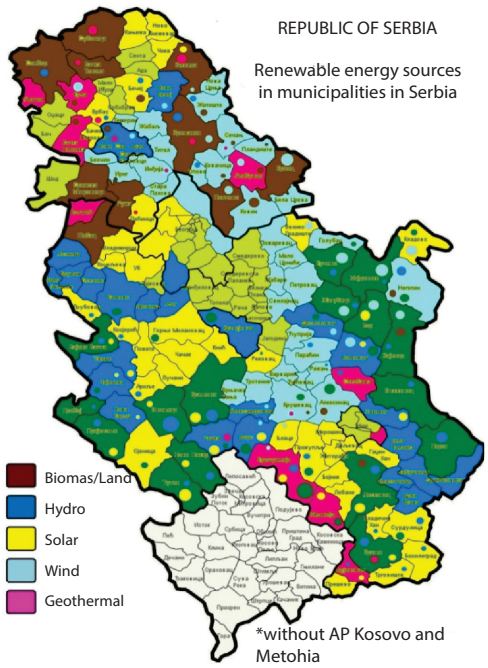

Figure 6. Territorial distribution of RES

Out of the total installed power capacities in Serbia, about 14% will come from RES in 2025 and about 17% in 2030 [26]. From the RES development perspective, the significant potential in solar, biomass and biogas could be used. As Serbia is implementing the healthier, cleaner and sustainable energy policies, each local and regional authority must analyze its energy RES potentials. Figure 6 presents territorial distribution of local RES potential in Serbia which could help diversification of energy sources [6].

With distributed energy sources in most municipalities in Serbia, security of energy supply will be increased. Besides economic benefits, they would experience many other advantages, *e. g.*, during the construction of wind, biomass or solar power plant, local labor could be engaged in order to contribute to the development of the local community.

To asses further prospects for the RES in Serbia, the future needs of gross final energy has to be analysed. By employing the system dynamics (SD) methodology which relies on causal relations, feedback loops, delays and non-linearity, two scenarios of final energy consumption in Serbia by the year 2030 have been developed with the aid of the UN Environmental Programme (UNEP) [28]:

– a set of business-as-usual (BAU) scenarios that assume the continuation of historical and present trends of energy demand and no marked expansion of RES for power generation, and
– a set of green economy (GE) scenarios that simulate additional interventions that reduce energy intensity, increase the use of RES as highlighted by the scenarios included in the strategy [4].

Figure 7 compares the two scenarios under varying assumptions for GDP and urbanization with different level of probabilities (indicated by yellow for high, by green for medium and by blue for low probability). The GE Scenario, fig. 7(b), projects energy demand to reach 9.7 Mtoe and 10.5 Mtoe by 2020 and 2030, respectively, or 8% to 12% below BAU Scenario, fig. 7(a), which is always below the strategy baseline projection (red).

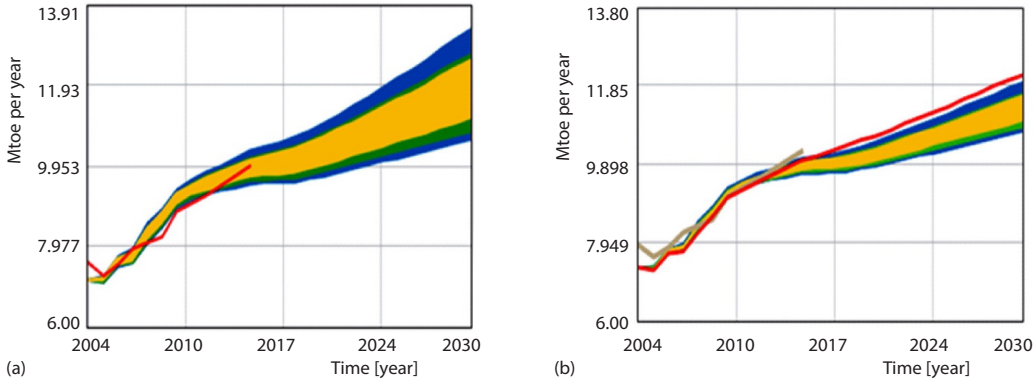

Figure 7. Projected final energy consumption by the year 2030; (a) BAU scenarios, (b) GE scenarios

The SD modelling results, presented in [28], indicate that there are significant long-term benefits from a transition a green economy with increased use of RES. For example, in energy demand avoided costs will be higher than investments by 2030, reaching a cumulative net benefit of approximately €50 to 100 million per year and the overall pay-back time 7 to 10 years [28]. Also, in energy supply the avoided power generation from coal reaches 5000-10000 GWh in 2030, generating capital savings of up to €1.3 billion and additional employment between 1500 and 2600 jobs, assuming the potential for domestic manufacturing of power generation capacity from RES. Particular prospects are seen for the distributed solar PV generation. For example, if only 300000 households (10% of total) in Serbia had at least 5 m² of solar collectors for heating water or air, it would save 1500 GWh per year, which corresponds to an installed production capacity of approximately 400 MW.

Conclusions

There is no doubt that the increased use of RES in Serbia offers a variety of benefits. The available potential of RES is considerable and may lead the country towards green economy ensuring the sustainable energy supply. The RES currently participate with about 15% in the domestic primary energy production in Serbia, with about 60% in solid biomass and 40% of hydro potential, while biogas, wind, solar and geothermal energy account for less than 1%. However, by subsidizing the use of RES for electricity generation, Serbia has already commissioned over 350 MW generating capacity, while additional 250 MW will be put into operation by the end of 2019 and 2020 in order to reach the target of 27% RES share in gross final consumption by 2020.

The energy potential of biomass in Serbia is estimated to be 115000 TJ per year, of which wood mass, agricultural biomass and biodegradable wastes account for 1.5 Mtoe, 1.7 Mtoe, and 0.2 Mtoe, respectively. According to recent studies, the most promising options for biomass utilization in Serbia are for space heating in households and public buildings, as well as for co-firing or total replacement of fossil fuels in district heating plants. However, in order to use biomass as RES, it is necessary to create the appropriate conditions and to overcome different problems which have been identified in security of feedstock supply and demand, licenses, communication, technology and knowledge, as well as financial and economic issues implementation and monitoring to adjust the use with the annual yield of forest biomass in particular.

Estimated total hydro potential in Serbia is 1.7 Mtoe, of which a large portion has already been used in large hydro power plants. The energy potential of low water flow streams suitable for the construction of SHPP amounts to less than 0.4 Mtoe. Geothermal sources in Serbia are estimated at 0.2 Mtoe. However, the use of solar energy is well below the available solar radiation on the territory of Serbia and offers the possibility to grow considerably in the future, particularly in the distributed generation. In total, the available RES potential in Serbia and the need to be increasingly used in a gradual transition from fossil towards low carbon energy sources offers good prospects for the green economy to be developed.

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