GLOBAL AND EUROPEAN STATUS OF RES USE IN COMPARISON WITH MACEDONIAN CASE

POPOVSKA-VASILEVSKA S.
University St.Kliment Ohridski, Faculty of Technical Sciences-Bitola
pvsanja@yahoo.com

Abstract - In the paper a review of the global and European status of the renewable energy sources use (RES) is made. Than the current status and the status few years backwards of the RES use in Macedonia is summarized, to be than compared with the world trends. At the end possible causes of the situation are discussed.

Key words: renewable energy sources, status, Macedonia

1. INTRODUCTION

The climate changes along with the high prices of the fuels, as also the increasing governmental support, are the main promoters of the RES incentives, legislation and commercialization. The new governmental investments, regulations and politics, have enabled the industry working with RES to deal better with the economic crisis during 2009 compared with the other sectors. [6]

Even the status of RES use is intensively improving, still only a small part of the RES potential is utilized. Therefore, it is now expected to move to the next level where massive expansion of renewable technologies should happen. That level of scale is needed to enable the renewable sector to play its critical role in building a long-term, stable, low-carbon global economy - one that promotes energy security, industrial development and competitiveness, local economic development and jobs, climate change mitigation, and universal access to energy.[6]

Where is the RES status of Macedonia in this story?

2. GLOBAL STATUS OF RES USE

In 2008, 19% of the final global energy consumption has been covered by RES, of which approximately 13% by biomass (mainly firewood) used for cooking and heating, hydropower participated with 3.2% (mainly large hydro) and other (small hydro, modern biomass, wind, solar, geothermal and biofuels) with 2,6%.[6]

10-60% annually is the rate of growth of the global renewable capacity during 2004 to 2009 (tab.1). For some renewable technologies accelerated growth can be observed, as for the wind power, where the largest growth rate of 60% is for the grid connected solar photovoltaic. (table 1)

The average growth rate of the other technologies (hydro, biomass for heat and power, and geothermal power) has been 3-6%, while in some countries much higher rates are observed.

The estimated existing renewable power capacity for 2009 is 1230 GWe (7% more than in 2008) or quarter of the global power capacity. This renewable capacity supplies approximately 18% of the global electricity production. Approximately 15% of the global renewable electricity has been produced by the hydro capacities. The rest 3% has been produced by the other non-hydro renewables (wind, PV, CSP, biomass, geothermal).[6]

Globally the industries dealing with RES have shown growth in 2009 in spite of the economic crisis. Many industries have even enlarged their production capacities.

From the end of 2004 to the end of 2008, the installed PV capacity has increased six times, the wind capacity increased for 2.5 times and the total renewable capacity for electricity production has increased for 75%. In the same period the solar thermal capacity has doubled, while the biodisel production has increased six times.

Table 1. Annual growth rate [6]

Selected indicators	2006	2007	2008	2009
Investment in new renewable capacity [10^9 $]	63	104	130	150
Growth rate (%)		65	25	15
Renewable power capacity (excluding.large hydro) [GWe]	207	210	250	305
Growth rate (%)		1	1.9	2.2
Renewable power capacity (including.large hydro) [GWe]	1020	1085	1150	1230
Growth rate (%)		6	6	7
Hydropower capacities [GWe]		920	950	980
Growth rate (%)		3	3	3
Wind power capacity [GWe]	74	94	121	159
Growth rate (%)		27	29	31
Grid connected solar PV capacity [GWe]	5.1	7.6	13.5	21
Growth rate (%)		49	78	56
Solar hot water capacity [GWt]	105	125	149	180
Growth rate (%)		19	19	21
Ethanol production [10^9 liters]	39	53	69	76
Growth rate (%)		36	30	10
Biodiesel production [10^9liters]	6	10	15	17
Biomass (thermal) [GWt]			250	
Biomass (power) [GWe]			52	
Geothermal (thermal) [GWt]			50	51
Geothermal (power) [GWe]			10	10.7

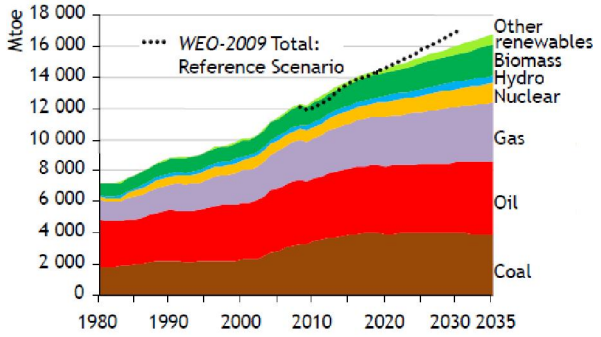

Fig.1. Global share of different energy sources [9]

Major impact to the global increase of the interest and investments in RES capacities has the promotion policies. Such policies have been very uncommon by the end of the 20th century, to be widely implemented in the after 2000. Many countries experienced doubling of their RES capacities during this decade.

3. RES STATUS IN EUROPE

At present European Union is among the leaders in the development and application of renewable energies. The final targets are reduction of the energy imports dependence and mitigation of the climate change (tab.2).

Table 2. Share of renewable energies in gross electrical consumption in EU-25 countries in 2006 [3]

	EU country	2006 share (%)	2010 target (%)	To achieve (%)
1	Austria	62,89	79,10	16,21
2	Sweden	48,47	60,00	11,53
3	Latvia	38,75	49,30	10,55
4	Portugal	29,94	39,00	9,06
5	Denmark	26,59	29,00	2,41
6	Finland	25,54	31,50	5,96
7	Slovenia	23,96	33,60	9,64
8	Spain	19,38	29,40	10,02
9	Slovak Rep.	17,12	31,00	13,88
10	Italy	14,82	25,00	10,18
11	Greece	13,92	20,10	6,18
12	Germany	12,47	12,50	0,03
13	France	12,38	21,00	8,62
14	Ireland	9,67	13,20	3,53
15	Netherlands	5,67	9,00	3,33
16	Czech Rep.	5,60	8,00	2,40
17	United Kingdom	4,62	10,00	5,38
18	Hungary	3,88	3,60	-0,22
19	Luxemburg	3,60	5,70	2,10
20	Poland	2,99	7,50	4,51
21	Belgium	2,98	6,00	3,02
22	Lithuania	2,83	7,00	4,17
23	Estonia	1,91	5,10	3,19
24	Cyprus	0,02	6,00	5,98
25	Malta	0,00	5,00	5,00
	European Union	14,65	21,00	

In 2005 RES industry in EU has created 230.000 jobs, in 2006 – 300.000, in 2007 – 360.000, 2008 – 400.000 and 2009 – 550.000 jobs.[3]

Total installed geothermal power capacity in Europe in 2005 has been 1031 MWe, with Italy and Island as leaders. Total installed wind capacity in Europe in 2009 has been 76 GWe and 86 GWe in 2010, the leaders being Germany and Spain. Total installed capacity in PV for 2009 has been approx. 16 GWe, with Germany, Spain and Italy at the first three positions. [3]

Total installed solar thermal capacity for 2009 has been 19 GWt, having Germany, Greece and Austria as leaders. In 2007 in EU-27, 89.5 TWh in biofules (bioethanol and biodiesel) have been consumed mainly in Germany and France.[3]. Total installed geothermal capacities for direct use in 2005 has been 13.64 GWt having Sweden, Iceland and Turkey as leaders.

4. RES STATUS IN MACEDONIA

The RES application in Macedonia includes: hydro potential, biomass – mainly firewood (combusted and used very inefficient) and briquettes (small quantities) for households heating and sanitary water preparation, geothermal energy for heating greenhouses and solar energy for sanitary water and PV application (neglecting participation). In the energy balance of Republic of Macedonia, RES cover approximately 10% of the annual final energy consumption [7].

Biomass. With utilization of about 8000 TJ the biomass has important role in the energy balance of the Republic of Macedonia. The biomass is especially present in the households, covering of 30-33% of the total energy requirements. About 430000 households (76%) use biomass for heating purposes. From the total biomass quantities used, the firewood and charcoal participate with 80%. The rest of the biomass is represented by small quantities of grape branches, rise husks and orchard branches, while the greatest part of the straw is used for soil fertilization, forage and cellulose raw material. Few studies for assessment of the waste biomass in RM have been realized, some of them being quite comprehensive, but it can not be taken as reliable enough for assessment of the economical feasibility of the potential, and neither there is sufficient experience in realization of concrete plants.[5]

From table 3 it is evident that dominant renewable resource is the firewood which in the final consumption participates with 6.15% for 2011 (planned), 6.53% in 2010, 4.67% in 2009 and 5.95% in 2008. Except in the capital (Skopje), firewood is dominant energy resource for households' heating purposes. The participation of the firewood is probably considerably higher since illegal wood cutting exists, which of course does not enters in the energy balance. Despite the importance of the firewood is substantial, year backwards this issue is neglected and energy tree cultivation is not even mentioned. Two years ago, so called tree-planting days are introduced – intended to become traditional. During these days few million plants are planted, but so far the results are doubtful, since there is no dedicated care afterwards. Proudly sounds when it is stated that the biomass in Macedonia participates with 5% in final energy consumption, but if the way of using this resource and efficiency of its utilization are not mentioned. There are few small capacities for production of pellets and briquettes, but there is no available data on their capacities, either there is information that they are facing the problem of providing the raw material.

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Table 3. Primary energy consumption in 2011, 2010, 2009 and 2008 [1]

	Energy type	2011		2010		2009		2008	
		Units	TJ	Units	TJ	Units	TJ	Units	TJ
1.	Electricity [GWh]	2814	10129	3695	13301	2834	10201	3583	12899
	Hydro PP (+PV)	**1400**	**5040**	**2325**	**8369**	**1198**	**4314**	**836**	**3008**
	Net import	1413	5088	1370	4932	1635	5887	2747	9891
2.	Coal [10^3 t]	8077	61792	7546	57727	7383	56482	7743	59232
	Domestic sources	7771	59448	7409	56679	7258	55524	7491	57305
	Net import	306	2344	137	1048	125	957	252	1927
3.	Coke [10^3 t]	107	2964	69	1896	52	1431	96	2658
4.	Oil derivatives [10^3 t]	822	36140	785	34509	822	36156	740	32513
	Import	1250	54951	1083	47610	1015	44616	1016	44616
	Export	428	18812	298	13100	192	8459	277	12168
5.	Natural gas [10^6 nm^3]	427	14306	117	3931	82	2750	120	4004
6.	**Firewood [10^3 m^3]**	**757**	**8244**	**717**	**7808**	**483**	**5260**	**650**	**7079**
7.	**Geother. energy [10^3 m^3]**	**1949**	**458**	**1906**	**448**	**2011**	**473**	**2226**	**524**
	TOTAL PRIMARY ENERGY		**134032**		**119621**		**112752**		**118908**
	Domestic sources		55%		61%		58%		57%
	Net import		45%		39%		42%		43%
	RES participation		10,25%		13,9%		8,91%		8,92%

In relation to the exploitation of the wood biomass, a particular attention needs to be paid to the utilization of the residuals left after the woodcuttings in the forests (wood waste) the quantity of which is about 80.000 m³, and the technical energy potential is approximately 200 GWh/yr. [5]

There is a necessity for stimulation of the production of pellets and briquettes, as well as introducing standards about this kind of production. For the time being, in the Republic of Macedonia there are individual initiatives and experimental installations for production of pellets and briquettes from the forest and agriculture biomass, but this will not mean any significant change in the energy balance by the year of 2020. [5]

The extent to which the biomass energy potential will be used in Republic of Macedonia depends not only on the energy politics in the state, but also on the ability and the readiness of the different consumers, investors, producers, research institutions, the sectors of forestry, agriculture and finance, and the capacity of all the above mentioned to participate effectively in the sustainable use of biomass.

Estimations made for the theoretical, technical and economical energy potential of waste biomass in Republic of Macedonia (forestry, agriculture, animal husbandry and communal waste) enable to make also estimation of its summary and participation of different categories. The largest participation in the total economical energy potential of waste biomass in Republic of Macedonia is the one of agricultural waste. Second one is the solid communal waste with 2,33 PJ/y (20,14 %), than the wood waste with 1,22 PJ/y (10,55 %) and at the end energy potential of the waste from animal husbandry with 0,94 PJ/y (8,1) %.[5]

Biofules. First factory for biodisel in Macedonia has started with production in 2007. The refinery is owned by private company Makpetrol, with annual capacity of 30 thousand tons. For the production of the biodisel fuel unrefined oil from rape seed is used, which at this stage is imported.

Hydro energy participates with 3.76%, 6.96%, 3.83% and 2.53% respectively in 2011, 2010, 2009 and 2008. Even this resource has important role in final energy supply, it is based on capacities inherited with the independency in 1992, i.e. major part of the capacities is in operation more than 40 years. Last two years several small hydro power plants have been build with capacities ranging from 32 kW to 996 kW in total 3089 kW with planned annual production of 15094 MWh.

In Macedonia there is considerable hydro energy potential, which is estimated to be around 5600 GWh technically usable hydro potential. Today, it is used around 1470 GWh which is only about 26% from this potential. The Strategy for utilization of renewable energy sources in R.Macedonia [7] gives four scenarios depending on participation of renewable energy in total final energy consumption. In all four scenarios it can be expected that R.Macedonia by 2020 can realistically achieve 21% participation of renewables. Scenarios C2 and C3 appear as the most likely. C3 scenario is based on final energy consumption scenario with enhanced energy efficiency measures under the Strategy for Energy Development in Macedonia [2], so that it represents a target option. The C2 scenario foresees final energy consumption as it is in the basic scenario of the Strategy [2]. For realization of scenarios C2 and C3 or any option between them, by 2020 it is needed to use hydro energy from large HPP in amount of 2000 - 2350 GWh, as well as hydro energy from small HPP in amount of 350 - 360 GWh. Moreover, the percentage participation of large and small HPP in the total amount of renewable energy by 2020 is: according to the C2 scenario large HPP participate by 34.1% and small HPP by 5.2%, and according to the C3 scenario large HPP participate by 30.9% and small HPP by 5.4%. The Strategy [7] predicts the participation of HPP electricity generation in the final energy consumption in the limits 3430 - 4410 GWh from large HPP and in the limits 510 - 710 GWh from small HPP by 2030.[5]

The Ministry of Economy has undergone four tender procedures for 121 small HPPs with total installed power of 93 MW. Up to now the procedures for the first three tenders are realized for which 35 concession

contracts have been signed (in total 21 MW installed power). Table 4 gives overview of the existing and planned hydro power potential in Macedonia.

Table 4. Overview of the existing and planned hydro potential in Macedonia [7]

	EXISTING		PLANNED		TOTAL	
HPP	Inst. MW	Prod. GWh	Inst. MW	Prod. GWh	Inst. MW	Prod. GWh
Large	552	1392	960	2280	1512	3672
Small	27	76	100	267	127	343
Total	**579**	**1468**	**1060**	**2547**	**1639**	**4015**

Geothermal energy. Macedonia has long-year experience in geothermal energy utilization. Nevertheless, the last 20 years for Macedonia is stagnation period for the geothermal development. As a result, there is significant decline in this energy use. From 21 ktoe annual utilization it is reduced to 9 ktoe (approx. 400 TJ or 110 GWh) in 2006. In the final energy consumption geothermal energy participates with approximately 0.4 to 0.5%. The utilization of this potential is mainly for greenhouse heating and few applications for space heating. The largest temperature observed so far is 78ºC in the Kocani geothermal field where currently the most active application exist. [7]

There is information for more than 100 heat pumps installed in the country (geothermal and air), but no data is available. Heat pumps are very up to date in EU and they are considered as renewable only if their average COP is larger than 4 since the average COP for electricity production is considered to be 0,27 at EU level. It means that in Macedonia the COP of the heat pumps should be larger than 5 since the basic power supply originates from thermal power plants. Anyway the heat pumps are not treated at all and no attention is given yet.

Republic of Macedonia passed twenty years of stagnation in geothermal development. Some of previously developed large projects have been abandoned or destroyed. There were no investments in explorations and new projects development. Geothermal energy production in 2010 dropped down for nearly 50%, compared to the situation in 1991.[5]

Recently, first signs of economy recovery of some users and finalized privatization process resulted with several investments in reconstruction and optimization of geothermal projects. There is interest of the others to do the same and some home and foreign investors are trying to get concession for development of new projects.

Solar energy. Despite the advantageous geographical position and climate offering great energy potential, in Macedonia the solar energy use is at minimal level. The total installed operative capacity for thermal energy production (flat plate and evacuated collectors) is 13,5 MWth or 6,6 kWth per capita [8].

Solar energy is viable energy source. The initial assessments made (on solar thermal) give indication that if 10 year investment is made for 1 million m^2 collector area, considerable participation in the energy balance can be achieved (such 1,55% from the gross energy consumption in 2006 yr.), and the return period of the investment is maximum 12 years.

Solar energy might be important energy resource for Macedonia. There is no doubt that the solar resource is plentiful, but dedicated work is required to ensure suitable conditions for its wide-spread use. The examples which can be followed are numerous, showing that it is worth investing in this ecological resource.

The assessed price for 1 kWh produced thermal energy is 0.017 euro [5].

For the solar thermal systems and components a preferential tax exists of 5% instead the regular VAT of 18%, but no increase in the application is noticed due to this measure.

Solar energy has symbolic application, mainly for sanitary water heating. It is expected that after introduction of the real market price of the electricity (2015) and expected increase of the electricity price in the region (due to the costs of the greenhouse gases emissions imposed to the thermal power plants), solar systems will become more and more attractive. In Macedonia great interest exists for PV applications, due to the attractive feed-in tariffs. With the expected improvements in the legal aspects more intensive investments are anticipated. After 2020 building of solar thermal power plant is planned. [7]

Concerning PV plants, up to now there is 359.64 kW capacity installed with planned production of 541 MWh. This capacity belongs to four plants in total (10.2, 49.72 x 2 and 250 kW).

Wind energy. For more than three years there is preferential feed-in tariff for wind energy, but so far no any capacity is installed. So far in Macedonia several studies have been realized for determination of the most appropriate locations for wind turbines, as also assessment of the wind energy potential. According to the study based on satellite recordings from AWSTruewind3, an atlas of the wind energy potential for Macedonia has been made. Using those data, most suitable locations for further research of the wind energy have been chosen. Four locations have been selected for continual measurements performed since 2006 (velocity, direction and other meteorological parameters). At one of the locations and its surrounding in 2009 four additional metering systems have been placed. Average wind speeds at the monitored locations range between 6.7 to 8.5 m/s, which might be suitable for wind power generators. Of course the building of wind turbines depends not only on the wind velocity but also on the terrain configuration, land ownership, the infrastructure, accessibility to roads and grid, investment feasibility, etc. [7]

There are no other renewable energy resources in the energy balance of Macedonia.

4. CONSTRAINTS

It can be concluded that there is no significant improvement over the years, on the contrary there are examples where the participation of some RES type is declining.

The observed constraints for this situation are the following:

- inappropriate legal framework;

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- sudden changes in the regulative;
- inappropriate and insufficient incentives for certain RES types;
- neglecting the opportunity of creating new employments with increased RES application (current incentives mainly support foreign investors, not the domestic economy);
- unequal treatment of the thermal energy as final product in comparison with electricity;
- slow and uncertain administrative procedures, and uncertain costs involved;
- problems with the property rights and building permissions;
- insufficient cooperation between the institutions involved in RES project realization;
- insufficient possibilities for electronic submission and communication;
- unavailable guidelines for the potential investors (concerning the legal aspects, administrative procedures, building and exploitation of different RES capacities, etc.);
- unavailable mechanism for registration of the small and micro individual RES capacities;
- unavailable RES application financing schemes for private and legal entities;
- necessity for adoption of standards for RES technology;
- necessity for administrative capacity building;
- necessity for quality provisions (design, installation, components, systems);
- necessity for awareness raising, etc.

Obviously the efforts must be concentrated in removing the obstacles for wider introduction of RES capacities.

5. DISSCUSION

The benefits of RES application are multiple and continuously emphasized, but the most important issue is that it is not matter of choice, but obligation – not to the EU, but to the own citizens. Each citizen has right for clean environment and available energy. The solution of course is in RES utilization. Obviously to enable their wider application certain preconditions are necessary to be fulfilled. Countries with characteristically high percent of RES use have minimum 20 years backwards dedicated work. EU sets new targets, with higher and higher RES participation in the final energy consumption. Macedonia is only postponing the penetration of the renewables and the moment will come when there are will be no time to make assessments of the resources, feasibility of their use and possible participation in the energy balance.

It is indisputable fact that the use of renewable energy sources opens new employments in production, research and development, and service sector. Why this aspect even so important for the countries in development is continuously neglected, while the economy standard is decreasing and unemployment increasing. An important period has been lost when the critical point could be achieved, so today we could speak about sustainable development of the RES use in Macedonia.

All energy forms are expensive, but as the time is passing the renewable sources are becoming cheaper while the price of the fossil fuels increases continually. The largest investments for RES utilization are in the infrastructure, but when once built they use either free of charge or locally produced fuel, thus creating energy independence and social benefits. If Macedonia would clearly devote for RES development and application, the increasing production would reduce the costs and would motivate the research and development for further acceleration of the progress.

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