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UTILIZATION OF THE RENEWABLE ENERGY SOURCES IN THE REPUBLIC OF MACEDONIA – PRESENT STATUS AND PERSPECTIVES

Abstract: Currently, Renewable Energy Sources (RES) supply more than 10% of the total Macedonian primary energy consumption. The percentage share of the RES in the final energy consumption in Macedonia, according to the real average values, will grow from 13,8% in 2005 to 21% in 2020. This 2020 RES target corresponds to the obligation of Macedonia, as the Contracting Party to the Energy Community Treaty, of implementing the new EU Renewable Energy Directive 2009/28/EC. To meet this 2020 RES target, four scenarios have been considered. The conducted analyses show that Macedonia can realistically achieve participation of RES of 21% by 2020 and improve the renewable energy mix as well.

Key words: *renewable energy sources, Macedonian renewables target, renewable energy mix*

INTRODUCTION

With the energy imports relative to the primary energy consumption of nearly 50%, Macedonia belongs to the group of countries which are strongly energy import dependent. Macedonia imports its total demand for oil and petroleum products and natural gas and, since 2000, a growing amount of electricity. The only existing energy resources in Macedonia are lignite, hydropower, and biomass, as well as, to a smaller extent, geothermal, solar and wind energy.

In the primary energy mix, coal (with a share of about 46%), primarily lignite, and crude oil and petroleum products (35%) have a prominent place. They are followed by biomass with 6,3%, imported electricity (6%), hydropower (3,7%), natural gas (2,5%), geothermal energy (0,4%), solar energy (0,03%) and biofuels (0,02%).

In order to achieve energy security, Macedonia should intensify its efforts towards: improving energy efficiency in production, transmission and consumption

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of energy, particularly electricity, and increasing of the diversification of the energy mix. This requires maximizing the possible use of the renewable energy sources.

OVERVIEW OF RENEWABLE ENERGY SOURCES RELEVANT FOR MACEDONIA

Currently, renewable energy sources (RES) supply more than 10% of the total Macedonian primary energy consumption. Regarding the renewable energy mix (Fig. 1), the biomass (mostly wooden mass as a source of heating fuel in the residential sector), with a share of around 60% and the hydro energy, with a share of more than 36% have a prominent place. They are followed by the geothermal energy (mainly for heating the greenhouses) with a share of 4% and to some extent the solar energy (for hot water in the households), (0,3%) and the biofuels, (0,2%).

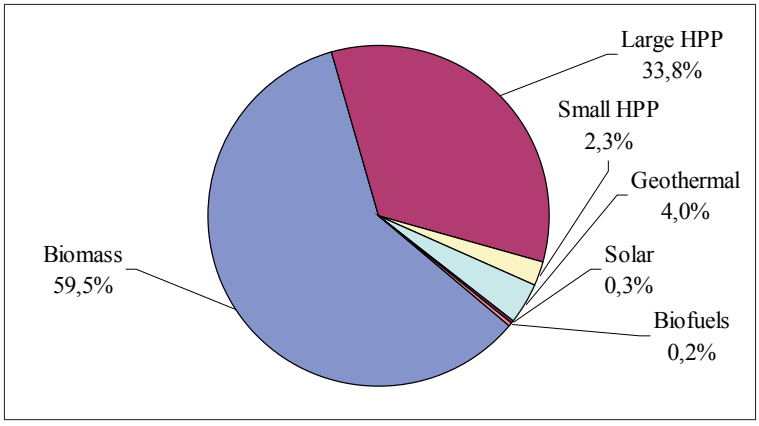

Figure 1. Macedonian renewable energy mix in 2009

Biomass for combustion. With consumption of 7080 TJ (1970 GWh) [1], biomass has a significant share in the energy balance of the Republic of Macedonia. It should be noted that, according to experts' estimations, there is also a non-registered consumption of biomass for combustion, which is estimated at 25–35% of the registered consumption.

Wood and wooden coal account for 80% of total biomass used for energy purposes. Use of vine sprouts, rice chaff and fruit tree branches for energy purposes is also common in the Republic of Macedonia, but major portion of straw is mainly used for fertilizers, animal feed and production of cellulose. Therefore it is not available for energy purposes.

Biomass is mainly used by households and fulfils 30–33% of total energy needs. Around 430000 households (76%) use biomass for heating purposes.

Biofuels. The first factory for biodiesel fuel in the Republic of Macedonia was commissioned in 2007. The Refinery has a capacity of 30 thousands tons per year.

Non-refined rape seed oil is used for production of biodiesel fuel. At this stage, non-refined oil is supplied from import.

Hydro energy. Hydro energy potential in Macedonia is primarily used by the constructed nine large hydro power plants (HPP) with total installed capacity of about 550 MW. At the moment, 13 small HPPs (up to 10 MW) with total installed capacity of approximately 30 MW are in operation in Macedonia. The total average annual generation of the all HPP, under average hydrology, is around 1200 GWh.

The construction of hydro facilities with potential of around 1000 GWh can be expected by the year 2020, which will provide a total use of the potentials at around 2200 GWh or around 40% of the technical potential in the country.

One of the planned large HPP is under construction by state owned company AD ELEM and plans are in place to start construction of two other large HPP by the same company. For the additional two, tender procedure using the public-private partnership is in progress.

Macedonia has 400 potential sites for construction of small HPPs with total technical capacity of 170 MW and estimated annual generation of around 440 GWh. The Ministry of Economy is gradually announcing construction tenders for the best and most perspective sites. So far, 4 tender procedures have been implemented for a total of 117 SHPPs with total installed capacity of 90 MW and estimated annual generation of around 240 GWh and 35 concession agreements for total install capacity of 21 MW have been signed.

Geothermal energy. Macedonia has a long-standing experience in terms of use of geothermal energy. Nevertheless, the last 20 years for Macedonia have been a period of standstill as concerns the development of geothermal energy. As a result thereof, the use of geothermal energy has significantly declined in the last several years: from 880 TJ (240 GWh) in 2001 to around 470 TJ (130 GWh) in 2009. Having in mind the relatively low temperature (highest temperature recorded is 78 °C), it is mainly used to meet heating needs. Its dominant use has been noted in regard to heating greenhouse complexes.

Solar energy. Symbolic level of solar energy use is noted in regard to hot water preparation in households. It is expected that the introduction of market electricity price (from 2015) and the expected increase of electricity prices in the region (due to the price paid by thermal power plants on the account of greenhouse gas emission) will make the solar systems more attractive.

In Macedonia, there is great interest in construction of photovoltaic systems (PV) for electricity generation (considering the favourable feed-in tariffs). One such system was already constructed, but improvements in the legislation are expected to facilitate greater construction of such systems. In the period following 2020, plans are made for a construction of a solar power plant with thermal technology.

Wind energy. Up to this moment, several studies were developed for Macedonia in the light of screening the most favourable sites for construction of wind power plants. According to the study developed on the basis of satellite images from AWS Truewind [2], the wind energy potential atlas was designed for Macedonia. Based on the Atlas, selection was made of the most favourable sites for further research of

wind energy. As of 2006, wind speed, direction, and other meteorological parameters were continuously measured on four selected sites [3]. In 2009, additional four metering systems were installed on one of the sites and its surrounding. Preparations for metering of additional five sites are underway. Average wind speed at metered sites in Macedonia ranges from 6.7 m/s to 8.5 m/s, while experiences show that they are suitable for Wind Power Plants (WPP) construction. The site selection will certainly depend on other conditions, including: terrain configuration, site tenure matters, infrastructure and access to roads (for transport of equipment), distance from high voltage or medium voltage grid, and the cost-effectiveness as precondition for attracting investors, etc.

THE RES TARGET AND RES ELECTRICITY TARGET

The New EU Renewable Energy Directive [4], sets the following targets:

– a binding target of a 20% share of renewable energies in overall EU energy consumption by 2020;

– a 10% binding minimum target to be achieved by all Member States for the share of biofuels in overall transport petrol and diesel consumption by 2020.

From the overall renewables target, differentiated national targets are allocated. The methodology used by the European Union to calculate the allocation of its 20% target between its Member States involves three elements:

– share of renewables in gross final energy consumption in 2005;

– flat rate increase of 5.5%; and

– additional residual effort determined on the basis of relative GDP per capita.

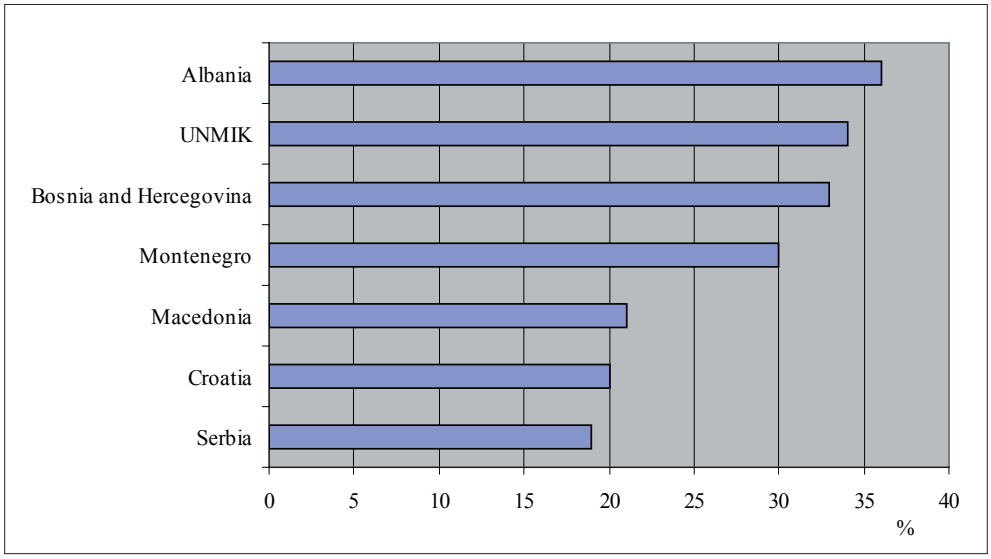

Figure 2. Energy Community parties targets for the share of energy from renewable sources in gross final consumption of energy in 2020

In 2005, the share of 13.8% for renewable energy sources in the gross final energy consumption listed Macedonia among countries with relatively high use of renewable energy sources. By implementing the above procedure, the calculated target for Macedonia is 21% [5]. This 2020 RES target corresponds to the obligation of Macedonia, as the Contracting Party to the Energy Community Treaty, of implementing the new EU Renewable Energy Directive. The calculated targets for the energy community countries, (Fig. 2), are between 19% for Serbia and 36% for Albania [6].

The planned share of 21% for RES in 2020 Macedonia can achieve by various combinations of use of RES and of gross final energy consumption within the given limits. Four possible scenarios were analysed [5]. Scenarios S2 and S3 or any other option between them are deemed to be most likely. Scenario S3 is based on final energy consumption according to the scenario with stronger energy efficiency measures from the Strategy on Energy Development of Macedonia and is considered the target option. Table 1 shows the RES share and gross final energy consumption for the lower limit (LL), the upper limit (UL) and values anticipated pursuant to scenarios S2 and S3 that are to contribute to the attainment of the target share of 21%. Both scenarios (S2 and S3) anticipate reduction of electricity and heat losses in transmission and distribution until 2020 pursuantly to acceptable European levels.

Table 1. Shares of RES in the gross final energy consumption in Macedonia

(GWh).	2009	2020 LL	2020 UL	2020 S2	2020 S3
Electricity from RES	1201	2539	3482	3039	2679
HPPs	1200	2300	3000	2710	2350
Large HPPs	1120	2000	2600	2350	2000
Small HPPs	80	300	400	360	350
Wind PPs	–	180	360	270	270
PV Systems	0,5	14	42	14	14
Biomass	–	25	50	25	25
Biogas	–	20	30	20	20
Heat from RES	2110	3100	3350	3200	3240
Biomass	1970	2640	2740	2740	2740
Solar energy	10	60	90	60	60
Geothermal energy	130	400	520	400	440
Biofuels	7	560	655	655	560
TOTAL RES	3318	6199	7487	6894	6479
Gross final energy consumption	22910	32873	30825	32873	30825
RES share (%)	14,5	18,9	24,3	21,0	21,0

The low share of RES (LL) in the gross final energy consumption was obtained based on the lowest planned shares for each RES in the final energy consumption pursuantly to the basic scenario from the Strategy on Energy Development in Macedonia [7].

The high share of RES (UL) in the gross final energy consumption was obtained based on the highest planned shares for each RES in the final energy consumption pursuantly to the scenario with strong energy efficiency measures from the Strategy on Energy Development in Macedonia [7].

Scenario S2. This scenario assumes the final energy consumption according to the basic scenario from the Strategy on Energy Development of Macedonia [7].

The target setting under this scenario anticipates a construction of HPPs St. Petka, Boskov Most, Galiste and Cebren and the reservoir system Lukovo Pole with the downstream HPP Crn Kamen. The difference up to the target share of 21% for RES will be covered by increasing use of hydro energy from Small HPPs, Wind Power Plant (WPP) and biomass. Planned consumption of biomass for combustion in 2020 is set at the upper limit, which is by less than 10% higher compared to the 2006 consumption level, including both recorded and non-recorded consumption [7]. Such use of biomass can be achieved in reality by small increase of wood potential and by improving forest cutting and processing technology, which will reduce the unused waste biomass.

In the light of the EU Directive 2009/28/EC, the share of biofuels in the final energy consumption in transport is planned at the rate of 10% in 2020.

Scenario S3. This scenario is based on the final energy consumption as anticipated under the scenario with strong energy efficiency measures from the Strategy on Energy Development in Macedonia [7].

The dynamics of Large HPPs construction has been postponed for one year in regard to the S2 scenario, and thereby the construction of HPP Cebren is anticipated to be completed after 2020. The necessary difference to attain the target share of 21% of RES will be covered with additional use of geothermal energy by 40 GWh and under same capacity of other RES types as given in the scenario S2.

Biofuels share is within the lower limit range in compliance with the estimated consumption from the scenario with stronger energy efficiency measures.

In Figure 3 the 2020 S3 scenario is compared with the 2009 RES consumption.

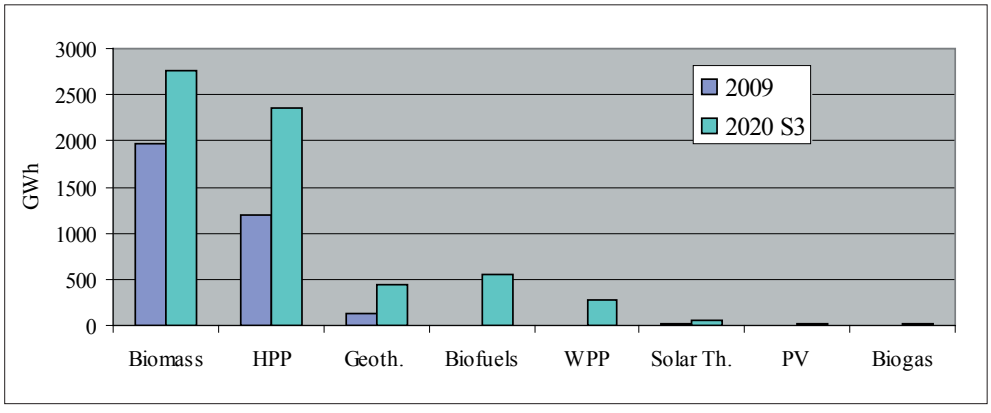

Figure 3. Comparison of the 2009 RES consumption and the 2020 S3 scenario

Electricity generation from RES. Under electricity generation growth rate of 3%, 2% and 2.5% [7], and electricity generation from RES pursuant to LL (2539 GWh, Table 1), UL (3482 GWh), S 2 (3039 GWh) and S 3 (2679 GWh), the share of RES in electricity generation by 2020 will account for 20.1%, 31.5%, 25.7% and 24.2%, respectively (Table 2). According to previous analyses, the share of electricity from RES by 2020 can be expected around 25%.

Table 2. Share of electricity from renewable energy sources in 2020

Electricity from RES	2020 LL	2020 UL	2020 S 2	2020 S 3
GWh	2539	3482	3039	2679
Total el. generation under a growth rate of	3%	2%	2.5%	2%
GWh	12616	11060	11842	11060
RES share (%)	20.1	31.5	25.7	24.2

CONCLUSION

By implementing the New EU Renewable Energy Directive procedure, the calculated 2020 target for Republic of Macedonia is the share of 21% for renewable energy sources in the gross final energy consumption. To meet this 2020 renewable energy sources target, four scenarios have been considered. The conducted analyses show that Macedonia can realistically achieve participation of renewable energy sources of 21% by 2020 and to improve the renewable energy mix as well. Scenario S 3, based on final energy consumption with stronger energy efficiency measures is considered the target option.

To achieve the 2020 renewable energy sources target, the Republic of Macedonia accepted the system on stimulating electricity generation from renewable sources by means of feed-in tariffs and issuance of guarantees of origin for the electricity generated. In addition, on few occasions in the last several years, the Government of the Republic of Macedonia provided direct budget subsidies aimed to stimulate installation of solar collectors for hot water. But, the most important is the construction of the planed large hydro power plants. It should be pursued by means of public-private partnership or build by the state owned company AD ELEM.

Increasing the share of renewable energy sources is not possible without adequate (incentive-providing) primary and secondary legislation. The legislation is to provide a framework that would enable simplified construction of generation facilities, incentives (financial measures) and implementation thereof. Currently in progress is adoption of a new Energy Law of the Republic of Macedonia.

LITERATURE

[1] Energy Balances of the Republic of Macedonia, *Ministry of Economy, 1996–2010.*
[2] Wind Energy Resource Atlas and Site Screening of the Republic of Macedonia, AWSTruewind, June 2005.

[3] Pilot-project – Wind Farm, *ELEM, Skopje 2008.*
[4] Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources.
[5] Strategy for Utilisation of Renewable Energy Sources in the Republic of Macedonia by 2020, *Macedonian Academy of Sciences and Arts, Skopje, 2010.*
[6] Study on the Implementation of the New EU Renewables Directive in the Energy Community, IPA Energy + Water Economics & EPU-NTUA, Report to Energy Community Secretariat, February 2010.
[7] Strategy for Energy Development in the Republic of Macedonia until 2030, *Macedonian Academy for Sciences and Arts, 2010.*