

The State of Renewable Electricity – Worldwide, in EU and in R.Macedonia

Gordana Janevska¹

Abstract –The paper gives a brief overview of the role and importance of renewable energy sources focusing on the power sector. From these aspects, the situation worldwide, in EU and in the Republic of Macedonia is considered, pointed out the visions for the future in this sector.

Keywords – renewable energy sources, renewable electricity, potential, strategy

I. INTRODUCTION

Technological development of civilization causes ever increasing electricity demand, while stocks of non-renewable energy sources rapidly decrease simultaneously with the rise of costly requirements for environmentally acceptable way for their conversion into electricity. Awareness of complete dependency of civilized society on electricity, and the fact that non-renewable sources of energy are limited, cause a change in thinking about the cost-effectiveness of electricity generation from renewable sources. In this sense, worldwide government stimulate not only the development of new technology of electricity (and heat) from renewable energy sources, but also bring new laws that encourage the wider application of existing technologies, aiming to increase the share of renewable energy sources (RES) in the total production of electricity.

Global warming along with the need for secure energy supply, is increasingly contributing to the need for creating an integrated energy strategy at European and national level. The time of cheap energy for Europe's past. The challenges of climate change, increasing import dependence and higher energy prices are faced by all EU Member States.

The main objectives of EU energy policy are: secure energy supply, increase competitiveness, environmental sustainability and climate change. In the EU, there is strong political, public and economic support for all RES technologies. Directive 2001/77/EC aims to meet 12% of electricity production from RES by 2010. The new Directive 2009/28/EC on renewable energy sets binding national targets that member states should achieve through promoting renewable energy in the electricity, the heating and cooling, as well as in the transport sector. This Directive aims to achieve 20% share of renewable energy in final energy consumption by 2020. The most recent initiatives have already begun the process of transforming

EU's energy supply to 100% RES. The EREC in its report "RE-thinking 2050" outlines a pathway towards a 100% renewable energy system for the EU, as the only sustainable option in economic, environmental and social terms.

The global commitment to environmental protection and in particular to reduction of greenhouse gas emissions, dependence on energy imports, as well as the need to secure greater variety and thereby reliability of energy supply undoubtedly impose increased share of RES in the final energy consumption in Macedonia. Macedonia is strongly energy import dependant. The energy imports have grown during the past period, and during the latest few years the imports of electricity have grown rapidly. Identified objectives of the national energy policy are: to increase the use of environmentally-compatible low-cost domestic energy sources; to reduce the country's dependence on imported fuels; and to implement medium and long term plans for development of sectors related to RES. The Republic of Macedonia signed the **Agreement for Energy Community**. According to this Agreement the signatories should harmonize their national legislations with the existing legislation in the European Union (acquis communautaire) related to energy, environment, competition, renewable energy sources, energy efficiency. From the aspect of legal and institutional frameworks, the basic elements related to RES are stipulated under the **Law on Energy** (Official Gazette of RM no. 63/2006, 36/2007, 106/2008) which - inter alia- promotes the use of RES. For the purposes of implementing the provisions from the Law on Energy, as well as the Laws indirectly connected to the energy sector, appropriate secondary legislation has been adopted. In preparation for the adoption of EU legislation on RES and its implementation at the national level, in 2010 the Government adopted the **Strategy for the utilization of renewable energy sources in the Republic of Macedonia by 2020**.

II. GLOBAL STATE OF RENEWABLES IN POWER SECTOR

Changes in renewable energy markets, investments, industries, and policies have been so rapid in recent years that perceptions of the status of renewable energy can lag years behind the reality. The REN21's annual **Renewables Global Status Report** captures that reality and provides an overview of renewable energy worldwide, showing that the renewable energy obtained a great importance in the context of the global energy and climate situation. Even in 2009, when up against strong headwinds caused by the economic recession, low oil prices, and the lack of an international climate agreement, renewables managed to hold their own. Indeed, as other economic sectors declined around the world, existing

¹Gordana Janevska is with the Faculty of Technical Sciences at University St. Kliment Ohridski, 7000 Bitola, R.Macedonia, E-mail: gordana.janevska@tfb.uklo.edu.mk

renewable capacity continued to grow at rates close to those in previous years, including grid-connected solar PV (53%), wind power (32%), geothermal power (4%), and hydropower (3%). Exceptional growth has led to changes in the geography of renewable energy in ways that suggest a new era of geographic diversity.

RES have grown to supply an estimated 16,7% of global final energy consumption in 2010. During 2011, modern renewables continued to grow strongly in all end-use sectors: power, heating and cooling, and transport.

In the power sector, renewables accounted for almost half of the estimated 208GW of electric capacity added globally

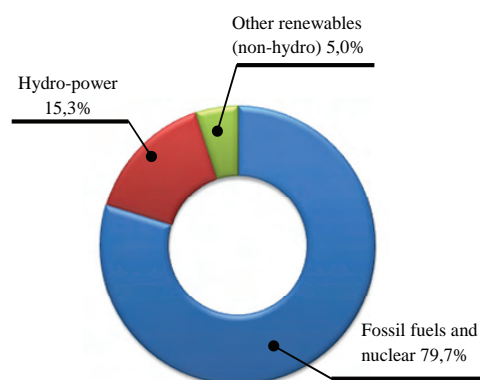


Fig. 1. Estimated renewable energy share of global electricity production, 2011

during 2011. Wind and solar PV accounted for almost 40% and 30% of new renewable capacity, respectively, followed by hydropower (nearly 25%). By the end of 2011, total renewable power capacity worldwide exceeded 1360GW, up 8% over 2010; renewables comprised more than 25% of total global power-generating capacity (estimated at 5360GW in 2011) and supplied 20,3% of global electricity. Non-hydropower renewables exceeded 390GW, a 24% capacity increase over 2010.

Renewables represent a rapidly growing share of energy supply in a number of countries and regions:

- In the EU renewables accounted for more than 71% of total electric capacity additions in 2011, bringing renewable energy's share of total electric capacity to 31,1%. In 2010 (latest available data), the renewable share of total electricity consumption was 19,8% (up from 18,2% in 2009);
- In USA, renewable energy made up an estimated 39% of national electric capacity additions in 2011. The share of US net electricity generation from non-hydropower renewables has increased from 3,7% in 2009 to 4,7 % in 2011;
- China ended 2011 with more renewable power capacity than any other nation, with an estimated 282 GW; one-quarter of this total (70 GW) was non-hydro.

Including hydropower, China, USA, Brazil, Canada, and Germany were the top countries for total installed renewable electric capacity by the end of 2011. The top seven countries for non-hydro renewable power capacity (China, USA, Germany, Spain, Italy, India and Japan) accounted for about 70% of total capacity worldwide.

Even so, renewable technologies are expanding into new markets. In 2011, around 50 countries installed wind power

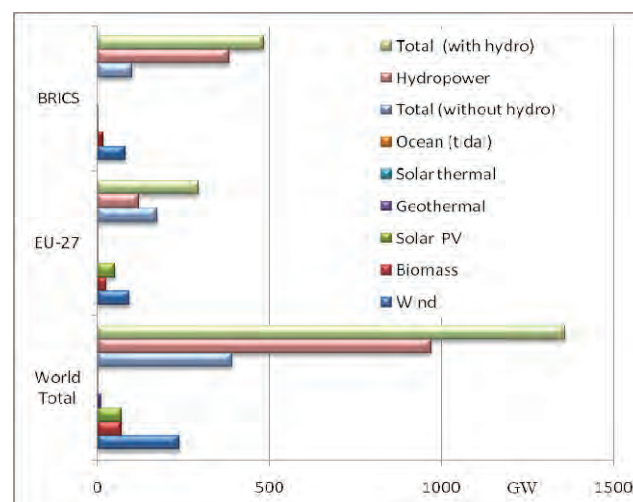


Fig. 2. Renewable electric power capacity, World, EU 27, and BRICS, 2011

capacity, and solar PV capacity is rapidly moving into new regions.

At least 118 countries, more than half of which are developing countries, had renewable energy targets in place by early 2012, up from 109 as of early 2010. Renewable power generation policies remain the most common type of support policy (at least 109 countries had some type of renewable power policy by early 2012). Feed-in-tariffs are the most commonly used policies in this sector.

III. EUROPEAN UNION – CURRENT SITUATION AND VISION FOR THE FUTURE

Europe's demand for energy is increasing in an environment of high and unstable energy prices. Greenhouse gas emissions are rising and the energy sector is one of the main emitters of greenhouse gases. Climate change along with an increasing dependency on energy imports are only a few of the risks the European economy is facing today. As investments in the energy sector are of a long-term nature, today's energy decisions will have an impact on the energy system of tomorrow, thereby determining the future level of greenhouse gas emissions, fossil fuel dependency and the competitiveness of European economies in view of the fundamental transformation needed to ensure a sustainable Europe by the middle of the 21st century.

Looking more closely at the development of renewable energy in recent years, it becomes apparent that renewable energy is a promising way to ensure that Europe's energy future is the future of renewable energy. In 2007, renewable energy reached a share of 9,9% of the EU's final energy consumption. In the period from 2005 to 2007, the RES share increased by 1,3 percentage points (0,65%-points per year). The rapid development of the renewable energy industry is underlined by another historical fact. In 2008, more new renewable energy capacity was installed in the field of

electricity than any conventional source of electricity. Renewable energy made up 57% of the overall 23,8 GW installed in 2008. This figure was topped in 2009, where 62% of all new installed electricity capacity was in renewable energy, clearly led by wind, PV and biomass [2].

The increase in renewable electricity output in 2011 might seem low in comparison to previous years, but the reduction in total electricity consumption across EU (from 3281,2 TWh in 2010 to 3350,3 TWh in 2011) consolidate the renewable share. Wind energy contributed most to the renewable electricity production increase by generating 30TWh more

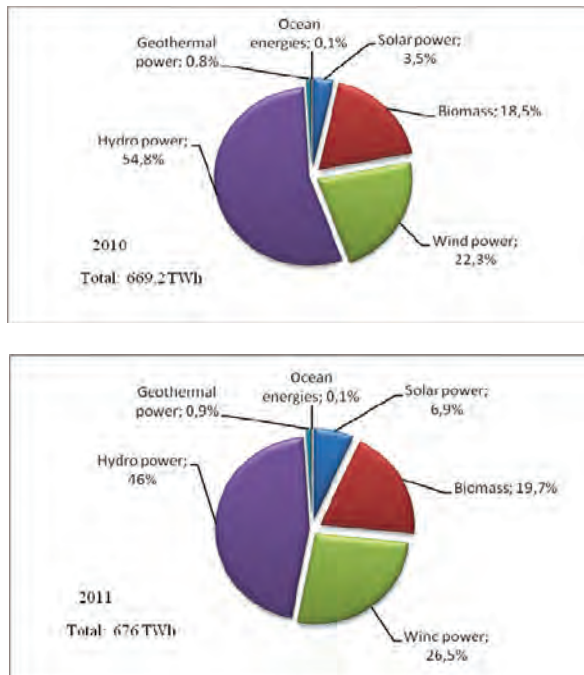


Fig. 3. Share of renewable energy in gross electricity consumption of EU in 2010 and 2011

than in 2010 (20,1%). Solar power, primarily generated by PV plants, registered its biggest increase by doubling its 2010 output (99,7%) to produce an additional 23,1TWh. Electricity from biomass contribution, which in 2010 had registered the highest increase, made an additional contribution of 9 TWh in 2011. Hydropower is still the EU's main renewable electricity source but output slipped below 50% mark (to 46%) in 2011. Total renewable electricity output is broken down by producer sector (Fig.3) [3].

As mentioned previously, the RES Directive sets an overall target of a share of at least 20% renewable energy by 2020. As far as electricity is concerned, the European commission expects that the share of renewable energy will need to increase to 34%. Realizing these ambitious goals will be difficult. Technical challenges will need to be overcome. The technologies also need to become progressively more cost competitive. To ensure large scale investment and deployment in the electricity, heating and cooling and transport sectors, the required policy framework needs to be developed and implemented, including appropriate financial incentives and measures to tackle the other non economic barriers.

Europe's current energy system is confronted with a number of uncertainties: unpredictable and highly volatile fossil fuel prices and the resulting economic challenges, geopolitical risks related to import dependency, and the harmful environmental consequences of fossil fuel based energy generation. Significantly increasing energy efficiency and deploying RES technologies is the most promising effort that can be made to mitigate man-made climate change and reduce hazardous pollution, enhance local and regional energy independence. In view of the fundamental transformation needed to ensure a sustainable Europe by the middle of the 21st century, a fundamental structural change is needed. For all these reasons, Europe must prepare the ground for a 100% renewable energy future, starting today. The EREC report **RE-thinking 2050** presents a pathway towards a 100% renewable energy system for the EU. "RE-thinking 2050" sets a long-term vision for the energy system in the EU, one which is entirely based on RES. In addition, it analyses the economic, environmental and social benefits likely to accompany such a transition and points out the necessary framework conditions to make this vision become reality.

IV. MACEDONIA - CURRENT SITUATION AND PROJECTIONS FOR 2020 AND 2030

Macedonia is strongly dependent on energy imports. It does not have any sources of crude oil or of natural gas, and in recent years it faces an ever increasing electricity imports. The energy sector in Macedonia greatly contributes to the environmental pollution because around 90% of the primary energy is produced from fossil fuels, mainly lignite and heavy crude oil. Therefore, this sector participates with over 70% in the total emission of greenhouse gasses and the participation is the same in the local pollution. However, with a share of RES of 13,8% in the final energy consumption in 2005, Macedonia belongs to the countries with a relatively high utilization of this type of energy [4]. In the past period, out of the RES, Macedonia primarily used hydropower (for production of electricity), biomass (mostly wooden mass for heat in the residential sector), the geothermal energy (mostly for heating the greenhouses), and some solar energy (for hot water in the households) and biofuels. In the future the plan is to increase the previously mentioned RES and to additionally use wind and solar power and biogas for production of electricity as well as waste biomass for cogeneration of electricity and heat.

Hydropower. Macedonia has available technical potential for hydropower for generation of about 5500 GWh of electricity per year in average hydrologic conditions. From this potential, the total installed power of the existing HPPs is 580 MW and their average annual generation is about 1500 GWh which is 27% of the available potential. According to the Study, construction of new HPPs with an annual generation of about 2500 GWh is planned, which would make the total production reach a level of 4000 GWh or 71% of the available technical potential [5].

Wind energy. Based on previous research, the realistic expectations include the construction of 90 - 180 MW WPPs by 2020 with annual generation of 180 - 360 GWh and a total

of 180 - 360 MW by 2030 with annual generation of 360 - 720 GWh [5].

Photovoltaic Solar Energy. Macedonia disposes with solid solar potential and applies high feed-in tariffs for electricity generated from solar energy. However, Macedonia does have in-country production of relevant technology and the feed-in tariff is fully levied to electricity consumers without indirect benefits for the economy. Therefore, the construction of total 10 - 30 MW PV systems has been anticipated by 2020 with an annual generation of 14 - 42 GWh, while 20 - 40 MW by 2030 with annual generation of 28 - 56 GWh. Upper limits can be considered achievable in case of significantly higher electricity market price and development of cheaper technologies on use of solar energy for electricity generation.

Waste biomass for combined heat and power generation. Activities to assess this potential in Macedonia are underway, but there are no specific results as yet. According to the Strategy [5], the construction of total 5 - 10 MW with annual generation of 25 - 50 GWh is possible by 2020 and construction of 10 - 14 MW with generation of 50 - 70 GWh is possible by 2030.

Biogas. The potential for electricity generation from biogas has not been sufficiently researched. The present Strategy [4] anticipates a total capacity of such plants in the range of 7 - 10 MW by 2020 with annual generation of 20 - 30 GWh and 10 - 15 MW by 2030 with generation output of 30 - 45 GWh.

Table I shows the share of electricity from renewable energy sources under the lower limit (LL), upper limit (UL) and the planned values (PV) [4], [5]. Considering an electricity generation growth with an average annual rate of 3%, 2% and 2,5% and electricity generation from RES according to the LL (2539 GWh), UL (3482 GWh), PV (2924 GWh) the percentage share of RES in electricity generation in 2020 would be 20,1%, 31,5% and 24,4% respectively, and in 2030 the RES share in electricity generation will account for 23%, 39,3% and 30,3%, respectively.

TABLE I
RES SHARE IN ELECTRICITY GENERATION

	GWh					
	2005	2020 DG	2020 GG	2020 PV	2030 DG	2030 GG
LHPPs	1090	2000	2600	2350	2920	3700
SHPPs	54	300	400	300	510	710
Total HPPs	1144	2300	3000	2650	3430	4410
WPPs	0	180	360	180	360	720
PVSystems	0	14	42	14	28	56
Biomass	0	25	50	25	50	70
Biogas	0	20	30	20	30	45
Electricity from RES	1144	2539	3482	2889	3898	5301
Total electricity generation		12616	11060	11842	16955	13482
RES share (%)		20,1	31,5	24,4	23,0	39,3

All four scenarios analyzed in the Strategy [5] indicate the fact that in 2020 Republic of Macedonia can realistically attain the target share of RES set at 21%.

Increasing the share of renewable energy sources is not possible without adequate (incentive-providing) primary and secondary legislation. In that context it is necessary to finalize the legislation and eliminate the administrative barriers. The utilization of renewable energy sources is supported with a whole host of measures (the most significant of which is the stimulation of electricity generation from RES through the use of feed-in tariffs) and their use is expected to increase in the future. Feed-in tariffs are stipulated by the Energy Regulatory Commission and currently in effect are tariffs applicable for SHPPs, WPPs, PVPP, power plants using biogas from biomass and power plants using biomass.

V. CONCLUSION

Sustainability is becoming the major goal in many communities. One of the crucial tasks in reaching sustainability is solving the problem of how to ensure adequate energy for development from locally present resources and cost effectiveness. In this situation, a mix of RES distributed around the world appears to be a promising sustainable solution.

The world has tapped only a small amount of the vast supply of RES. Policy efforts now need to be strengthened and taken to the next level in order to encourage a massive scale up of renewable technologies. That level of scale is needed to enable the RES 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.

The United Nations General Assembly declared 2012 as the International Year of **Sustainable Energy for All**. This initiative aims to mobilizing global action to achieve universal access to modern energy services, improved rates of energy efficiency, and expanded use of RES by 2030. The trends point to a very different energy system that will begin to emerge over the next decade. To be sure, political leaders will need to continue enacting additional and effective policies, engineers and scientists will need to continue creating new technologies, and businesses will need to continue investing if this bright new future is to be realized.

REFERENCES

- [1] REN21., *Renewables 2012 Global Status Report*, REN 21 Secretariat, Paris, 2012.
- [2] EREC, *RE-thinking 2050: a 100% Renewable Energy Vision for the European Union*, 2010. www.rethinking2050.eu.
- [3] EurObserv'ER, *The State of Renewable Energies in Europe*, 12th EurObserv'ER Report, 2012 Edition, www.energies-renouvelables.org.
- [4] MASA, *Strategy for energy development in the Republic of Macedonia until 2030*, Ministry of Economy, Skopje, R.Macedonia, 2010.
- [5] MASA, *Strategy for utilisation of renewable energy sources in Republic of Macedonia by 2020*, Ministry of Economy, Skopje, R.Macedonia, 2010.