[1.]Gabriela Cristina SIMION, [1.]Mirela Nicoleta DINCĂ, [1.]Georgiana MOICEANU, [1.]Mihai CHITOIU

RENEWABLE ENERGY IN CONTEXT OF SUSTAINABLE DEVELOPMENT

[1.]University Politehnica of Bucharest, Faculty of Biotechnical Systems Engineering, ROMANIA

Abstract: At the basis of the evolution and development of modern human society lies the energy, being one of the input components for most production processes and comfort offered to people. Energy can be analyzed from a safety perspective through the availability of energy resources for the economy, sustainability, the impact of using different energy sources on the environment and competitiveness, at the level of attracting energy sources. The paper explores the analysis of renewable energy resources: biomass, wind, solar energy and its current development at national and European level.
Keywords: renewable energy, biofuels, biomass, wind energy, solar energy, biogas, fermentation

INTRODUCTION

The concept of energy security is in connection with sustainable development by identifying and exploiting alternative energy sources, reducing environmental pollution, upgrading and modernizing existing transport routes. The European Union is increasingly exposed to instability and rising prices on international energy markets, as well as, to the consequences of the fact that hydrocarbon reserves are gradually being mobilized by a small number of holders.

Renewable energy refers to forms of energy obtained through energetic transfer of the resulting energy from natural renewable processes. Therefore, solar energy, wind energy, flow waters energy, that of biological processes and geothermal heat can be taken by humans using different procedures. The types of energy that are not renewable include nuclear energy, as well as, the energy generated through burning of fossil fuels, like oil, charcoal and natural gases. These resources are, evidently, not renewable, as they are found harder each year. From the renewable energy sources we can find-wind energy, solar energy, water energy, biofuels and biogas. All of these forms of resources are been used for generating biofuels, electric current, hot water, etc.

Wind energy is generated through the transfer of wind energy by a wind turbine. Winds form because the Earth is heated unevenly by the energy radiated by the Sun which reaches our planet. This variable warming of the air layers produces different air density zones, which, in turn, creates movement of the air. The kinetic energy of wind can be used by the wind turbines, which are capable of generating electricity. Some wind turbines are capable of producing up to 5 MW of electric energy, even though they require a constant speed of the wind of about 5.5 m/s. or 20 km/h. There are only a few areas on Earth which have those attributes, especially at high altitude and oceanic areas.

The concept of solar energy refers to the energy that is directly produced through transfer of solar energy radiated by the sun. This can be used to generate electric energy or to warm the air inside a building. Even though this type of energy is reusable and easy to produce, the main problem is that the Sun doesn't offer constant energy in any place on Earth.

Not to mention the rotation of the planet, the day-night temperature difference, the solar light can be used for energy only for a short part of every day. Another setback of using this type is that of the cloudy days, when the energy potential drops because of the blocking of the solar light.

Hydro-energy represents the capacity of a system (water) to make energy from the passing from one state to another. In practice, this is the energy produced in hydro stations with the help of the movement of water, caused by the level difference between the accumulation lake and the station.

Biomass represents the renewable resource which is most abundant on our planet. This includes absolutely all the organic matter produced through metabolically processes of the living organisms. Biomass is the first form of energy used by man, once with the discovery of fire.

At the present day, in the European Union, the Renewable Energy Directive sets rules for the EU to achieve its 20% renewables target by 2020. http://ec.europa.eu/energy/en/topics/renewable-energy.

MATERIAL AND METHOD

From the 1990, the UE has put itself in an ambitious plan to become a worldwide leader in the renewable energy domain. For example, the UE disposes at the present day of a capacity to create wind energy the equivalent of 50 coal based factories, to which their costs have been reduced to half in the past 15 years. The renewable energy market of the UE has an annual business number if 15 billion EURO (half of the entire worldwide market), an average of 300000 workers and is an important exporter. At the present day, the renewable energy is beginning to compete, from the cost point of view, with fossil fuels.

In 2001, EU decided that the electricity percent produced from renewable resources should reach 21% by 2010. In 2003, it was decided that at least 5.75% of the entire quantity of gas and diesel should be made from bio-fuels by 2010. A few countries record a rapid rise in usage of renewable energy through support national policies. But

according to the actual times< EU will be around 1-2 percent below the fixed targets.

For the EU to fulfill its long term objectives of climatic changes and reduce its dependency for the import of fossil fuels, it must reach and even top those objectives. The renewable energy occupies the third place for producing electricity and still has risen potential, with all the advantages for the environment.

An efficient measure for preventing climatic changes represents an urgency and the EU must continue to keep control as a leader through examples and act for extending as much as 92possible the international action. Europe must be ambitious and act in an integrate way and promote the Lisbon objectives.

The EU made already its first steps in the direction of limiting the economic rise from the energy usage increment. The EU initiative combined legislative initiatives and energy efficiency programs which encourage competition and the efficient usage of renewable energy. The EU engagement of preventing climatic changes is a long term one.

For reducing the rise of global temperature to a maximum of 2 degrees over the pre-industrial levels, the gas emissions with greenhouse effect should reach the maximum value until 2025 and then they should be reduced by at least 15%, preferably at most 50% comparative to those levels from 1990. This challenge means that Europe should react now, especially in the fields of energetic efficiency and renewable energy.

Aside from the prevention of climatic changes, measures regarding renewable resources and the energetic efficiency will contribute to the rising of this energy usage and lowering the UE dependency to average energy. Also this policy will create numerous workplaces of good quality in Europe and will maintain the no.1 place as a leader in technology, for a worldwide sector in full development.

From this perspective, the UE plan of Emission Commercialization creates a flexible frame from the point of view of costs for a cleaner production of energy. This plan is also the nucleus for the worldwide market of CO2.

The maximum potential will be exploited only through a long term engagement for development and installation of renewable energy.

Table 1. A synthetic analysis of the resources and their potential on the market in Romania

Technology	Level of resource existence	Market Potential
Wind	2-3	2
Solar Photovoltaic	2-3	1
Solar Thermal	2-3	2-3
Micro-hydro	3	3
Biomass	3	3
Geothermal	3	2-3
Energy valued waste	2	2

In Romania there is a technical and scientifically experience important in the domain of renewable resources, but that remained at the theory levels. In present the market conditions do not favor their direct competition. The closest to a commercial use are applications that use biomass, micro-hydro, geothermal resources.

In the present day, the electric energy that comes from renewable sources is 42.29%. Therefore, hydro is 29.88%, wind is 11.07%, solar photovoltaic is 1.18% and biomass is 0.16% [www.agerpres.ro/economie/2017/04/19].

Both the energy law and the energy efficiency law stimulate the development of renewable energy and the ANRE has in plan the completion of a specific program.

RESULTS

Renewable energy resources that compete directly with fossil fuel are biomass and wastes from agriculture.

Since biomass is the only carbon-based renewable fuel, its application becomes more and more important for climate protection. Among the thermochemical conversion technologies (i.e.. combustion, gasification and pyrolysis), combustion is the only proven technology for heat and power production. Biomass combustion systems are available in the size range from a few kW up to more than 100 MW. The efficiency for heat production is considerably high and heat from biomass is economically feasible[14]

Biomass represents the renewable resource which is most abundant on our planet. This includes absolutely all the organic matter produced through metabolically processes of the living organisms. Biomass is the first form of energy used by man, once with the discovery of fire.

Biomass has a worldwide interest as a renewable energy resource that can make a big contribution to rural development and to the implementation of sustainable energy supply systems at local, regional and global level. The current primary energy conversion technologies contained in biomass are the following: direct burning, gasification, pyrolysis, biological fermentation.

Energy security and climate change mitigation are core elements in current European energy policy. The EU countries are mandated to meet by 2020 a target of 20% renewable resources in the energy supply and 10% renewable resources in energy in the transport sector [4]. The latter corresponds to a replacement of 50 billion liters of fossil transportation fuels. The Energy Strategy 2020 [3] of the European Commission calls for increased use of renewable resources in the energy system and the European Council has presented a long term target for the EU and other industrialized countries of 80 to 95% cuts in greenhouse gas emissions by 2050. A cornerstone in renewable energy projections of the European Union is biomass, which is expected to account for 56% of the renewable energy supply in the EU by 2020

When biomass is used as a fuel, instead of fossil, the same amount of carbon dioxide is released into the atmosphere. If the use of biomass is to produce energy, it is considered a neutral carbon fuel, due to the drastic reduction of gas emissions into the atmosphere by producing methane instead of CO2. Carbon represents about 50% of the dry

vegetal mass and is part of the atmospheric carbon cycle. Biomass fixes CO2 from the atmosphere during growth after carbon dioxide is released as a mixture of carbon dioxide (CO2) and methane (CH4), depending on the last use of the plant material.[1]

Almost all the resulting agricultural residues can be used as resource for renewable energy, but considering the possibilities of collection and baling for transportation, only the following types of agricultural residues are considered:

» straw
» maize stalks
» corn hammers
» sunflower – strains, capite and seed husks
» vineyards
» flax and hemp pocketing

In the category of "straw" were included the residues resulting from the harvesting and treatment of the main crops of grain cereals – wheat, barley, rye, oats. It is obvious that depending on the species and the variety, the weight of the straw in relation to the weight of the grain varies widely. Under these conditions it was considered that an average of straw weight is about 90% of the grain weight. [4]

Corn stalks are the plant, as harvested less. The weight of the maize strains is very varied depending on the maize variety and the humidity at harvest. Corn ham is the support of corn grains in the pot. The weight of corn ham is on average equal to the weight of the grain. The flakes and hemp are the remains of the plant stems after the fibers have been extracted. The weight of the cases is approx. 50% of the weight of the plants. [20]

Table 2. The biomass potential by sorts, regions

Region	Forestry biomass thousand tones/year	Wood waste thousand tones/year	Agricultural biomass thousand tones/year	Biogas ml.mc/year	Urban waste thousand tones/year	TOTAL TJ
Dobrogea	54	19	844	71	182	29,897
	451	269	13,422	1,477	910	
Moldova	166	58	2,332	118	474	81,357
	1,728	802	37,071	2,462	2,370	
Carpatic Region	1,873	583	1,101	59	328	65,415
	19,552	8,049	17,506	1,231	1,640	
Transilvania	835	252	815	141	548	43,757
	8,721	3,482	12,956	2,954	2,740	
Vest Plain	347	116	1,557	212	365	60,906
	3,622	1,603	24,761	4,432	1,825	
Subcarpatic Region	1,248	388	2,569	177	1,314	110,198
	13,034	5,366	40,849	3,693	6,570	
South Plain	204	62	3,419	400	1,350	126,639
	2,133	861	54,370	8,371	6,750	
TOTAL	4,727	1,478	12,637	1,178	4,561	518,439
	49,241	20,432	20,093	24,620	22,805	

Starting from the above, the total biomass production used for fuel is:

» straw – 3,357 thousand t / a
» maize stalks and corn hammers – 17,286 thousand tons / year
» sunflower – 7,350 thousand t / a
» vineyards – 255 thousand tons / year
» flax and hemp pocket – 5,590 thousand t / a

The resulting agricultural biomass traditionally has three possible uses, namely:

» re-use in agriculture (animal husbandry)
» raw materials in the pulp and paper industry
» fuel

What is not consumed by one of these forms is burnt in the field, embedded in soil or stored for biological degradation. In areas with a lot of arable land, biomass can play an essential role in energy production.

Table 3. Energy potential of biomass

Parameter	UM	Technical	Economical
a) Vegetal biomass			
Thermal/ electrical energy	TJ/year	471,000	289,500
	Thousant tep/year	11,249	6,915
b) Biogas			
Thermal/ electrical energy	TJ/year	24,600	14,800
	Thousand tep/year	587	353
c) Urban waste			
Thermal/ electrical energy	TJ/year	22,800	13,700
	Thousand tep/year	544	327
TOTAL	TJ/year	518,400	318,000
	Thousand tep/year	12,382	7,595

CONCLUSIONS

From the 1990, the EU has put itself in an ambitious plan to become a worldwide leader in the renewable energy domain. For example, the EU disposes at the present day of a capacity to create wind energy the equivalent of 50 coal based factories, to which their costs have been reduced to half in the past 15 years. The renewable energy market of the UE has an annual business number if 15 billion EURO (half of the entire worldwide market), an average of 300,000 workers and is an important exporter. At the present day the renewable energy is beginning to compete, from the cost point of view, with fossil fuels.

In 2001, EU decided that the electricity percent produced from renewable resources should reach 21% by 2020. In 2003, it was decided that at least 5.75 % of the entire quantity of gas and diesel should be made from bio-fuels by 2010. A few countries record a rapid rise in usage of renewable energy through support national policies. But according to the actual times, EU will be around 1-2 percent below the fixed targets. For the EU to fulfill its long term objectives of climatic changes and reduce its dependency for the import of fossil fuels, it must reach and even top those objectives. The renewable energy occupies the third place for producing electricity and

still has rise potential, with all the advantages for the environment.

For the potential to be reached, the web of policies must support and stimulate competitiveness of such sources of energy. Some internal sources of low CO2 emission are already available, others, such as wind energy, wave energy still require support for entering the market.

The maximum potential will be exploited only through a long term engagement for development and installation of renewable energy.

Note

This paper is based on the paper presented at ISB-INMA TEH' 2017 International Symposium (Agricultural and Mechanical Engineering), organized by University "POLITEHNICA" of Bucharest – Faculty of Biotechnical Systems Engineering, National Institute of Research-Development for Machines and Installations Designed to Agriculture and Food Industry – INMA Bucharest, Scientific Research and Technological Development in Plant Protection Institute (ICDPP), National Institute for Research and Development for Industrial Ecology – INCD ECOIND, Research and Development Institute for Processing and Marketing of the Horticultural Products "HORTING" and Hydraulics, Pneumatics Research Institute INOE 2000 IHP, University of Agronomic Sciences and Veterinary Medicine of Bucharest (UASVMB) – Faculty of Horticulture and Romanian Society of Horticulture (SRH), in Bucharest, ROMANIA, between 26 – 28 October, 2017.

References

[1] www.gazetadeagricultura.info/.2011Biomass Renewable energy resource Sursa de energie regenerabila;

[2] Commission E: Energy (2010).2020 A strategy for competitive, sustainable and secure energy. European Commission. Brussels. BE;

[3] Bentsen N.S., Felby C. (2012). Biomass for energy in the European Union- A review of bioenergy resources assessments. Biotechnology for Biofuels;

[4] Ros V., Chira T., Balc G., Fechete L. (2004). Method for evalation of energetic potential in a farm Metoda de evaluare a potentialului energetic dintr-o ferma agricola. vol.5. ISSN 1312-5443

[5] http://www.minind.ro/domenii_sectoare/energie/studii/potential_energetic.pdf (2006) Studiul privind evaluarea potentialului energetic actual al surselor regenerabile de energie in Romania(solar. vant. biomasa. microhidro. geotermie). identificarea celor mai bune locatii pentru dezvoltarea investitiilor in producerea de energie electrica neconventionala. ICEMENERG SA. Bucuresti;

[6] http://leg-armonizata.minind.ro/leg_armonizata/energie/Directiva_2009_28_CE.pdf(2009) Directiva 2009/28/CE privind promovarea utilizarii energiei din sursele regenerabile. Jurnalul oficial al Uniunii Europene. L140/6;

[7] Chum H.L,. Overend R.P.(2001). Biomass and renewable fuels. Fuel Processing Technology 71 2001. 187–195;

[8] Hovelius K. (1997)- Eneregy and analysis of biomass production/Energia si analiza productiei de biomasa. Raport 222. Suedia. Universitatea de stiinte agricole. Uppsala. ISSN 0283-0086;

[9] http://www.renascc.eu/documente/sa33134ro_1282ro.pdf(2011) Treaty regarding the EU functioning. European Directive2009/28/CE regarding the promoting of renewable sources energy /Tratatul privind funcționarea Uniunii Europene Directiva 2009/28/CE privind promovarea utilizării energiei din surse regenerabile European Comission Bruxelles;

[10] Bent Sørensen.(2004) Renewable Energy. Its physics, engineering, use, environmental impacts, economy and planning aspects. Third Edition. Elsevier Science;

[11] EUROPEAN COMMISSION - EUR 21350 (2005). Biomass - Green energy for Europe. Luxembourg: Office for Official Publications of the European Communities. 2005;

[12] Demirbas A.. Combustion characteristics of different biomass fuels.(2004) Progress in Energy and Combustion Science 30 (2004) 219–230;

[13] Van Loo S. and J. Koppejan (2002) Handbook of Biomass Combustion and Co-firing. Twente University Press. 2002;

[14] Thomas Nussbaumer (2003) Combustion and Co-combustion of Biomass: Fundamentals. Technologies and Primary Measures for Emission Reduction Energy & Fuels 2003. 17. 1510-1521.

ISSN: 2067-3809