

RENEWABLE ENERGIES AND PRESENT DAY ENERGY ECONOMICS

Abstract

Once all available energy resources of Romania are inventoried, the scientific and business communities must support each other in attaining their common goals to raise the living condition for both themselves, and for the indigenous population, by making the catchment, production and supply of all energy types, needed for a wealthy and facile life, more efficient.

Keywords: solar energy, aeolian (wind) energy, geothermal energy, biomass with biogas, hydrogen, electric energy, recycling of nutrients in nature, employment.

1. Introduction

In the present context, of raising the price for energy on a world level, of reducing conventional resources and environmental pollution, a new strategy of research and development is required from all developed countries, such that all challenges, brought by the growing consumption of energy due to Global population growth, will be met. Romania, as a country member of the European Union, must also change and diverse its strategy for energy production on a national level, as well as on a local level. From a renewable energies point of view, Romania still has an immense potential to produce energy, especially electric, using more resources of energy, meaning:

- **Hydraulic energy** of hydrographic basins for both large, as well as medium and small capacities.
- **Wave energy** of the seas and oceans, which can be obtained only under conditions of sea/ocean turbulence, waters' calm is not a stimulative factor.
- **Tide energy** can be caught both at marine/oceanic flux, and reflux.
- **Solar and aeolian (wind) energies**, which are plentiful at high sea and on the sea-shore of the Black Sea, in the zone of Moldavia and on mountains' peaks.
- **Geothermal energy** is available both in the Black Sea, as well as on land (hydro-thermal springs).
- **Biomass with biogas** in rural environment, as a means to produce biogas, that can be used as fuel in schools, canteens, hospitals etc., but also for biologic, organic agriculture, assiduously invoked by the European Union.
- **Biofuels** (bioethanol, biodiesel etc.) can replace diesel fuel or other conventional carburants, but they need vast fields for agricultural crops specific to afterwards processing and have the disadvantage of affecting edaphic layers.
- **Fermentation gases** caught inside domestic waste water treatment plants both in rural environment, as well as in urban, from agro-zootechnic farms, from food industry in its extents and other small industries.

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- **Gases caught from non-dangerous waste landfills**, which can be available by collecting them on site.

- **Hydrogen** can be obtained through electrochemical hydrolysis of water.

Reaching a certain level, Romania can even export a part of the energy produced through these means. Informally, for Romania's energy potential only from a single clean renewable resource to be noticed, below it is shortly described only the hydraulic source, the capacity to produce energy based on this source and the potential means.

The system of hydrocentrals (hydropower plants) across the territory of the country has been created nearby large hydrographic basins, but beside these ones there is a whole series of water streams with larger or smaller flows, that were not caught for supplying respective accumulations. The furnishable potential of these water streams is around four billion kWh,² a value that represents approximately 10 % of the hydraulic potential of the country. The percentage of 10 % is relatively insignificant taken as it is, but nonetheless neglectable.³ What still must be added to this thing is the fact that there can be created local energy systems, that will uncongest the national system on one hand, and will lead to large cable savings in the local distribution networks, uncomparable shorter than it would be required to connect some towns to NES (National Energy System), on the other hand. To all these there must be added the reduction in loss of energy on long outlines of supply when connected to NES. All these plead and pleaded in favor of utilizing these resources, which led to the emergence of the so called microhydrocentrals (micro hydropower plants). Comparatively with the large hydrocentrals, that needed years of study, design and execution, and enormous costs to bring them from the stage of design to the one of functioning, microhydrocentrals are a lot cheaper and easier to assemble, exploit and maintain, moreover they consolidate the ecologic equilibrium around hydrotechnical furnishings through river reclamation needed to stabilize the river banks on which they are furnished.

A good thing that the European Union turned to is that it financially supports the production of energy through clean alternative means. Even the Government of Romania has shown its interest for such projects on a national and local level, to raise the comfort and living condition of the population. Notable is the fact that on a world level countries like Germany, Great Britain, the United States of America, Holland, Denmark, Sweden, Norway, China, India, Indonesia etc. have commenced a series of major projects to sustain alternative energy systems, and others are already functioning for years. Resources, technology, funding and manual labor are plentiful, initiatives are the only ones that have to be stimulated.

2. Definitions

As it is well known in the field of energy, there are two energy types: primary (fossil) and alternative (renewable). Primary resources of energy, beside the fact that they make the planet, through their lessened or on global scale utilization, undergo a slow and certain destruction, are on the point of exhaustion. An important fact to mention is the one that they cannot be utilized the way they were caught from nature and need a whole chemical process so they can be used in complex, individual industrial systems and to supply other multiple secondary, tertiary chain products. Of course, on the present level of development many of these products are strictly necessary to us from certain points of view, but nevertheless all repercussions upon the planet and humanity itself must be taken into consideration. What must be considered, beside the fact that based on primary (fossil) resources of energy a whole series of products is supplied, utilized mainly on large scale in energy and fossil fuels (carburants) production, is that there is also the other category of energy resources, the one of alternative (renewable)

² "Carpatica Romanian Mountain Development Foundation" – project of microhydrocentrals

³ Ibidem

resources, which can be used employing the proper means and technologies the way they were caught from nature, without any natural or industrial process of processing them, and that is from start an advantage. Human society should with the entire predilection be centered on utilizing these resources, for the fact that both nature and sustainable development of all humanity must be supported.

Wind or aeolian energy can be used catching the energy of atmospheric currents of very low height, making use of wind turbines located from high seas and seashores of seas and oceans, to mountain peaks, depending on the favorability of the speed of the predominant wind throughout the year under studied and researched conditions over several years (10 – 20 years). These installations can be located either individually or grouped up to the natural and technical and financial potential and then they can be connected to consumers (domestic, industrial, in rural, in urban environment and/or to National Energy System (NES)) in a simple to complex system depending on the case.⁴

Solar energy or the radiation of the Sun can be used catching the energy transmitted by the Sun throughout the year through solar collectors equipped with photovoltaic cells capable to absorb and further transmit the energy emitted by the Sun. These collectors can be located anywhere on the surface of the land and water on the Globe, from high seas and seashores of seas and oceans, to mountain peaks, even on windows, terraces and rooftops of constructions, both in an industrial system (solar parks), as well as in an individual (domestic) system. Connecting these installations to consumers (users) is from simple to complex depending on the case.⁵

Geothermal energy is one of the most coveted types of present alternative energy on the Globe, not because of the type of energy in itself, but because of its abundance. Known is the fact, thanks to MIT in the year of 2006,⁶ that, at a present annual technological consumption rate and the huge availability of this resource, humanity would have the possibility to exploit it for 4,000 years, and man would never need to use other fossil resource to produce energy for thousands of years. This type of energy is so abundant in Earth's crust and with the proper technology it can easily be caught and utilized on a large scale, initiatives are the only ones that have to be supported.⁷

Hydraulic energy or of water wheels can be caught using water wheels equipped with hydraulic turbines located from the smallest creeks depending on the fall height and flow, up to the largest rivers on the planet. This potential must not be neglected at all, but studied in detail and exploited according to location's specificity, without many likenesses and generalities, as it has been wrongly done in the past. Such installations can be connected from one user, to National Energy System (NES) depending on the case.⁸

Wave energy of seas and oceans can be caught using oceanic engines that take this energy, transform it into mechanical energy and transmit it to users converted into electric energy, a system successfully applied especially in the case of oil platforms at high seas and oceans.⁹

⁴ "Managementul energiei. Principii, concepte, politici, instrumente", Second edition, Leca Aureliu, Muşatescu Virgil coordinators.

⁵ Ibidem.

⁶ "The Future of Geothermal Energy, Impact of Enhanced Geothermal Systems [EGS] on the United States in the 21st Century", MIT (2006).

⁷ "Managementul energiei. Principii, concepte, politici, instrumente", Second edition, Leca Aureliu, Muşatescu Virgil coordinators.

⁸ "Managementul energiei. Principii, concepte, politici, instrumente", Second edition, Leca Aureliu, Muşatescu Virgil coordinators

⁹ Ibidem

Tide energy can be caught utilizing a certain type of hydraulic turbine, which catches the energy at both flux, as well as reflux, the bulb turbine. Unfortunately Romania has no tide resources.

Biomass with biogas represents a way to both produce energy and save ecosystems and to support sustainable rural development. Based on collected biomass' fermentation in bunkers and boilers biogas can be produced, which on one side can be used as fuel in schools, canteens, kindergartens, hospitals etc., and on the other side organic nutrients can be recycled in nature by incorporating the fermented biomass, through composting it with other organic wastes and applying the compost on the land of diverse cultures, in the soil. Thus organic agriculture can be sustained and jobs can be created for unqualified workers.¹⁰

At present it has become, through convention, that **biofuels** are now part of renewable energy resources' category. Though it is being insinuated that they would not compete with the other crops, there is nonetheless a great impediment, the soil. After cultures that serve as raw material for biofuels, the soil remains poor in nutrients and drops in evaluation and favorability classes for other crops. Indeed, considerable crops can be obtained, but it would be desirable from the scientific and business communities' side to turn to something that really supports sustainable development, than to destroy our food basis.¹¹

It has been known that once closed, making use of vertical aerators and gas collectors, from **non-dangerous landfills fermentation gas of wastes** can be collected. Such gases can be used in various industries as fuel. However, in the United States of America the transformation of domestic organic wastes, from agro-zootechnic farms and various food industries, into biofuels for supplying diverse consumers with natural carburants has been practiced for years, as a means of reconversion of manual labor from mining industry into energy industry and to convert fully exploited mines and quarries in natural furnished depozites for producing biofuels (bioethanol). Romania has still to recover.

In a similar way **fermentation gas inside domestic waste water treatment plants**, from agro-zootechnic farms and diverse food industries, can be obtained, where, in the biological process of waste water treatment with active muds, fermentation gases come out, which can be used as fuel in various industries.

Beside these already known types of obtaining energy there are plenty more, like **obtaining hydrogen through electrochemical hydrolysis of water** and using it as a universal fuel by burning it, which once burned combines with oxygen and forms water, a clean renewable universal process. On an international level there are already some automobile industries, and not only, who researched and developed technologies that were incorporated into fuel supply system of hybrid autovehicles. Thus, beside the classical fossil carburants tank, on hybrid models from BMW, Mercedes etc. hydrogen tanks were installed, which complete the power source of the autovehicle. Moreover, to some specialists in the autovehicle industry it seemed rather little from an energy and technological point of view and they installed an electric engine too, which goes along with the classical one, and which it too develops a few more tens of kW. So, here we find that ideas, resources, technologies, funding and manual labor are plentiful.

3. Renewable energies presentation

If it were to take into consideration the clean energy resources of the planet and the fact that to this day Romania has failed to take advantage of its economical recovery chances, we

¹⁰ "Valorificarea resurselor vegetale secundare în conexiune cu progresele biotehnologiei", Rusan Viorica și Popa Valentin I., in: "Memoriile Secțiilor Științifice", Seria IV, tomul XIII, nr. 1

¹¹ "Managementul energiei. Principii, concepte, politici, instrumente", Second edition, Leca Aureliu, Mușatescu Virgil coordinators

should stop looking with such longing to results that other countries members of the European Union have obtained and start learning from our own and others' mistakes, from our beneficial experiences and of those in the union and get to work intelligently. Therefore, here is a brief presentation of renewable energies on a global level and not only.

Solar energy is derived from the Sun and is so abundant, that one hour of light at noon has more energy than the whole world would consume in a year. If from that huge amount only 0.01 % were taken, the world would never need to use oil, natural gas or other fossil fuels again. The problem is not in availability, but in technology to use it. And there are many sources today like that.¹²

There is also **aeolian (wind) energy**, which has long been denounced as weak because of the fact that it depends on location, unpractical. That is not true. The Department of Energy of the United States of America in the year of 2007 admitted that, if the wind would be entirely used only 3 hours/day in all 50 states, the whole nation could be supplied with energy.¹³

There are also other less known sources: **tide and waves. Tide energy** is derived from tide motion of seas and oceans. By installing turbines to catch this motion energy is generated. In Great Britain there are 42 noted locations available and it is estimated that 34 % of all Great Britain's energy could come from tide energy. **Wave energy**, which can be exploited by extracting energy from surface motion of seas and oceans, is estimated as having a global potential of 80,000 TWh/year. This means that 50 % of the energy used by the planet could be produced only from this source. It is important to say that, beside coal, oil, natural gas, biomass and all other energy sources, tide, wave, solar and aeolian energy do not need energy to preliminary be caught. All these four sources combined, if they were caught efficiently with the help of technology, we could supply the world for ever.¹⁴

There happens to be yet another clean renewable source of energy, which has an even greater potential than all the others, **geothermal energy**. This energy uses what is called "heat mining", which through a simple process, using water, it is capable to generate massive quantities of clean energy. In the year of 2006, in a report of MIT regarding geothermal energy¹⁵ it has been calculated that 13,000 ZJ are available in the Earth, with the possibility that at present only 2,000 ZJ are accessible through improved technology. The total energy consumed by all countries on the planet is approximately 0.5 ZJ/an. After a simple calculation it results that, on present humanity's technological level of exploitation, enough energy could be caught for 4,000 years from this source alone. When we understand that Earth's heat is constantly regenerating, then we realize that this energy is actually limitless. It could be used for ever.¹⁶

Centering our attention on geothermal energy from a global level to the surface of Romania, land and water, in Academy member's Mihai C. Băcescu reception speech it can be noticed the description of hydrothermal springs in the Black Sea, which Romania would have access to. Thus, for more than two decades it has been known that not for nothing the Black Sea has been given this name. The reason it has been given this name is because the sea water from the depth of 60 – 80 m to the bottom is full of sulphur and a few other salts and elements. Therefore, nothing can live under these conditions from a depth larger than 60 m.

The causes for such inhospitable sea water for life are hydrothermal springs on the bottom of the Black Sea. These hydrothermal springs have been studied by international marine crews, but to this day there has not been found a way to exploit them because of the environ-

¹² "Zeitgeist Addendum", www.thezeitgeistmovie.com.

¹³ Ibidem.

¹⁴ "Zeitgeist Addendum", www.thezeitgeistmovie.com.

¹⁵ "The Future of Geothermal Energy, Impact of Enhanced Geothermal Systems [EGS] on the United States in the 21st Century", MIT (2006).

¹⁶ "Zeitgeist Addendum", www.thezeitgeistmovie.com.

ment itself and of the lack of proper technology necessary to man.¹⁷ Judging things from a marine cartographic point of view, from the depth of 60 m to the bottom of the sea, depending on sea bottom's cartography, each country that has access to the Black Sea and in international waters could exploit this fantastic resource of geothermal energy and a series of elements so necessary to some industries, like sulphur which is abundantly present in these marine springs. Unfortunately no one has come up with an idea or a corresponding technology to exploit this resource that is not to be neglected at all. However, the problem remains open for the present generation and for the next ones to find a solution in this case and similar ones. These sources of energy are only a few from the clean renewable sources available and over time we will find more. The great achievement is that there is energy in abundance, without the need of pollution, traditional conservation or price.¹⁸

Another problem that needs more attention is transportation. The main means of transportation in our societies is by automobile or airplane, both predominantly need fossil fuels to work. In the case of automobile, battery technology necessary to power an electric car, which can drive at speeds of over 160 km/h for more than 320 km on a single charge, exists and it has existed for many years.

In the case of airplanes, it is time that specialists realized that this means of transportation is ineffective, heavy, slowly and it causes much pollution. The MAGLEV train uses magnets for propulsion. It is completely suspended by a magnetic field and it needs less than 2 % of the energy used by an airplane. This train has no wheels, so nothing can break. The current maximum speed of a version of this technology, which is being used in Japan, is 581 km/hour (361 miles/hour). Nevertheless, this version of technology is very old. An organisation called ET3, who is in connection with "The Venus Project",¹⁹ has designed a MAGLEV train in a tube, which can travel at speeds up to 6,400 km/h, in a tube without motion, friction, which can be on land or under water. This technology and many others are at present highly obsolete. Imagine that you go from New York to Los Angeles for an extended lunch break or from Washington to Beijing in two hours. This is the future of continental and intercontinental travelling, fast, clean, consuming just a fraction of the energy consumed today for the same tasks. Between MAGLEV technology, batteries with advanced charging and geothermal energy there will never be a reason to burn fossil fuels again. And all of these we can do them now.²⁰

Turning our attention to a much smaller matter, to rural settlements in mountain environment, but not only, we can observe an already known type of energy, at a lower potential, though considerable regarding the situation of undeveloped and developing countries, the energy of all streams and creeks and even waterfalls along them. An aspect not to be neglected at all is the fact that at present in Romania there is still a very low living condition,²¹ under the conditions of unutilized energy sources. An unexploited source of electric energy, and not only, is hydraulic energy, which can be exploited through the means of microhydrocentrals of different capacities under clean conditions, that can bring a support in environmental protection and raise the living condition of the population in rural environment. This technology can be developed and taken advantage of by using as much as possible local materials and unqualified manual labor for the execution.

Based on this simple technology, current domestic activities, crafts can be sustained, new jobs can be created and local communities can be supported by developing infrastructure,

¹⁷ "II. Izvoarele hidrotermale (17 octombrie 1991)", academician Băcescu Mihai C., in: "Discursuri de receptie", Vol. VIII, anii 1990 – 1995

¹⁸ "Zeitgeist Addendum", www.thezeitgeistmovie.com

¹⁹ "The Venus Project", www.thevenusproject.com

²⁰ "Zeitgeist Addendum", www.thezeitgeistmovie.com

²¹ Unelectrified villages, without cold and hot tapped water, without a sewer network etc.

turism and agroturism. Once they have electric energy, agricultural, horticultural, dendrological etc. plantations' irrigation systems can automatically be sustained and developed. Judging things at a rural intercommunity's level, thus national electric energy transport system can get uncongested, on one side, and even supplied in case of local electric systems' overload, on the other side.

At the same time, if we take into consideration biomass with biogas, also in rural environment, which can be exploited both in domestic, as well as in industrial environment, we get yet another source of energy on one side, and a natural recycling way of nutrients in nature, beside compost platforms, on the other side.²² There are two processes that take place. In **the first process**, through the fermentation of biomass in fermentation boilers **biogas** can be obtained, which can be used in canteens, schools, hospitals etc. in different ways. In **the second process, fermented biomass**, which can be added on compost platforms for obtaining, eventually in a mixture with peat and highly decomposed organic matter, the best natural organic fertilizer or directly applied on agricultural, horticultural, dendrological etc. lands and **leachate or leaching** can result, i.e. what drains off biomass fermentation boilers and compost platforms, which added in irrigation water we can perform what is called natural fertirrigation. Through these processes and those alike we support what is desired by the present community, i.e. organic, biologic agriculture.²³

So, here we shortly have a natural way to recycle nutrients in nature and obtain both conditions for producing food, as well as energy useful to man. This way not only that nature is being helped to help itself, but small communities of people are supported to ensure their essential needs for a civilized life and to evolve as much as possible. Notable is the case of Germany, who managed over years to devise a system to run all necessary works for soil, agriculture, silviculture, environment and for all to match to all and all to work in a synergistic symbiotic system of all beauty. Likewise is the stage of making all these systems more efficient and raising their degree of reliability, and not these ones' only, but all others' in economy.

Renewable energy sources' (RES) management must be concentrated and concerted on creating a regulatory framework for supporting their utilization on energy market and on technologies to integrate the energy produced from renewable sources into the National Energy System (NES). An important component of renewable energy sources' management is that of promoting these technologies to public opinion, who "should" accept their higher costs in favor of their achieved ambient benefits and of business community, who must see their important implementation in the context of fossil sources' continuous depletion.²⁴ China has come to fine operators in energy sector if they do not buy the energy produced in a clean alternative way, beside considerable investments in such systems.²⁵ India has invested 900 million U.S. dollars in alternative energy systems.²⁶ Indonesia wants to recover much the period in which it has been seen as a great polluter by massively investing in energy systems based on geothermal energy, of which it has a considerable amount available, considering the fact that it is geographically and geologically positioned on Pacific Ocean's Ring of Fire.²⁷ Also,

²² "Valorificarea resurselor vegetale secundare în conexiune cu progresele biotehnologiei", Rusan Viorica și Popa Valentin I., in: "Memoriile Secțiilor Științifice", Seria IV, tomul XIII, nr. 1.

²³ Ibidem.

²⁴ "Managementul energiei. Principii, concepte, politici, instrumente", Second edition, Leca Aureliu, Mușatescu Virgil coordinators.

²⁵ www.ecomagazin.ro/china-va-folosi-energie-regenerabila.

²⁶ www.ecomagazin.ro/india-investeste-900-milioane-de-dolari-in-producearea-de-energie-solara.

²⁷ www.ecomagazin.ro/indonezia-trece-pe-energie-geotermala-detine-cel-mai-mare-potential-geotermic-din-lume.

countries like Germany, Scotland, Canada, and the United States of America massively invest in alternative energy systems.²⁸

Beside all these, there is the problem of education, which in Romania must be redirected and recalibrated according to present demands of economic development in each and every field.

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²⁸ www.ecomagazin.ro.