Fişa suspiciunii de plagiat / Sheet of plagiarism's suspicion	Indexat la: 0103/06

Opera suspicionată (OS) Suspicious work	Opera autentică (OA) Authentic work

OS	RACOCEANU, C. and POPESCU, L. Study on the use of renewable energy sources. *Annual of the University of Mining and Geology "St. Ivan Rilski".* Part III, Mechanization, electrification and automation in mines, Vol. 54, 2011, 53-56.
OA	POPESCU, L.; GORUN, A.; POPESCU, C. and RACOCEANU, C. Possibilities of producing green energy by installing solar panels on the dumps career Roşia. *9th IASME / WSEAS International Conference on heat transfer, thermal engineering and environment*, (HTE '11). Florence, Italy. August 23-25, 2011. Disponibil / Available: http :// www . naun . orgwww . naun . org / multimedia / NAUN / energyenvironment / 20-671.pdf, p.367-273.

Incidența minimă a suspiciunii / Minimum incidence of suspicion	
p.54:14s - p.54:42s	p.368:07d – p.368:45d
p.54:01d - p.54:08	p.369: 01-p.369:10
p.54:Table 1	p.369:Table no.3

Possibilities of producing green energy by installing solar panels on the dumps career Rosia

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Abstract. In this paper is present a possibility for capitalization of areas of lands covered by dumps. Rosia career there in large areas of land occupied by dumps: external dump occupies an area of 473 ha (4.730.000 m^2), and external dump occupies an area of 232 ha (2.320.000 m^2). Because Rosia career in situated in the southern half of Gorj County, we can say that medium number of daily hours of sunlight is about 6 h/da, and solar potential is about (1000-1300) kW/m2/an.

Key Words: renewable energy, solar panel, green certificates, dumping site

1. Introduction

Energy is a crucial issue regarding the competitiveness of any economy, its potential for growth, and the environment protection [1].

In a more and more globalize economy, the energetic strategy of a country cannot exclude the context of evolutions occurring in today's world. In the current structure of the world energy market, the total demand is estimated at the level of 2030, to be almost 50% higher than in 2003, which jeopardizes the existential future of humankind itself. We are referring to the exhaustion or drastic decrease of exploitable resources in the field of non-renewable resources: the oil demand is estimated to grow – based on the current consumption rhythms – by 46%, under the circumstances in which the certain oil reserves can support a current level of consumption until 2040; in the case of natural gases, reserves are enough only until 2070; in the case of pit coal reserves the time horizon is encouraging – 200 years, even in the conditions of exploitation level increase. More difficult to bear is the "shock of future" if we consider the increased calculations of energy producing natural resources, generated by the accelerated rhythms of economic growth [2].

Gorj County possesses a diversified natural frame, through a uniform distribution of the relief, of the hydrographical net, equilibrated climate and valuably resources for the landscape and the economy of the area.

The territory of Gorj County is situated in the S-W art of Romania being crossed by parallel 45^0 Nordic latitude, being positioned on the middle course of Jiu River, river crossing it from North to South. It belongs to the historical province Oltenia, being positioned in its northern part, having borders in common at the north with Hunedoara County, at the south with Dolj County, at the West with Caraş-Severin and Mehedinţi County and at the west with Vâlcea County. It occupies a surface of 5600 km^2 (2,4% from country's surface), the administrative residence being in municipality Târgu-Jiu, situated at a distance almost equal (about 300 km) from important municipalities, representative, like Bucharest (Capital city of Romania), Cluj-Napoca, Timişoara [3].

The total coal reserves of Romania amount to aproximately 1 gigatonne of hard coal and 3 gigatonnes of brown coal and lignite and are sufficient to cover power generation needs for 70 years. More than the Romanian coal reserves are in the Oltenia Region figure 1 - and could be efficient exploited in open pits [4].

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Fig.1. Location of Oltenia region

2. National energy potential [5]

Romania has a wide, but reduced amount of primary energy resources: crude oil, natural gas, coal,uranium ore and a valuable potential of important renewable resources.

Exhaustible energy resources

Geological reserves of primary energy intern resources available to Romania are presented in Table. 1.

Table. no.1. Geological reserves of primary energy intern resources available to Romania

Source of intern energy	Reserve			Annual production in 2005	Estimated period of insurance	
	Geological		Exploited (for which there is a licence)		Geological Reserves	Exploitable reserves (for which there is a license)
1	**2**	**3**	**4**	**5**	**6=3/5**	**7=4/5**
Coal: hard coal lignite	Mil. t. Mil. t.	279 1490	72 719	3 28	93 years 53 years	31,3 years 23 years
Oil	Mil. t.	74		5,2	14 years	
Natural gas	Mld. mc	185		12,5	15 years	
Uranium*	Mil. tone	1		0,061	16,4 years	

****according to the use of a single nuclear group***
Source: Energy Strategy of Romania during 2007-2020, approved by HG no. 1609/2007

From the analysis of geological reserves results that oil and natural gas is exhausted in a period of 14 or 15 years, while lignite provides a consumption for a period of 53 years. Limited reserves of oil and gas will lead to increase the import dependence to about 38% in 2015.

Hydrocarbon deposits are limited, due to a decline in domestic production and and due to the fact that no new deposits have been identified with important potential**.** Current oil reserves are estimated at 73.7 mil. tons. Annual oil production declined from 14.7 millions tons in 1976 (the year with peak production) to 5 millions tons in 2006.

Natural gas deposits are also limited, and after 1990, intern production is declining. Current gas reserves are estimated at 184.9 mld.m^3. Annual natural gas production was 12.3 mld.m3 in 2006, which represented 69% of total annual national consumption of natural gas.

Romania's known coal resources are of 755 million tons are, from which exploiting in leased perimeter 105 millions tons. Romania's lignite resources are estimated at mil.tone 1490, from which exploiting in leased perimeters 445 millions tons. The resources located in new, unleased perimeters are 1.045 billion tons. From the 1.045 billion tons of lignite reserves in the mining basin of Oltenia, 820 million tons from the new perimeters are located in leased perimeters continuity presenting the most favorable conditions for recovery by extending concessions.

Because Oltenia lignite deposit consists of 1-8 exploitable layers of coal, the superior capitalisation of those requires the urgent adoption of regulations to ensure rational use safe, total (minimal loss) and in terms of efficiency.

The existing exploitable ore reserves cover the demand for natural uranium by the year 2017 for operating two nuclear units at the site of Cernavoda. New potential perimeters of uranium ore deposits can not significantly change this situation, which requires specific measures to ensure the resources of natural uranium as the necessary resulted of nuclear energy development program.

Renewable energy resources

The capitalized power potential of renewable energy in Romania is presented in Table. 3.

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Tabel no. 3. The capitalized power potential of renewable energy in Romania

Source	Annual Potential	Application
Solar energy	60 PJ/an=16,67 TWh 1,2 TWh	Thermic Energy Electric Energy
Wind energy (theoretical potential)	23 TWh	Electric Energy
Hydroenergy, From which 10 MW	36 TWh 3,6 TWh	Electric Energy
Biomass and biogas	318 PJ=88,34 TWh	Thermic Energy Electric Energy
Geothermal Energy	7 PJ=1,94 TWh	Thermic Energy

Source: Romania's energy strategy for 2007-2020, approved by HG no. 1609/2007

Regarding the costs and benefits, excluding large hydropower plants, the costs of producing electricity using renewable units are now higher than those for fossil fuel use, according to European Commission Communication on the promotion of renewable energy, published in December 2005[7]. The stimulation of the use of these sources and and the attraction of investments in energy units that use renewable sources are achieved through support mechanisms in accordance with European practice.

The producers of electric energy from renewable sources gain an additional benefit represented by Green Certificates[8]**.** As the benefits of capitalizing the solar energy potential of career are mentioned the instruments to promote energy production from renewable sources, which are promote by the Law no. 139/2010 regarding to modify and complete the Law no. 220/2008 for the establishment the system of promoting the production of energy from renewable energy sources. According to this law, for the electricity from hydroelectric plants with installed powers of maximum 10 MW are given tree green certificates for each 1 MWh produced and delivered, if the hydroelectric plants are new [8].

A **green certificate** is a document which shows a quantity of 1MWh of electricity produced by renewable sources of energy. According to Law no. 139/2010 regarding to modify and complete the Law no. 220/2008 for the establishment the system of promoting the production of energy from renewable energy sources [8], the producers of energy from renewable sources benefit of a number of green certificates for electric energy produced and delivered, including the quantity of electric energy produced during probation the functioning of the electric groups/ plants as follows:

a) for electric energy from hydropower plants with installed powers up to 10 MW:

(i) 3 green certificates for each 1 MWh produced and delivered, if the hydropower plants are new,

(ii) 2 green certificates for each1 MWh produced and delivered if the hydropower plants are refurbished,

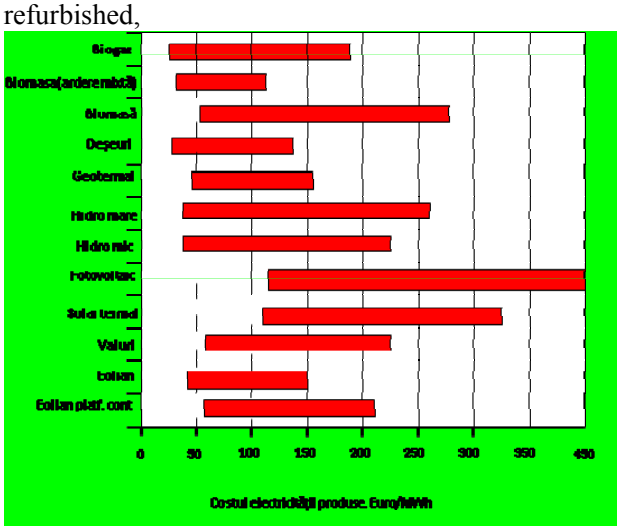

Fig. 2. Production costs of electricity SRE, EUR/MWh. (Premises: 6,5% interest rate,15 years payback period)

Source: *Commission of the European Communities - Communication from the Commission - The support of electricity from renewable energy sources - Brussels, 7.12.2005, COM (2005) 627 final*

b) a green certificate for every 2 MWh from hydropower
plants with an installed power up to 10 MW, which don't fit in the conditions from paragraph a)

c) two green certificates, until 2017 and one certificate starting with 2018, for every 1 MWh produced and delivered by the electric energy producers from wind energy,

d) 3 green certificates for every 1 MWh produced and delivered by the electric energy producers from the sources: geothermal energy, biomass, bioliquids, biogas, the gas resulting from waste processing,

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fermentation gas of the sludge from the installations of wastewater treatment
e) 6 green certificates for every 1 MWh produced and delivered by the producers of electric energy from solar energy.

For the period 2008 – 2025 the trading value of green certificates is between:
a) a minimum trading value of 27 euro/certificate; and
b) a maximum trading value of 55 euro/certificate [8,9].

Producing energy from renewable sources is encouraged also by the Report of the European Commission regarding to Strategy Europe 2020, according to that, the share of energy from renewable sources in final gross energy consumption must reach 24% in Romania until 2020 [10].

3. Location of Rosia career on the energy map of Romania

Operating Rosia career belongs to National Company of Lignite Oltenia, with the object of activity exploitation of lignite

The career Rosia de Jiu is located in Rovinari basin mining basin, in the commune Farcasesti and Bilteni, at a distance of 30 Km south of Targu-Jiu city.

The perimeter is determined as:

- at N, a conventional line which follows the Timişeni valley, the southern limit of the coal deposit and the railway Filiaşi –Târgu Jiu
- at NE, a conventional line parallel to the regulated dam Jiu
- at SE, a conventional line which determines the outer pit heaps of Pesteana Nord and Rosia de Jiu careers,
- at S, a conventional line which follows the Valley of River and the NE side of the localities Farcasesti and Farcasesti Mosneni,
- at V, a conventional line which unites Valley of River cu Valley of Ionaşcu and with Valley Timişeni.

In terms of morphology, the perimeter of the career is part of the Plateau area Getic career and in geographically from Jiu platform.
Located in the interfluve between Jit and Jiu career develops in one third of the surface in the Jiu valley and the remaining two thirds in the hilly area.
Thus, the perimeter includes two zones:

- Area of meadow which lies between the regulated flow of the river Jiu and localities Fărcăşeşti Jiu, Fărcăşeşti Mosneni, Rosia Jiu and Rovinari.
- Hilly area, bounded by Valley Timişeni at north and at south Valley of River.

Based on available data a map has been realized a map with the territorial distribution of solar radiation in Romania (Fig. 3). The map includes the distribution of annual average flow of solar energy incident on horizontal surface in Romania. It highlights five areas, differentiated by the values of average annual flows of incident solar energy. It is found that more than half of the country benefits from an annual average flow of 1275 kWh/m2 energy [6].

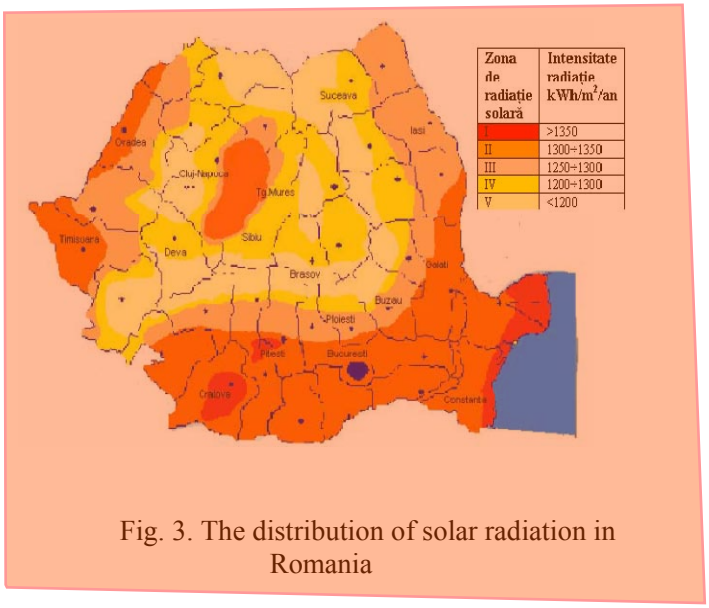

Fig. 3. The distribution of solar radiation in Romania

The solar map was realized using and processing data given by NAM and also NASA, JRC, Meteotest. The data were compared and excluded those who had more than 5% deviation from the average values.The data are expressed in kWh/m2/year, horizontally, this being the usual amount of energy used in applications for both the thermal and solar photovoltaic application..
The areas of particular interest for electric power applications of solar energy in our country are:

-The first area, which includes areas with the **highest potential** covering a large part of Dobrogea and much of the Romanian Plain

-The second area, with **good potential**, including northern Romanian Plain, Plateau Getic, Oltenia

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and Muntenia, The Subcarpati, much of the Danube Valley, southern and central Moldavian Plateau and Plain and Western Hills and West Plateau of Transylvania, where solar radiation on horizontal surface is between 1300 and 1400 MJ / m 2.

-- The third area, with **moderate potential**, has less than 1300 MJ/m2 and covers most of the Transylvania Plateau, Northern Moldavian Plateau and Carpathian frame. Especially in the mountains the territory variation of direct solar radiation is very large, negative relief forms encouraging the persistence of fog and even reducing the possible duration of sunshine, while positive relief forms, depending on the orientation relative to the Sun and dominant direction of air circulation can promote growth or, conversely the decrease of the direct solar radiation.

As shown in Fig. 3 southern half of the county is located in Zone II and III of sunlight. Because the plants producing electricity by the photovoltaic effect are energy efficient at intensities of the solar radiation higher than 1000 kWh/m2, results that the southern half of the county is suitable for producing solar electricity.

4. The development of photovoltaic applications in the dumps of Rosia career

Solar panels generate electricity about 9h/day (the calculation is the minimum, winter day is 9:00). In the day, for 9 hours, these solar panels generate electricity and at the same time, store energy in batteries to be used during night. Solar installations work even when the sky is cloudy. *The photoelectric cell* is the cell that converts solar energy into electricity. In a photocell there isn't stored any energy, in any form or chemical, therefore it is not a pile, but a flash converter which can't supply electricity without solar radiation. A cell in total darkness acts as a passive element

Photovoltaic solar energy is based on direct production of electricity through silicon cells. When it shines and when climatic conditions are favorable, the sun provides the power of 1 kW/m^2. Photovoltaic panels allow direct conversion into electricity of 10 to 15% of this power. The energy production of such a panel varies with the increased or decreased solar intensity: 1000kWh/m²/year in Northern Europe and in the Mediterranean area is two times higher.

The main obstacles in widespread use of solar energy (photovoltaic and thermal) are represented, on one hand the available power provided, which constrains the storage of electricity for an autonomous operation or use of complementary energy solutions, and on the other hand competitiveness economic.

There is the possibility to make systems which can deliver the energy produced (energy surplus) in the network (fig. 4.).

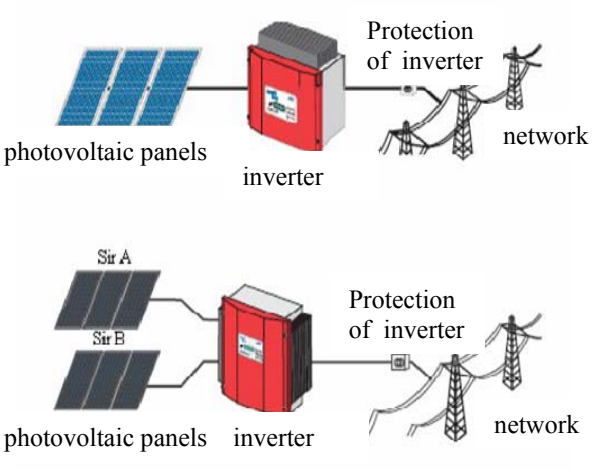

Fig. 4. Photovoltaic system for energy production

This type of system consists of (fig. 4):

• photovoltaic panels for electricity production,
• inverter for cc-ca transforming and adapting frequency,
• electric meter to measure the amount of energy produced and delivered to the network.

5. Conclusions

The essential advantages of photovoltaic systems are:

- they produce electricity without polluting effects on the environment (full recycling),
- no moving parts (high reliability, long life, easy operation, low-cost, technology without noise),
- they produce and consume in the same place for lower installed power, consumed locally (reduced transport losses, reduced space for production and transport, they do not produce changes in the environment - clean energy).

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Rosia career there in large areas of land occupied by dumps: external dump occupies an area of 473 ha (4.730.000 m^2), and external dump occupies an area of 232 ha (2.320.000 m^2). Because Rosia career in situated in the southern half of Gorj County, we can say that medium number of daily hours of sunlight is about 6 h/da, and solar potential is about (1000-1300) kW/m2/an.

After extracting coal, Rosia career must do works for recovery of land and improvement of soil quality. For example: realize arrangement works, to fertilization soil, to grow different plant species for three years. All these works involve additional costs. These costs can be eliminated if instead of these works would make an investment in solar panels.

If solar panels are mounted on 10% of these areas, 705.000 m^2, taking into account a specific area mean power 0,5kW/m^2, with an efficiency of transformation (10-15) % is result that on these areas can give about (35-52) MW. Considering an average of 6 hours of sunlight per day, result that on these "energy dumps" we can get (210-312) MWh per day (fig.5).

Fig. 5. Picture from Rosia career

It is obvious that the investment is very expensive, but it can be equal to the cost of works for restitution in civil circuit of these lands.

In addition, if we considering the system for promote energy production from renewable sources which granted 6 green certificates means about 300 EUR for 1 MWh produce and delivery in the network, the investment can be amortized fast.

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