

ROMANIAN RENEWABLE ENERGY PROJECTS. CASE STUDIES

Mihai CRUCERU, Bogdan DIACONU

University "Constantin Brancusi", e-mail: cruceru@utgjiu.ro

ABSTRACT. Officially launched mid-2003, the Romanian Energy Efficiency Fund (the Fund) concluded 18 financing agreements amounting to US\$ million 8.837 for investments of about US\$ million 18. Today, the Fund is currently running 4 financing agreements of US\$ million 2.187 for investments amounting to US\$ million 4.012. Transgex Oradea has modernized a geothermal station and 5 related thermal substations, the food oil factory Ulerom Vaslui has installed a sunflower husks fired boiler, the County Clinic Hospital Oradea is currently installing two wooden pellets fired boilers and the pulp and paper mill Omnipex Hârtia SA from Busteni will launch the modernization of the existing micro hydro power generation facilities. The paper proposes to present how succeed private companies and public institutions accessing the commercial financing in the implementation of RES investments. Based on the information gathered from the existing Fund project portfolio, the profitability of RES investments will be revealed.

РУМЪНСКИ ПРОЕКТИ В ОБЛАСТТА НА ВЪЗОБНОВЯЕМИ ЕНЕРГИЙНИ ИЗТОЧНИЦИ – ПРИМЕРИ В ТАЗИ ОБЛАСТ

Михай Кручеру¹, Богдан Диачону²

¹ Университет „Константин Бранкуши“, Търгу Жиу, Румъния

² Университет „Константин Бранкуши“, Търгу Жиу, Румъния

РЕЗЮМЕ: Официално стартирал в средата на 2003 година, румънският фонд за енергийна ефективност сключи 18 финансовеи договора на стойност 8, 837 милиона щ.д. за инвестиции в рамките на почти 18 мил щ.д.. Днес фондът управлява 4 финансовеи договора на стойност 2, 187 милиона щ.д. за инвестиции в рамките на 4, 012 мил. щ.д. Така например компанията Трансджекс орадея е модернизирала една геотермална станция и 5 прилежащи термални подстанции, фабриката за растително масло Улером Васлуй е инсталирала котел за лющене на слънчоглед, клиничната болница Орадея предстои да инсталира 2 котела на твърдо гориво и шлам и хартиеното предприятие Омнимпекс Хартия в Бустени ще продължи модернизацията на съществуващите хидроенергийни мощности. Статията илюстрира успехите на частните компании и публичния сектор в резултат на използването на инвестициите на румънския фонд за енергийна ефективност. Предоставената информация за фонда ще допринесе за увеличаване печалбата от тези инвестиции.

1. Introduction

The Romanian Energy Efficiency Fund is a financial institution providing commercial financing of investments projects aiming the rational use of energy (RUE) and the use of renewable energy sources (RES). The funds for financing are constituted by an initial US\$ 10 million grant provided by GEF to Romania. The Fund will revolve, and the interest payments and principal repayments will be used for new loans.

Methods of project financial support may include debt financing, equipment leasing, and payment for services, and/or various combinations of these. The Fund is flexible both in terms of product mix and terms such that the Fund can offer the financial products which the evolving market demands. Before deploying all these methods the Fund is using its own expertise in assessing the 'capability' of the project to generate enough financial benefits which come from energy savings, with the main purpose to provide the project sponsor with the comfort that the investment generates enough income to easily cover its debt service. To date, only debt investments have taken place to energy end-users and energy services companies.

2. RES Case studies

Transgex Oradea is involved in geological explorations and surveys for geothermal water resources, drilling of geothermal wells and provision of sanitary hot water and heat extracted from geothermal energy to the general public (private, public and institutions). The company holds concession licenses for geothermal areas situated in the north-western part of Romania, representing approximately 50% of the whole country's resources.

Before the project implementation in Oradea, geothermal energy covered about 50,000 Gcal/year, about 5% of the annual consumption of heat in Oradea city, the rest of 95% being supplied mainly by combined heat and power (CHP) plant. The financial gap between the heat price in CHP and the price paid by final consumers is currently subsidized from the local budget.

Transgex decided to invest in order to extend the use of geothermal energy available in the area for district heating purposes. In order to implement the project, the company concluded with Oradea Local Council an association contract. The project consisted in the connection of 5 thermal substations in Oradea city (Iosia Nord living area) to the geothermal well no. 4767 and the realization of a geothermal substation next to the well. The five thermal substations were

fully modernized by using plate heat exchangers, high energy efficiency pumps and automation equipment. The main advantages achieved by project implementation were:

- use of renewable energy resources: using the geothermal energy for covering a part of heat consumption of Oradea city leads to savings of fossil fuels; meanwhile the production costs and the selling price for heat is significantly lower than before the project implementation;
- heating network rehabilitation: transport pipes for hot and warm water were replaced; this will reduce energy and water losses and thus it will reduce the operating costs;
- environmental impact: replacing the use of fossil fuels in the CHP facility by using geothermal energy for heat generation leads to important reduction of pollutant emissions.

The project was implemented in two stages. The first one, initiated in 2004, led to a financial investment of about USD 690,000. The second phase, consisting of about USD 490,000, raised the total financial effort to about USD 1,800,000, including all auxiliary expenses. Additionally two hot-water peak boilers were installed in the geothermal substation, in order to cover winter peak loads. The project was expected to lead to the following savings:

- Primary energy: using a renewable source of energy, the project will reduce fossil fuel consumption, mostly coal, of the CHPP facility in Oradea city; these savings are estimated at about 42,000 Gcal/year.
- Labor, maintenance: installing new, more reliable, fully automatic equipment, other financial savings will be generated; the project uses plate heat exchangers, a proven technology that reduces thermal losses and minimizes spare part costs; nevertheless, these savings were not determined separately.

The analysis of the cash flow for the next 10 years was made based on 2004/2005 energy prices. The evaluation of the feasibility of this project was performed taking into consideration the following criteria: Payback Period, Internal Rate of Return (IRR), and Net Present Value (NPV), based on a discount rate of 12%. Considering the total financial investment of USD 1,178,474 and the annual financial savings of about USD 472,000, the simple payback period was estimated at 2.5 years. The financing of the project has been covered as follows: in the first phase 60% covered by a loan from the Romanian Energy Efficiency Fund and the rest by Transgex and others; the second phase was completely covered by Transgex with their own funds.

The USD 425,000 FREE loan had a maturity of 3 years and a 6 months grace period. The loan was reimbursed in unequal quarterly installments according to the company's request and to the project cash flow. For covering a part of the first phase investment Transgex concluded "an emission reduction purchase agreement" with the Danish Environmental Protection Agency, for the project "Geothermal Energy in Oradea - Area II and Beius". The "crediting period" is from January 1st, 2005 to December 31st, 2012. The total amount to be paid by the Danish party to Transgex is EUR 473,400, consisting of (i) an advance payment of EUR 54,600 (which

Transgex already received) and (ii) 8 equal annual payments of EUR 52,350 each, starting in the year 2006.

Ulerom Vaslui has been established in 1974. Nowadays it produces oil for food industry using sunflower and soybeans. Besides these activities the company provides different types of services in the agricultural sector, commerce, transportation and steam distribution and animal breeding. For the sunflower and soybeans processing the company operates 4 saturated steam boilers. 3 of them operate on natural gas while the 4th operates using sunflower peels. Presently, the company's capacity of sunflower processing is about 5,000 tons per month for a period of 5 months per year. This activity generates about 450 tons/month of sunflower peels. The company increased its processing capacity up to 8,000 tons/month, one of the effects being the generation of 1,200 tons/month of sunflower peels. On short term the capacity will be increased up to 9,000 tons/month, leading by consequence, to a quantity of 1,350 tons/month of sunflower peels.

Ulerom decided to invest for the optimization of energy consumption by using sunflower peels for steam production, with the main purpose the diminishment of energy costs by reducing natural gas consumption for steam generation. The project consisted in the installation of a new steam boiler that uses as fuel sunflower peels. The new boiler could generate 10 t/h of saturated steam at a pressure of 15 bar. By installing the boiler the entire quantity of sunflower peels will be used for steam production. The old sunflower peels based boiler is kept in a stand-by mode. Some other much smaller energy efficiency projects were also implemented such as: installation of steam and water meters, installation of pressure and temperature regulators, replacing of power factor compensation units and installation of a blower of 55 kW for sunflower peels transportation. The main features of the project are as follows:

- reduction of natural gas consumption: increasing of the processing capacity will lead to increasing of sunflower peels quantity, which cannot be entirely used in the old boiler. Thus implementing the project all the quantity of the sunflower peels can be used for steam generation decreasing the natural gas consumption.
- pollutant emissions reduction: the reduction of natural gas consumption will lead to diminishing of CO₂ emissions.

The project was implemented during the period of April-October 2005. The total cost of the project has been estimated at about USD 560,000. The following savings were expected to be achieved after the project completion:

- Fuel. The installation of the new boiler based on sunflower peels will lead to 557,000 Nm³ of savings of natural gas in the first year. In the following years the savings will reach 835,000 Nm³/year.
- Maintenance, salaries, etc. The new equipment has reliability and is fully automated. The additional savings are generated due to a better sunflower peels management.

The cash flow analysis has been performed for the next 20 years based on the energy and fuel costs in 2004 and 2005.

The project evaluation has been performed using the following criteria: Simple Payback Period, Internal Rate of Return and Net Present Value calculated for and actualization rate of 12%. The analysis has also taken into consideration the 2 stages of capacity increase that company intends to perform. Knowing that the total investment was about USD 560,000 and considering the annual savings, the Simple Payback Period was estimated at about 4.3 years. Thus, the company's management decided to invest USD 560,000 for installation of a new sunflower peels boiler for steam generation.

Being an energy efficiency project Ulerom applied for a FREE loan of about USD 448,000 (80%), the company participation being of USD 112,000 (20%). The FREE loan was for 4 years, having a grace period of 12 months. The loan reimbursement was made on a quarter rate basis.

Oradea County Clinic Hospital is the largest medical care center form Bihor County, and provides medical services for more than 200,000 inhabitants from Oradea city and 600,000 inhabitants from whole the county. The County Clinic Hospital is a 1,083-bed hospital and provides 29 specialized clinical services. The hospital is structured in four different site locations: 'Stationary I', 'Stationary II', 'Specialized Ambulatory' and the Administrative Department. The 'Stationary I' building is located in Oradea city, and was founded in 1977. The 'Stationary I' is a 721-bed hospital, structured in 19 specialized clinical departments, supplied by 5 medical analyses laboratories. The building itself is structured in three different corps A1 and A2 (9-floor buildings) and A3 (a 5-floor building).

The heat sources in the 'Stationary I' hospital are a heat plant for steam generation, built in 1978, and a thermal substation connected to the municipal district heating system. The steam and the hot water were generated in three outdated ABA boilers fuelled with light fuel oil, with the rated capacity of 1 tone/hour and the active surface of 3.5 m² and the rated pressure of 16 bar.

The Executive of Oradea County Clinic Hospital decided to invest in the replacement of the outdated steam boilers with two new steam boilers fired with wooden pellets. The aim of the project was to diminish the energy costs of the hospital, especially by total elimination of light fuel oil use for steam generation. The project consisted in dismantling two from three existing outdated steam type ABA boilers fuelled with light fuel oil and in installing new modern boilers fired with wooden pellets. One of them will have the rated power of 0.5 MW_t and will generate steam for sanitary purposes and the other will have the rated thermal power of 1.4 MW_t and will generate hot water for heating. For safety reasons, the current connection of the hospital to the municipal district heating system will be kept functional and operated only to the peak of the heat demand curve (during severe winter conditions). The main features of the project are:

- Elimination of light fuel oil consumption. By installing the new wooden pellets fuelled boiler the hospital will completely eliminate the light fuel oil consumption. Thus, implementing the project the wooden pellets can exclusively be used for steam and for hot water generation for use and heating purposes.
- Pollutant emissions reduction. The reduction of natural gas consumption will lead to diminishing of CO₂ emissions.

The project was be implemented during the period of October 2006 – May 2007. The total cost of the project was estimated at about USD 405,000. The following savings were expected to be achieved after the project completion:

- Fuel. The installation of the new boilers based on wooden pellets will lead to 199 tones of savings of light fuel oil.
- Maintenance, salaries, etc. The new equipment has reliability and is fully automated. Insignificant maintenance and personnel costs are required.

The cash flow analysis has been performed for the next 20 years based on the energy and fuel costs in 2005 and 2006. The project evaluation has been performed using the Simple Payback Period, Internal Rate of Return and Net Present Value calculated for and actualization rate of 12%. Taking into account that the total investment is about USD 405,000 and considering the annual savings as presented in Table 2, the Simple Payback Period was estimated at about 5.6 years. Thus, the hospital's management decided to invest USD 405,000 for installation of new wooden pellets boilers for hot water and steam generation.

Being an energy efficiency project the Executive of Oradea County Clinic Hospital applied for a FREE loan of about USD 324,000 (80%), the hospital contribution to investment being of USD 81,000 (20%). The FREE loan has a maturity of 3 years, with a grace period of 6 months. The loan reimbursement will be made on a quarter rate basis.

Omnimpex Hârtia Bușteni operated as a private paper mill since 1882. In 1948 the company was took over by the state and continued to manufacture paper up to its recent privatization in 2000. Since the beginning of the last century, the company has in operation 3 obsolete and outdated horizontal Pelton type hydro units for power generation, other 2 obsolete and outdated horizontal Francis type hydro units being currently out of operation. All hydro power units have been supplied at the beginning of last century by the specialized German manufacturer Voith. The Refinery Steaua Română is one of the most important crude oil processors in Romania. The refinery presently holds a license of Independent Power Producer (I.P.P.), issued by the National Electricity Regulatory Body (A.N.R.E.), as in the company power generation facilities are in operation. Omnimpex Hârtia belonging to the same group of companies as the refinery, has concluded a renting management contract with the Refinery Steaua Română S.A. In line with the contractual arrangements the whole generated power in Busteni is totally sold by the Refinery Steaua Română to the electricity supplier and distributor Electrica Muntenia Nord S.A. from Ploiești. Under these circumstances, the Omnimpex Hârtia revenues are generated from a monthly flat fee and from another 'power generated' related payment, both paid by the refinery.

The Executive Board of Omnimpex Hârtia decided to invest in the installation of new hydropower equipments and the replacement of the existing water source caching facilities and driving pipelines. The aim of the project is the increase of Omnimpex Hârtia S.A. revenues (after being qualified as Renewable Energy Sources Power Producer-RESPP and electricity supplier) as result of an increased amount of 'green'

electricity supplied exclusively to the refinery. By consequence, a reduction of the refinery's exposure (including financially) to the electricity supplied from the National Power System will be provided. The project consists in the modernization of existing hydro power generation facilities from location Busteni 1 'Fierastrau', the dismantlement of existing equipments from location Busteni 2 and the installation of new facilities in the location Busteni 2 'Downtown'. The new hydro power facility installed in Busteni 1 location will be a hydro power Pelton type vertical turbine with the rated power of 700 kW and the new hydro power facility in the new Busteni location 2 called 'Downtown' will be similar with the previous described, respectively a Pelton type vertical turbine, but the rated power will be 450 kW. The main features of the project are:

- Increased amount of 'green' electricity supplied exclusively to the refinery. By installing the new hydro power units a reduction of the refinery's exposure (including financially) to the electricity supplied from the National Power System will be provided. Thus, implementing the project the resulting energy savings will rise from the consequent reduction of fossil fuel used at the level of national power generation sector.
- Environment impact mitigation. After the project completion, the impact of hydro power units operation on the environment will significantly decrease.

The project will be implemented starting with January 2007 and the commissioning of the hydro power plants being foreseen before mid-2008. The total cost of the project was estimated at about USD 1,869,000. The following savings are expected to be achieved after the project completion:

- Fossil fuel. The installation of the new hydro power units will lead to 1,012 tones of oil equivalent of savings.
- Maintenance, salaries, etc. The new equipment will have reliability and will be fully automated. Insignificant maintenance and personnel costs will be required.

The cash flow analysis has been performed for the next 20 years (against a standard lifetime of hydropower units of 30 years) based on the electricity prices in 2006. The project evaluation has been performed using the following criteria: Simple Payback Period, Internal Rate of Return and Net Present Value calculated for and actualization rate of 12%. Knowing that the total investment was about USD 1,869,000 and considering the annual financial savings earned after the project completion, the Simple Payback Period was estimated at about 4.4 years. Thus, the company's management decided to invest USD 1,869,000 for installation of new hydro power units for electricity generation.

Being committed to modernize the existing hydro power generation facilities in order to increase the annual electricity production to cover own demand and partly, the Refinery Steaua Romăna electricity demand, Omnimpex Hartia Busteni applied for a FREE loan of about USD 990,000 (53%), the company participation of USD 879,000 (47%) being covered with financial resources from a bank or from structural funds. The FREE loan is for 5 years, having a grace period of 9 months. The loan reimbursement will be made on a quarter rate basis.

3.Expected Results and Discussions

In Transgex Oradea project, annual fuel savings, estimated at about 5,800 tep, will have a positive environmental impact by reducing pollutant emissions. Considering that the CHPP facility uses coal and natural gas to generate heat, annual CO₂ emission reductions are estimated at about 14,300 tons. This quantity is the baseline used to trade carbon gas emissions with the Danish Government. Moreover SO₂, NO_x and particulates reductions are significant. As long as the subsidies for the domestic heating are provided, the use of a cheaper heat source will also lead to financial savings for the municipality and, eventually, for heat customers.

The Transgex project was implemented in two stages. The first stage ended in 2004 by investing 640.000 US dollars and the second stage ended in 2005, the total cost being 1.178.474 US dollars. The costs are shown in table 1.

Table 1

Costuri echipamente și de instalare	Anul	dolari SUA
Construirea buclei termice geotermale	2004	91.810
Echipamente din punctul termic geotermal	2004	174.303
Rețele de transport	2004	220.199
Echipamente din punctele termice 510-514	2004	101.007
Pompa pentru sondă	2004	104.032
Total (2004)	2004	691.351
Echipamente bucla geotermală (inclusiv 2 cazane de vârf)	2005	57.997
Reabilitarea rețelelor de distribuție	2005	426.126
Total (2005)	2005	487.123
Total proiect	2004 - 2005	1.178.474

* Costurile includ taxele vamale, taxele de stocare și transportul și nu includ TVA.

The cash flow analysis on 10 years period was computed referring on 2004/2005 energy prices – table 2.

Table 2

Obiect	Anul											
	0	1	2	3	4	5	6	7	8	9	10	
	mii USD	mii USD	mii USD	mii USD	mii USD	mii USD	mii USD	mii USD	mii USD	mii USD	mii USD	
Investiție (inițială)	-1.178	-	-	-	-	-	-	-	-	-	-	
Cash Flow anual	-1.178	472	472	472	472	472	472	472	472	472	472	
Cash Flow cumulat	-1.178	-706	-234	238	710	1.182	1.654	2.126	2.598	3.070	3.542	
Factor de actualizare	1	0,89	0,80	0,71	0,64	0,57	0,51	0,45	0,40	0,36	0,32	
Cash flow actualizat	-1.178	-631	-187	170	451	670	838	961	1.050	1.107	1.140	
Termen de recuperare brut (TRB)			2,5		ani							
Termen de recuperare actualizat (TRA)			2,3		ani							
Venit net actualizat (VNA)			1.140		mii USD							
Rata internă de rentabilitate (RIR)			39,0		%							

In Ulerom Vaslui project, the natural gas savings have been estimated at 557,000 Nm³ in the first year (470 tep equivalent). In the next years the project will generate savings of natural gas of about 835,000 Nm³/year, 710 tep equivalent. The reduction of natural gas consumption will also lead to diminishing environmental impact. Thus, the CO₂ emissions will be reduced by approximately 1,000 tons in the first year and by 1,500 tons/year of CO₂ in the following years. The sulfur dioxide, NO_x and dust emissions will also be reduced significantly.

In Oradea County Clinic Hospital project, the light fuel oil savings have been estimated at 199 tones (187 toe equivalent). The reduction of natural gas consumption will also lead to diminishing environmental impact. Thus, the CO₂

emissions will be reduced by approximately 445 tons. The sulfur dioxide, NO_x and dust emissions will also be reduced significantly.

In Omnimpex Hartia Busteni project, the total estimated energy savings to be considered after the project implementation are amounting to 3,530 MWh/year (1,012 toe equivalent). The estimation regards the refinery Steaua Romana and excludes the amount of green electricity used by Omnimpex Hârtia, for covering its own electricity demand. The use of green electricity will also contribute to a reduction of CO₂ emissions with 2,409 tones a year.

For each previously considered project, estimated and realized (for 2 from all projects presented) annual performances are presented in Table 3.

Table 3

No.	Project & Completion Date	Estimated Annual Performances			Realized Annual Performances			
		GPT (years)	Energy (toe)	CO ₂ (tones)	GPT (years)	Energy (toe)	CO ₂ (tones)	
1	Transgex Oradea: modernization of geothermal substation and 5 DH substation and related networks	2005	2.5	5,774	14,160	2.6	5,627	22,169
2	Ulerom Vaslui: new sunflower husk steam boiler	March 2006	4.3	676	1,487	2.6	1,110	2,441
3	Oradea County Clinic Hospital: new 0.5 MW Steam and 1.5 MW Hot Water Boilers fired with Wooden Pellets	August 2007	5.6	187	445	-	-	-
4	Omnimpex Hartia Busteni: installation of new hydropower equipments for industrial use in Refinery Steaua Româna	June 2008	4.4	1,012	2,409	-	-	-

For 2 from presented projects, the host companies have monitored the energy savings resulted after project completion. In the particular case of Transgex Oradea, the reduction units of CO₂ emissions have been monitored by a Hungarian specialized company as those reduction units have been transferred to the Danish Government in the frame of emission trading contract concluded with Transgex. The discrepancies between emission estimations and results could come from the different approaches used by Fund experts and Hungarian experts in assessing the conversion efficiency from fossil fume

to heat in the CHPP. For Ulerom Vaslui case, things are simpler; the extended use of sun flower husks for steam and hot water purposes lead to a decrease of natural gas consumption grater than initially considered by the Fund's experts and cheaper natural gas bills.

For the projects which are currently under implementation, the first results are to come by the end of 2007 and 2008, respectively.

4. Conclusions

The Romanian Energy Efficiency Fund is currently running 4 financing agreements of US\$ million 2.187 for investments in renewable energy sources capitalization amounting to US\$ million 4.012. Transgex Oradea has modernized a geothermal station and 5 related thermal substations, the food oil factory Ulerom Vaslui has installed a sunflower husks fired boiler, the County Clinic Hospital Oradea is currently installing two wooden pellets fired boilers and the pulp and paper mill Omnipex Hârtia SA from Busteni will launch the modernization of the existing micro hydro power generation facilities. In each case, after performing technical and financial analyses of possible investment, the project sponsors have been comforted by the Fund experts that based on financial benefits which come from energy savings the investment generates enough income to easily cover their debt services. In other words, investments are profitable.

Guidance is provided not only in the initial stage of performances evaluations but also during the contracting phase, implementation and commissioning and operation and monitoring results till the complete payment of debt service. Under such approach, including public institutions, without having specialized personnel, decided and succeed to invest in RES projects (i.e. the case of Oradea county clinic hospital).

Estimations presented to project sponsors during the evaluation phase are, in general, more pessimistic than the results monitored in the operation stage. Two are the possible reasons: an annual operation period after investment completion grater than expected and the ulterior increased of prices to electricity and fossil fuels. As consequence, the financial earnings of the company are often grater than initially foreseen and the profitability demonstrated.

To date, the Fund is the unique financial institution performing an operational procedure centered on the technical and financial analyze of proposed. Decision for awarding commercial co-financing is primarily taken only after deciding if the annual generated cash – flow after project implementation is enough to help the client to entirely cover the debt service. Based on the information gathered from the existing Fund project portfolio, one should note that the profitability of RES investments was revealed.

References

- *** - Proiecte de succes, www.free.org.ro
- * * * - Strategia pentru utilizarea surselor de energie regenerabile (HG nr.1535/2003, MO nr.8/7.01.2004);
- *** - HG nr. 443/2003 privind promovarea producerii energiei electrice din resurse de energie regenerabile (MO nr. 288/24.04.2004);
- * * * - energetice și utilizarea energiei regenerabile în anul 2006 (MO nr.279/28.03.2006);
- Cruceru M., Voronca M.M., Diaconu B., *Implementation of the EU legislation on Romanian power industry. Romanian legislation: achievements and shortcomings*, ELSEVIER Ltd., Energy, Volume 30, Issue 8, June 2005, pp. 1365-1376, ISSN: 0360-5442 , 2005.
- Cruceru M. – *Energy efficiency in Romania. Opportunitiers and expectations*, International Congress on Energy Efficiency and renewable energy sources in industry and constructions, 13-15.04.2005 Plovdiv, Bulgaria, Congress proceedings, pp. 43-46.
- Voronca M.M., Cruceru M. - *Sustainable and Competitive Development of Energy Sector in Romania*, Sustainable Development of Energy, Water and Environment Systems, 15-20.06.2003, Dubrovnik, Croatia, CD Proceedings, 11 pg., ISBN 953-6313-56-1.

Recommended for publication of Editorial board