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RENEWABLES ENERGIES INDUSTRY IN THE CURRENT INVESTMENT CONTEXT

Daniel MANAȚE *
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Pavel FĂRCAȘ ***

The current shifts in the global energies market lead the expected change in the long term from traditional energies sources, like fossil fuels, to renewable energies sources, e.g. sun, wind, water, energetic wood etc. The major commitments are: sustainability, productivity, smart energy grids and functional energy systems, industrial ecology, green chemistry, bio mimicry, green nanotechnology. The most important investment criterion relies upon efficiency: energy return of invested energy (EROIE), but there are also other relevant issues such as: policies to support RE, e.g. green certificates, legal issues to exploit resources or the capital costs and operational & maintenance costs. Romania's best RE potential lies in biomass, hydro and wind, but still is a lot to capitalize on geothermal and solar photovoltaic or in conjoint projects between private investors and authorities, especially in waste incineration power plants.

Key Words: capital costs, CO2 emissions, EROIE, O&M costs, renewable/ green energies.

JEL Classification: O13, Q42.

1. Global energy market

The attractiveness of industry sector for investors is great due to the prospects for continuous growth within the next 20 years. The Directorate-General for Research of the European Commission produced some very well documented forecasts in 2003, that were, since then, carefully considered by money suppliers when financing green field projects in energy producing domains. *(Directorate-General for Research EC, 2003)*

Relying on the expectations of economic and population growth and also, the energetic intensity improvement, the global energy demand was forecasted to grow with an average pace of 1,9% between 2000 and 2030. In this period the energy demand of the developed countries is expected to decrease simultaneously with the increase in energy demand of the emerging and developing economies, especially BRIC[1] countries, whose proportion of the total demand is predicted to appreciate from 40% up to 50% in 2030.

Still, the fossil energy resources will remain dominant, no less than 90% of the total, the projected structure being: 34% oil, 28% coal, 25% natural gas. The *Table 1* presents the expected primary energy demand by the EC in the interval 2006-2030.

Our first remark, view the investors viewpoint, is that energy market is definitively an attractive one for investors, either we refer to classical sources of energy, like fossil, or to the "*new*" sources, like the green or renewable energy.

Even if the demand for coal energy within the analysed period will slightly increase, the same for natural gas, and a faintly decrease in oil energy demand, we observe that the estimated growth rate for the renewables energy demand (biomass and waste excepted) is **7,2%**, by far the largest one. This estimate makes renewables more attractive than the rest of the sources, and thus a special investment alternative.

[1] Brazil, Russia, India and China.

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Table 1

Expected primary energy demand

	Energy demand [Mtoe]					Shares (%)		Growth (% p.a.)
Energy Source	2006	2015	2020	2025	2030	2006	2030	2006-2030
Coal	3.053	4.023	4.374	4.719	4.908	26,0	28,8	2,0
Oil	4.029	4.525	4.744	4.938	5.109	34,3	30,0	1,0
Gas	2.407	2.903	3.130	3.384	3.670	20,5	21,6	1,8
Nuclear	728	817	842	886	901	6,2	5,3	0,9
Hydro	261	321	353	383	414	2,2	2,4	1,9
Biomass and waste	1.186	1.375	1.465	1.562	1.662	10,1	9,8	1,4
Other renewables	66	158	216	276	350	0,6	2,1	7,2
Total primary energy demand	**11.730**	**14.112**	**15.123**	**16.148**	**17.014**	**100,0**	**100,0**	**1,6**

Source: *International Energy Agency, European Commission.*

In time, the predictions presented above, completed by IEA and EC, were confirmed, with marginally changes, by different specialised actors on the energy market, such as British Petroleum, one of the major players in this industry.

According to its (*British Petroleum, 2011*), the global energy demand will continue to increase at an average pace of 1,7% within 2010-2030 driven by the consumption and the development of power generation facilities. Its measure will be influenced by the level of industrialization in the developing and emerging economies. As those factors improve, the energy demand from these countries will lead the global energy depletion, being responsible up to 93% of the global energy growth rate!

Viewing the late contributions to the world growth rate of BRIC economies, especially China and India, BP estimates that until 2030, two thirds out of total energy demand is due to emerging and developing economies in the detriment of OECD countries.

If we refer to an energy efficiency rate, such as Energy / Gross Domestic Product, it is expected to grow faster within non-OECD economies, such as BRIC countries or Central and Eastern Europe (CEE) countries.

British Petroleum too, foresees a major growth rate of renewables; practically their contribution to the global energy growth is projected to evolve from 5% within 1990-2010 up to 18% in the next 20 years. The same optimistic prospects are for biofuels, these ones being the fuels with the firmest upward rate within 2010-2030, respectively 8,2%. What is significant is that from 2003 to 2011, the prospects for growth in RE proportion of the total consumption / production have intensely augmented and BP more than doubled its expectancies regarding the green energy total consumption relative to EC estimates in 2003, totalling for 2030 795,8 Mtoe.

Rendering to *Figure 1*, renewables are even more attractive than traditional energy sources.

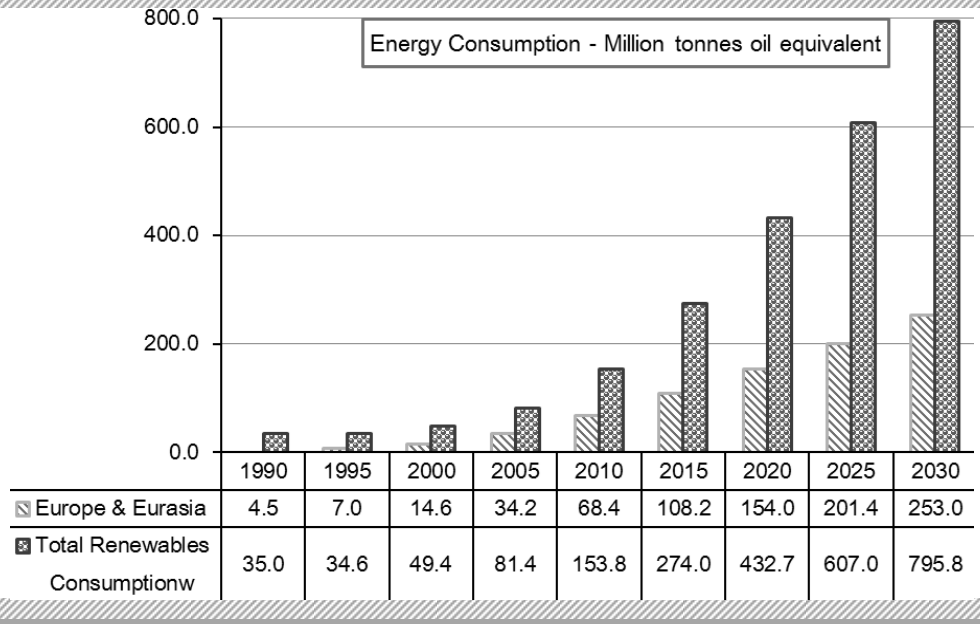
2. Traditional energies vs. Renewables energies

Energy market has two major components and a third developing one:

1. **Traditional energy (TE)**, whose sources are exhaustible, formed in the past, such as fossil fuels (e.g. oil, natural gas, coal, tight sandstones, shale gas etc.);
2. **Renewables energy (RE)**, whose sources are currently restored (e.g. biomass) or can be captured in the nature, being practically of an "*unlimited*" availability (e.g. sun, wind, tide, waves, geothermal, waterfalls etc.);
3. *Waste energy (WE)* biodegradable or not.

Traditional energies market faces several serious problems, among we underline the following:

- TE affects the environment and increase the CO2 emissions;
- TE are limited, the estimated time interval of availability is between 50 and 200 years;
- The returns associated with TE are continuously declining, due to the growing exploiting difficulties as long as the fossil resources become more scarce;



	1990	1995	2000	2005	2010	2015	2020	2025	2030
Europe & Eurasia	4.5	7.0	14.6	34.2	68.4	108.2	154.0	201.4	253.0
Total Renewables Consumptionw	35.0	34.6	49.4	81.4	153.8	274.0	432.7	607.0	795.8

Figure 1. Energy Consumption – Total Renewables Consumption and Europe&Eurasia

Source: *British Petroleum*

- The geographical concentration of some of the important TE resources generates, along with large transportation costs also political tensions and risks, availability or control, see also the Russian – Ukrainian incident regarding the natural gas delivery shortage to European Union in 2009.

The ecological leverage of the earth is already at a dangerous level, unsustainable. The continuing economic growths at current levels will double the CO2 emissions until 2050, the foremost responsible being the fossil fuels. *Table 2* presents the contribution of the main fossil fuel combustion sources to the carbon dioxide emissions.

Table 2

The contribution of the main fossil fuel combustion sources

Liquid fuels (e.g. gasoline)	36 %
Solid fuels (e.g. coal)	35 %
Gaseous fuels (e.g. natural gas)	20 %
Cement production	3 %
Others	6%

Source: *International Energy Agency*

Opposite to the drawbacks of the TE, the Renewables energies present the following main advantages:

- CO2 emission reductions due to TE and the fact that most of the RE do not engender CO2 emissions;
- Most of RE are unlimited (e.g. wind, solar, tide etc.);
- There are important technological premises associated to the reduction of costs associated with RE;
- RE beneficiate of a large geographical diversification, almost all regions devising a RE source;
- The transfer process from TE → RE creates new jobs;
- RE can significantly contribute to the wish of energetic independence, both nation level, European region level or EU level;
- RE do not present major geopolitical risks, linked to access & control issues, scarce resources etc.

The key element during the transfer process from TE → RE would be that **Renewables energies can cover several times the estimated energy demand of the whole earth economies and population.**

The critical factor to be taken in consideration by investors regarding RE is the measure governs all over the world favour and stimulate this domain, view the low return rates associated with green field energy investments, either wind onshore/offshore, solar PV or wave & tide. The stimulus package would be strongly justified if we only consider the sustainable development perspective, the benefits for humanity being of furthermost prominence. International Energy Agency evaluates this contribution to reach in 2035 0,17% of the projected world GDP.

The tendency in time is that this support slightly declines, due to the lowering of production costs, explained by tech-

nological learning practise. *Table 3* presents the technological learning rate per RE category and production type.

The latest global energy predictions (*International Energy Agency WEO, 2010*) rely on a greater role of RE in world electrical energy production, actually the forecasted figure for 2035 being almost one-third of the whole production, very close to future coal ratio.

The leading sources behind this abrupt increase and also the most attractive for investors are wind and hydropower. Though viewed as one presenting one of the paramount growing potential, solar photovoltaic will represent only 2% out of the total in 2035. Real estate and construction are industries that will benefit from the progression in RE, mainly in heat production in industry and edifices. Also, biofuel, seem to gain importance, increasing from a share of total fuel demand of 3% today up to 8% in 2035.

Another important figure is the estimated total amount to be invested during 2010-2035 in green energy projects: 5,7 trillion USD. Of course, the destination of the investments is related to the evolution of the energy demand, so the emerging economies are at the origin of it, first of all, China. In fact, China already became a leader in wind-mills and solar photovoltaic production, as well as a main provider of the related gear.

3. Specific investments aspects related to the Renewables energies

RE investment must face two real obstacles in order to attract venture capital, and these are: the low efficiency ratio and the lack of and adequate technology for storage. This is the main reason why, during 2008, the free green sources wind and sun were covering only 0,7% out of the total demand and their weighted average within RE was only 4% while the main steak was for biomass or hydro. RE sector must reach to the following results in order to become really striking for investors:

a) To raise the efficiency of electricity conversion rate in RE, especially solar and wind;

b) To facilitate through smart grids (networks) the efficiency in RE consume and production;

c) To enhance the technic solutions in order to solve the discontinuous providing of RE energy type and avoid the energy supply peaks or shortages.

All recent forecasts agree upon the continuous rise in energy prices, trend favoured, firstly, by the abrupt strengthening of the competition to control the known fossil and other primary natural resources, and, secondly, by **the future increasing costs associated to TE / high current costs associated to RE** (which incurs larger financing costs). It is common believe that this trend will

Table 3
Technological learning rate per RE category and production type

Renewable energy category	Production type	Technological learning rate		
		2006 - 2010	2011 - 2020	2021 - 2030
Biomass	Combined heat - power medium	5%	5%	5%
	Biogas	5%	5%	5%
	Waste incineration	5%	5%	5%
	Co-generation	5%	5%	5%
Geothermal		5%	5%	5%
Hydro	Small	1%	1%	1%
	Large	1%	1%	1%
Solar Photovoltaics		18%	15%	15%
Concentrating solar power		13%	10%	8%
Marine	Tide	15%	15%	10%
	Waves	15%	15%	15%
Wind	Onshore	5%	10%	5%
	Offshore	5%	15%	15%

Source: *International Energy Agency*

stop only around 2045, once the weight of RE will escalate and new and efficient technologies to produce, store and convey RE. Around this particular moment in time is expected a turning point in energy price, which eventually will become very cheap. A comparative centralized situation of costs for different RE types and other relevant aspects is contained in *Table 4*.

Currently, the larger capital costs in USD / kW are with biomass – waste incineration, followed by solar photovoltaic, tide & waves, concentrating solar power, geothermal, hydro – small and wind – offshore, all over 3000 USD / kW. In 2030 perspective, the most significant reduction of capital costs will be for PV and CSP, followed by W&T. Only for nuclear energy is estimated a surge of capital costs within this horizon.

The smallest current capital costs are associated with biomass – co-firing, view the possibility to use existing power facilities, based on traditional fossils, and followed by wind – onshore, hydro – large and nuclear.

Making an allowance for the operational & maintenance costs, the smallest present costs are for PV and followed by wind – onshore, hydro – large and biomass – co-firing. The largest contemporary costs are for biomass - waste incineration and followed by T&W, geothermal, wind – offshore and CSP. In the outlook of 2030, the top two in O&M costs will remain unchanged, but the third position will be held by nuclear while W&T will strongly decline, the same for CSP or PV, which will remain the cheapest energy type in view of O&M costs.

Bearing in mind the efficiency criteria, the top is formed by hydro, solar, wind and W&T, at a fantastic 100%. Out of the others RE the strongest position is for biomass – co-firing and the weakest for biomass – waste incineration.

Considering the period to erect the power plants, the most time consuming would be wind – offshore and followed by W&T, hydro – large and biomass (CHP, biofuel and waste incineration).

PV plants can become functional the quickest and this attracts investors. Actually, the 2010 vogue in RE was, by far, new capital pumped into small-scale commercial and residential photovoltaic systems, creating an increase to 18,4 giga Watts of new PV global, up from 7,6 gW in 2009. The short term PV forecasts are very optimistic: more than 25 gW in 2011 and more than 30 gW in 2012 (*Bloomberg New Energy Finance, 2011)*.

The main ratio to analyse RE industry is the **Energy return of invested energy** (EROIE) which shows the energetic return of the invested energy, respectively a net energy analysis. Considering the thermodynamic criteria, whatever energy source, except for hydro, all other are solar stored energies - SSE (oil, gas, coal, wood or energetic wood harvests). To bring the SSE on the market in order to be useful and tradable we must invest energy in the whole process: discovery, drilling, transform, store, convey, transfer the energy to the grids and so on. EROIE measures the quantity of energy needed to extract, process and deliver a specific quantity of energy to the market (e.g. electricity or diesel). Either RE technology which leads to a subunit EROIE are not recommended to investors and providing an unsatisfactory

Table 4

Comparison between different energy types in European Union

Comparison between different energy types in European Union	Capital costs [USD/kW]		Annual operations & maintenance costs [USD/kW]		Generating power / efficiency [%]		Capacity factor [%]		Period to erect [years]	
	2008	2030	2008	2030	2008	2030	2008	2030	2008	2030
Biomass - Combined heat & power plants (small & medium)	2,960	2,550	89	76	27%	29%	65%	65%	4	4
Biomass - biogas	2,970	2,560	89	77	30%	32%	62%	62%	4	4
Biomass - waste incineration	7,660	6,590	230	198	16%	17%	70%	70%	4	4
Biomass - cofiring	470	410	66	57	57%	60%	51%	51%	3	3
Geothermal	3,790	3,320	159	140	15%	15%	60%	76%	3.4	3
Hydro - large	2,320	2,320	58	58	100%	100%	32%	33%	4.5	4
Hydro - small	3,250	3,250	72	72	100%	100%	32%	33%	3.4	3
Solar Photovoltaics	6,270	2,300	41	15	100%	100%	10%	12%	1.7	1.5
Concentrating solar power	4,110	1,920	103	48	100%	100%	26%	26%	3	3
Tide & Waves (Marine)	5,320	2,320	160	69	100%	100%	25%	44%	4.5	4
Wind - onshore	1,880	1,540	43	35	100%	100%	21%	24%	2.3	2
Wind - offshore	3,060	2,430	107	85	100%	100%	33%	46%	5.1	4.5

Source: *International Energy Agency.*

long term yield due to larger energy inputs compared to the energy outputs, so there is an energy loss.

EROIE = Output energy / Input energy =
(Output energy - Input energy) / Net energy surplus

Within the next two decades the relative energy costs will stay at high levels for the reason that the energetic balance of fossil fuels is decreasing and there is no alternative energy source ready to replace very soon the fossil fuels due to the lack of operational & economic profitability or to the technological efficiency barrier. This would be the main motive for focusing on RE technologies that can offer a better energy output relative to the energy input. Out of all, the factors for the success in obtaining a larger EROIE are: the longest period of functioning during 24 hours cycle and using equipment with longest economic life.

According to a recent study (*Business Monitor International, 2011*) it was observed a drop in the financial effort of the authorities in several developing countries for developing and sustaining renewables energies, fact that induce regulatory, economic and political risks that can significantly affect RE developers within those geopolitical areas and also lead to the lessening of the degree of concern to such investment projects.

4. Conclusions and recommendations for envisaged Romanian green energy projects

Romania has a good renewables energies potential, particularly due to its marine wind climate and varied geography. Out of this, biomass and biogas cover the major part, around 65% out of al RE resources, except for large hydro. Electric and thermo RE energy without hydro large totals RE potential to 135 Terawatts hour / year, out of which wind covers 17%, solar 12%, hydro – small 4% and geothermal 1%. We must underline not only the hydro energy capacity, supported by a great number of rivers, but also the very good wind potential in Dobrogea, a better solar prospective than, for example, Germany, relatively large biomass resources and a yet undervalued geothermal "*Eldorado*" potential in Western part of Romania.

All of this concluded in 2009 a percentage of 30% of green energy sources for the internal gross electricity consumption. In ten years Romania assumed in Brussels this percentage to upturn to 38% but national RE potential, if properly valorised, would lead to a better figure, up to 43,5%.

For a sophisticated energy portfolio investor there are also new and innovative fields that can be valorised, such as: bio mimicry[2], green nanotechnology and biotechnology, all of these being boundary new sciences, able to grant the sustainability feature of the power generating process. Today is more important than ever, that most of industrial processes and energy plants are in line with the sustainable development concept, ensuring the economic growth and the social wellbeing without endanger the future of the next generations. In other words, the commitments relevant for this topic would be: to preserve natural resources for the generations to come, to reduce pollution and environment degradation, to shift to the renewables sources of energy, reducing in this way the CO2 emissions.

General investment criteria in Romanian renewable energy Greenfield projects should consider the next:

- RE industry is a dynamic and volatile one.
- RE investment in Romania faces significant legal risks due to the fact that investors are not safe with the number of green certificates granted for each RE type and the period of time for the GC rights. The main cause relies in the delay caused by the European Commission in approving the Romanian Energy Law that states these facts. Other risks are due to the unclear environmental requirements or property related issues (e.g. land claims, land use or land expropriation disputes).
- RE industry is a complex one, and investment process requires be designing and conducting according to specific concerns related with each resource: sun, wind, hydro etc. Even for one source, e.g. wind, capital and O&M costs are very different from onshore to offshore. Legal matters must be taken in attention and it is possible that projects benefitting from European Commission funding may not profit from the green certificates system.
- No matter what RE source key investment ratio must be EROIE and the most relevant aspects are:
  - Capital and operational & maintenance costs;
  - Accessibility of the RE source, especially for biomass;
  - Every investment project should be backed by technical qualified support[3];
- Green certificates system, promoted by Romanian Energy law but not yet approved by EC, is of furthermost interest to investors both for improving the return on investment and for possible trading related profits;
- Acceptable Romanian RE projects are, in our opinion, those with a rewarding return, that satisfactory cover the extra risk associated with the new technologies of the RE and the uncertain legal

[2] Bio mimicry is a border science based upon the observations on nature and bio systems, used to imitate the best natural solutions applicable in RE technologies. A noticeable example is the wind turbine designed by the British engineering company Wind Power that imitate the winding glide of the plane trees seeds.

[3] Technological energy institutes, energy research centers etc.

frame of the industry and also those related with unrestricted access to the RE source being processed into mechanical / electrical / caloric energy (focus mainly on biomass / biofuels / biogas.

The most attractive RE domains in Romania in our belief are:

- In the short term: hydro – small, biomass – co-firing / cogeneration (based on sufficient land surfaces to cultivate the needed energetic wood), conjoint projects between private investors and local authorities, especially in waste incineration power plants, green certificates trading;
- In the medium term: solar photovoltaic (small-scale logistic and residential photovoltaic systems[4] combined with green building design concept), geothermal (combined with spa & wellbeing projects);
- In the long term: wind – offshore.

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[4] PV panels that cover large parts of the green buildings.