RISK ANALYSYS ELEMENTS IN THE MANAGEMENT OF RENEWABLE ENERGY SOURCES

DUMITRESCU D., HORA C.,
University of Oradea, Faculty of Power Engineering
E-mail: dumitrescudan70@yahoo.com, chora@uoradea.ro

Abstract - The concept of sustainable development aims to meet current needs in terms of minimizing risks that may endanger the ability of future generations to satisfy their energy needs. In this context, the efficient exploitation of renewable energy sources requires the multiple risks analysis that may affect this process, respectively not only the identification and classification of these risks but mainly to establish the analyzing methodology and quantifying the elements in the application and enhancement of matrix method and statistical data valuation.

Keywords: sustainable development, renewable energy, risk management, risk matrix, statistical data valuation

1. INTRODUCTION

The issue of renewable energy sources exploitation is extremely complex, targeting multiple aspects, on the one hand inked to the abundance, distribution, availability and clean nature of their use, and on the other hand, the politico-economic implications arising from the " classical " existing industrial infrastructure of production, transportation, distribution and energy consumption. In this context must be equally considered the exploitation issues connected with the sources yields and the public and private entrepreneurial interests strongly influenced by economic opportunism and the rules of economic game.

The establishment of certain general objectives related to sustainable development, such as:

- harmonizing the relationship between economy and environment;
- reconfiguring the relationship between consolidated market economies and the emerging ones;
- treatment of local environmental issues in the context of internationally imposed general rules,

is filling in this picture with several action courses in the power industry field regarding the reorientation of production technologies and control of specific risks, the conservation and increasing of renewable energy sources or the coordination and improving of macroeconomic decision-making processes.

Starting from the objectives of higher capitalization of these resources, namely accessibility, affordability and acceptability in terms of their sustainable development and environmental protection, there stands the necessity of adopting certain decisions regarding the alternatives of operational policies implementation and specific instruments of renewable energy sources operational management. Although their future exploitation is rather a certainty than an option, under the conditions of serious disturbances in terms of climate evolution and dynamics, mainly attributed to the technologies that exploit fossil energy, the renewable energy use is also associated with specific risks. Their knowledge and control is an important premise to minimize their effects and thus, of increasing the yield of operating, distribution and consumption. It should be bear in mind that the reappraisal of these resources occurred in the context that the climatic, ecological, political and economic realities have imposed it, the entrepreneurial interest being less active than in the area of exploration, exploitation and consumption of the established energy sources. Therefore, the increasingly contributions of investments in this sector depend not only on technical and economic returns of harvesting, transport, distribution and consumption, but in an important measure on exposing to the potential hazards (natural, technological, economic, financial, etc.)

2. STUDY UPON CERTAIN RISKS SPECIFIC TO THE MANAGEMENT OF RENEWABLE ENERGY SOURCES

The Community strategic objective regarding the contribution of renewable energy sources foresees, at the European Union level, its doubling in the period 1996 - 2012, respectively from 6% to 12% in total primary energy consumption (White Paper for a Community Strategy), while in Romania, this share is to arrive in 2010 to about 11% and 11.2% in 2015. Consequently, if Europe-wide annual growth of renewable energy intake is over 16% in our country modestly attains a level below 0.04%. It is assumed that under these conditions the predictable lag will worsen if the European funding programs will not sustain the provided pace of the sector development and, the attractiveness of investment opportunities will be affected by multiple alternatives and associated risks.

National Energy Strategy for the period 2011-2035 envisages an increase of predicted energy demand up to about 50% over the entire period, according to a constant increase of fossil fuel prices and emissions costs. Therefore, the harnessing of renewable energy potential appears as the only alternative in terms of both energy security increasing and price control developments, as well of approaching to the climatical changings and

environmental conservation. This fact results also of the orientation and EU energy policy, directed mainly towards:
- maintaining the security of energy supply in the Union;
- promoting the energy efficiency and energy saving;
- development of renewable energy;
- reducing emissions of greenhouse gases;
- promoting the interconnection of energy networks.

Regarding Romania, there is an unanimous consensus on the importance of renewable energy potential and availability of their exploitation, but also an awareness of risk factors that may affect the strategic approach. On these lines, even the authors of the above mentioned national strategy agree that the real potential of the envisaged sources is much smaller due to technological limitations, environmental restrictions and economic efficiency.

There is eloquent the fact that in accordance with the assessments of hydropower resources, convertible energy potential is approx. 32,000 GWh / year and in 2009 the installed capacity does not exceed 6500 MW, in the context that an average hydrological year would ensure getting to 17,340 GWh / year. It follows that, at present, we have a convertible energy potential exploiting degree of 54%, the untapped reserve requiring current efforts that exceed the actual investment opportunities insofar the public and private domain.[1] In this regard, for example, the investing interest is affected by the fact that the exploitation of renewable energy sources generates electricity production costs over those implied by the employment of fossil and nuclear fuels.. The envisaged solution to stimulate the investment efforts under such conditions and in accordance with European practice is the state given support, even if the respective economic and financial mechanisms lead to price increases at the end consumer. Therefore, is looming the perspective of a public-private partnership as the only option, so far, that may lead to more intense exploitation of these sources.

It is important to have in view, as analysing the specific risks management, the geographic arrangement of these resources at country level (fig.1):

Fig. 1. Distribution of renewable energy sources potential in Romania

1. Elements of energy strategy for the period 2011-2035. Directions and strategic objectives in energy sector. Economy Minister Site, April 2011(fig.1).
Source: Finance and Economy Minister - 2007

Legend:
I. Danube Delta (solar energy);
II. Dobrogea (solar and wind);
III. Moldova (plains and plateaus - micro hydro, wind and biomass);
IV. Carpathian Mountains (IV1 - Eastern Carpathians, IV2 - South Carpathians, IV3 - Western Carpathians (biomass, microhydro)
V. Plateau of Transylvania (microhydro)
VI. Western Plain (geothermal energy);
VII. Subcarpathians (VII1 - Getic Subcarpathians; VII2 - Subcarpathians of curvature, VII3 - Moldavian Subcarpathians: biomass, micro hydro);
VIII. Southern Plain (biomass, geothermal and solar).

This natural distribution, both diverse and heterogeneous in terms of energy potential, especially represented in the required efforts to put its value, also provides a number of risks to be taken in the event of imperative management application to their exploitation.

Starting from the three vulnerabilities of the renewable energy sources potential development, namely **the technological constraints or limitations, the economic efficiency and environmental restrictions**, there is required a risks assortment from this perspective and their treatment as matrix variables,

thus opening the way for the evaluation, quantification and improving managerial performance.

Thus, any latent investor will be able to operate with a control and exploitation instrument of his business in the field of renewable energy sources, by entering an emerging electricity and heat market, hence having an even higher developing potential. The importance of attracting private and public capital in this area is obvious, and the realization of this goal has not only social and political reasons. At least the private sector primarily takes into account, without exception, the ability of returns on investment, generating value and future revenues, representing themselves an assumed risk under conditions of uncertainty.

The constraints or technological limitations include a wide range of issues related to the aspects of designing, building and investment operation, generally present but differentiated according to source:

● *considered natural reserve capacity*, may cause a greater or lesser interest of investing accordingly to the displayed potential, consisting of a concrete manifestation of this investors segregation criterion. Large markets attract large capitals, and vice versa, in accordance with their own gravity.

● *continuity of energy generation*, especially of wind and biomass sources, may be a factor for variation of productivity and efficiency in the long term exploitation. This can raise special problems both in terms of programming resources exploitation, but mainly in terms of meeting the needs of capital and human resources.

● *Location-design conditions* may be an important risk factor both in the formal aspect, but especially by the necessary technical-economic specific expenditures . Depending on the location of micro geographical and territorial positioning the technological limitations are likely to be important and therefore requiring a change in investor's strategy.

● *complexity and technological level* of constructing, equipping and out fit of the objective has the strongest impact on investment decisions in conditions that generate the most significant costs. Usually, here are involved the financers, guarantees and insurers which shall decide on the business opportunity and feasibility.

● *decommissioning and storage conditions* of the investment should be considered even from its design, as they are the entrepreneur's future obligations and thus being included in the management plan.

The economic efficiency of investment, essential in entrepreneurial terms, presents in its turn a number of common nature risk factors which, in the context of renewable energy sources exploitation dress a number of specific issues, namely:

● *operating and maintenance costs* of investment are closely related to its technical aspects, the economic returns directly being a consequence of the technical ones and the power market , as well, which aspires to become more competitive. The influence of these factors greatly vary from one source to another, thus requiring a differential weighting and harmonization with other managerial risk factors.

● *evolution of working capital,* respectively the permanent floating capital, expressing the capability to finance the current assets and therefore supporting continuous business. The more the renewable sources will require fewer capital assets, the more will be higher their ability to recover the investments and generate profit.

● *period of the power source operation* is, in its turn, a major managerial risk factor in both physical duration aspect and the intermittence of operating, knowing that functional disruptions and, inferentially, those in delivering the contracted production, negatively affects the economic efficiency of exploitation.

● *labor and capital requirements,* respectively the ratio of these production factorshas a major importance both in terms of capital relating costs, but most, those of the labor. The allocation level variability from one source nature to another determine also differential influences of that risk, namely by the costs of involved resources.

● *nature and level of state support* for investors in the capitalization of renewable energy sources directly leads to the efficienting of exploitation and investors' confidence increasing in these public-private partnership. State involvement will be hence perceived as a participation in risks sharing or reducing them from entrepreneurs'perspective.

Environmental restrictions are a group of increasing importance risk factors in the context of the above outlined climate evolutions , the exploitation of these sources might produce some direct or indirect effects on the respective environment. Therefore, the investors should take into account these restrictions in the management plan, having to treat them as risk factors if the predetermined conditions of locating and operating are not fulfiled:

● *location preserving biodiversity,* namely the vegetation and fauna that populate the area affected by the exploitation of renewable energy sources. Environmental law rules are restrictive in what is regarding the investors' options, mainly concerned by the involved costs reduction and higher utilization of resulted energy.

● *non-affecting the health of the population* through the projects development of the renewable energy sources exploitation requires its permanent monitoring by the authorities. In the event of disease occurrences whose etiology indicates as cause the operator's energy activities, his liability will be entailed , let it be, by case, administrative, contraventional or criminal.

● *conservation or architectural values, protected zones and archaeological sites* in the areas of renewable energy recovery is both a prerequisite condition for project validation and, subsequently, during the investment operation. In the extent that the operator would harm these natural or cultural asets by carrying out energy activities, he will have to answer under the laws in force.

● *microclimate and soil conservation,* especially their quality and characteristics. The placement and operation works of renewable energy sources may, accidentally or by failure of operational rules, produce changes in water quality parameters, air or soil, being in this regard a risk factor. Even if these source categories are organic by their nature, not involving industrial transformations, the specific equipment and machinery functioning out of

operational rules can generate such events and thus attracting mal consequences to the energy operator.

The application of an effective management of risks assumed by investors in the exploitation of renewable energy sources, requires on the one hand their weighting in the overall business risk and, on the other hand, the quantifying of potential effects , respectively the economic costs and legal consequences. The achieving of this goal is difficult, especially in terms of diversity of sources and unequal distribution of frequency and intensity as risks at each source category level. Under these circumstances, the achieving of a risk matrix may be, along with other risk assessments, a versatile and effective tool both in the design phase and also later, based on recorded activity data. However, the high degree of subjective assessments and lack of uniform assessing standards lead to an important relativ degree of the resulted data.

Usually, achieving such an array requires not only the agreement of those involved (designers, financiers, investors, authorities, customers) regarding the inventoried risks but mainly to their likelihood and consequences of producing such unwanted events. In order to simplify and harmonize the points of view, evaluators might use a scale of 1 to 10 for each risk (probabil event) applicable to both in terms of event frequency and consequences severity , mainly upon operating costs. For example, may be assigned a low probability to an event, between 1 and 3 but the foreseeable consequences could be important or serious, between 7 and 10, respectively. In this way, once these values assigned to each inventoried risk can be accomplished their matrix:

Risk category	Event probability	Possible consequences
Technological constraints or limitations (c)	**P(c) = 3,2**	**C(c) = 7,0**
Natural reserve capacity	2	7
Continuity of power generation	4	8
Terms of design-emplacement	5	3
Complexity and technological level	4	8
Storage and decommissioning conditions	1	9
Economic efficiency (e)	**P(e) = 2,6**	**C(e) = 7,0**
Operating and maintenance costs	3	7
Evolution of the revolving fund	2	4
Operating period of the power source	1	8
Labor and capital requirements	2	7
Nature and level of state support	5	9
Environmental restrictions (m)	**P(m) = 1,0**	**C(m) = 2,75**
Preservation of local biodiversity	2	3
Non-affecting the population health	1	3
Conservation of architectural values, protected areas and archaeological sites	1	2
Microclimate and soil conservation	1	3

Fig. 2. Specific risks matrix in exploiting renewable energy sources (example)

Where: **P(c), P(e), P(m)** represents the average of estimated probabilities for each risk categories, and **C(c), C(e), C(m),** average resulting probability of those risks consequences. The attributed values may be fractional numbers, hence allowing a more adequate risk grading.

One may conventionally consider three or four levels of expectation grading that will allow comparison of investing opportunities and strategic decisions upon the exploitation of renewable energy sources. Ex.:

- probabilities between 1 and 3 are considered low level;
- probabilities between 3.1 and 6 are considered medium level;
- probabilities between 6.1 and 10 are considered high level;

or,

- probabilities between 1 and 3 are considered acceptable level;
- probabilities between 3.1 and 5 are considered attention level;
- probabilities between 5.1 and 7 are considered alert level;
- probabilities between 7.1 and 10 are considered utmost level of danger or risk;

It is recommended that the assignation should be made by consensus or mediation between stakeholders, so that the values entered in the matrix to better reflect the considered characteristics.

Conclusions

1. The specific risk management decision-making processes require, unlike other fields, a series of assessments and forecasting of some random processes or casual events of whose quantifying depends on the financial and operational business success.

2. From this perspective, the identifying of instrumental means applicable to extensive diversity of potential energy sources, which might display differentiated features even within the same category (hydro, geothermal, wind, etc..), is imperatively necessary.

3. The risk matrix elaboration is a solution in this regard in terms of relative assessment accuracy of the considered factors but easily applicable and ensuring comparability of data in many cases and circumstances.

4. The operational value of the method can be enhanced by linking it with other means of evaluation and quantification of risks that can provide similar data or capitalizing the experience gained by specialists in the field of energy assessors.

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