ANNALS of the ORADEA UNIVERSITY.

Fascicle of Management and Technological Engineering, Volume VII (XVII), 2008

MANAGEMENT OF ENERGY SOURCES IN ECO-EFFICIENCY AND SUSTAINBLE DEVELOPMENT CONDITIONS

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Keywords: sustainable, renewable sources, eco-efficiency

Abstract: In the current context of a consumption society, the environment protection aspects have to be a real subject for any field of action, in order to ensure a sustainable development. In this paper, in a multidisciplinary approaching (energetic engineering, automotive, statistics, mathematics and economics), we shall combine efficiently the demand and the realization of an objective absolutely necessary in an energetically changing world. The approached subject has a very actuality both in regional level and national and international level. There are two research directions in this paper: the energy and the environment.

1. THE SUSTAINABLE DEVELOPMENT AND THE COMPETITIVENESS IN THE EUROPEAN ENERGETIC INDUSTRY

Sustainable development must to respond to the present necessities without compromises the capacity of future generations to satisfy their needs. The respect for solidarity between generations represents a real constraint for the economic actors. It enforces, in particular, a special way to manage the natural resources and settlement good methods for environment protection.

Delivering a maximum protected patrimony, both quantitative ground and qualitative ground, is a major objective and its achieving process allows forecasting, in good conditions, the future development, in order to help the social, economic or political decision makers to manage the environment protection.

Reinforcement of international security and peace keeping are the Great Powers' government prior goals, especially for EU. But, the most important effort can not be concentrated only to military dimension, because security and peace means also not allow to be done injustices what are happened in entire world. It is about a global concept of international security that could counterbalance the present American concept focused on military dimension. In this context, it is emphasizing the optimization process of military technical parameters, of performance parameters and armament systems. Furthermore, EU-Power „is searching to make the relationships to develop in entire world in order to produce advantages not only to riche countries but also to poorer countries" and „want to frame the internationalization process according to ethic principles, namely to anchor it in solidarity and sustainable development" (*Laeken Declaration* over the future of European Union).

Energetic industry is influenced by many of the technologic and economic forces that impel the revolution from telecommunication field and has a more impact over life, health and environment quality. The energetic industry (with its basic components: resources, production, transport, distribution, consumption) represents a strategic sector of any nations, it is a vital sector for economic and social development.

2. RENEWABLE AND NONRENEWABLE ENERGY SOURCES

Energy sources represent all that allow producing utile energy directly or by transformation. It is difficult to imagine a life without electricity, without using energy. These

are shared in two kinds: energy non-fossil sources or renewable sources (ERS) of energy and energy fossil sources (ENRS) or nonrenewable sources of energy. ERS represents the resources in the environment, that are regenerating continuously or with certain periodicity and their consumption don't lead to a possible depletion. These kinds of energy sources are constantly renewed or restored and include: sun (solar), internal heat of the earth (geothermal energy), wind (wind power), vegetation (biomass), falling water, tides, and wave motion (hydropower). A clear feature of ERS is their independent existence by any man's consistently activity. ENRS are not renewable resources and are represented by natural resources, by material reserves, used by man in order to produce energy. They are finite or cannot be replenished, such as fossil fuels (coal, oil, gas), shale, uranium aso. The energy of fossil sources, unlike the ERS' energy, is incorporated and it can be engaged only after human activity. Electricity is generated from both renewable and nonrenewable energy sources (Ayres, 1997).

The main differences between the two kinds of energy sources are illustrated in figure 1.

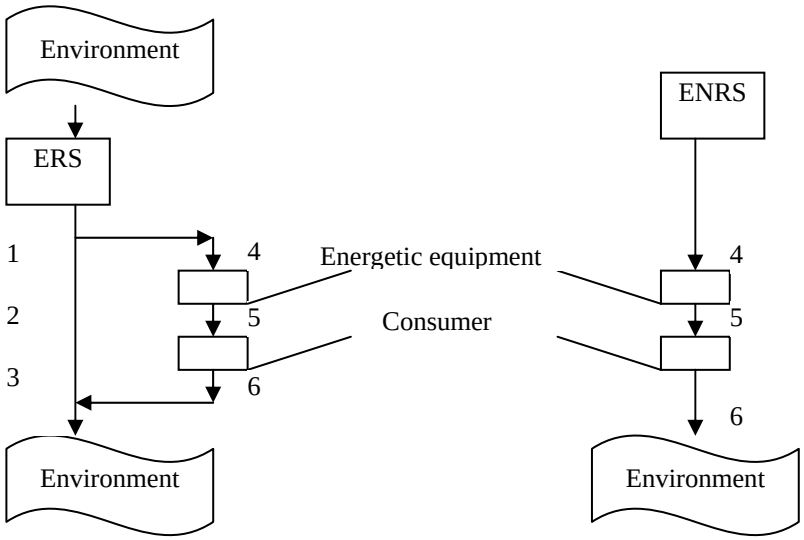

Figure 1. Differences between the energies: a) renewable and b) nonrenewable (fossil); 1-2-3 – unused energy flux; 4-5-6 – used energy flux

Sustainable development must to respond to the present necessities without compromises the capacity of future generations to satisfy their needs. The respect for solidarity between generations represents a real constraint for the economic actors. It enforces, in particular, a special way to manage the natural resources and settlement good methods for environment protection (Klarer et all, 1999).

Delivering a maximum protected patrimony, both quantitative ground and qualitative ground, is a major objective and its achieving process allows forecasting, in good conditions, the future development, in order to help the social, economic or political decision makers to manage the environment protection.

Energetic industry is influenced by many of the technologic and economic forces that impel the revolution from telecommunication field and has a more impact over life, health and environment quality.

The energetic industry (with its basic components: resources, production, transport, distribution, consumption) represents a strategic sector of any nations, it is a vital sector for rational economic and social development and these depends by the rationality the limited resources are exploited.

3. EFFICIENCY EVALUATION

3.1. Economic and financial evaluation aspects of alternative energy sources investments

The main economic and financial indicators of ERS are: the specific investment (I_S) represents the specific cost of the investment, the cost of ERS on kilowatt-power investment capacity and the price of cost to produce renewable energy. (C_W) is calculated for the life time (duration) of equipments. Besides these there are exploitation expensive (maintenance, reparation), they are very different for existent technology of producing energy.

About Aeolian installations, the specific investment (the cost of the investment) I_S is determined by the cost of turbo generators and the cost of infrastructure (roads, backgrounds, electric connections). For present, the specific investment in Aeolian equipments is about 1,0 … 1,2 thousands Euro/kW. The possibility to reduce the specific cost regarding the enhancement of turbo generators performances. But the cost will be reduced in the future years because of technologic development.

The price of energy cost very depends on Aeolian resources and the placement of the equipment. The volume of produced energy for the equipment is proportionally with the cube of wind velocity. This means that an error by 10% in wind velocity can make 30% error in energy cost calculation. The price of Aeolian energy cost can be from 4 to 15 Euro/kWh. This represents a competitive cost with traditional energy sources cost.

Regarding other aspects, the expenses on year for maintenance or reparation are about 1,5 - 2,5% from the investment cost. The normal duration for utilization of these equipments is usual between 15 and 20 years. The medium value of duration for utilization the maximum power is between 2.000 and 3.000 h/year. Taking into account the externalities cost in the price of the cost for energy produced by traditional sources can change the Aeolian equipments competition radically in the favor of the last.

Another aspect is the external cost of the produced energy. Therefore, to produce energy by traditional technologies, electric stations burn fossil fuel, sending out more oxides (SO_2, CO_2, CO, NO_x) and pollutant powders. The nuclear stations harm people's health and entire environment life. Even after the end of functioning, these lands will become "tombs" and will be no more used. These external effects, leads to external costs that illustrate the real value of the damages or the needed economic effort for avoid these effects producing. From examples, the external cost of traditional energy sources is very increased. But, also, energy renewable sources have a negative impact over environment, but more under the traditional sources level. For instance, more powerful solar equipments need more land surface, with an opportunity cost. Aeolian equipments arouse more noises. Bioenergetics supposes cultures with negative effect over human health. The equipments to use the waste products send out the same pollutant as common thermoelectric stations. But a simple comparison between total cost of one kWh energy (exploitation cost + external cost) for traditional energy sources and renewable energy sources emphasize that the last ones are more competitive from cost aspects too.

3.2. The feasibility condition of an investment project

The main question that needs a real response is "does really worth to invest in ERS?" This response can be given only after a technical-economic-financial analysis. Like any investment project, an energy renewable sources investment project needs to be

feasible (justified by technologic, ecologic, economic, financial point of view), that implies a cost-benefit analysis. Therefore, the proposed project worth to be implemented even if the expected effects surpass the realized efforts (relation 1 and 2), with other words, when there is a positive net effect (the general condition of economic feasibility of an investment project).

$$Expected\ effects \geq \Pr ogrammed\ efforts \quad (1)$$

Or

$$Net\ effect \geq 0 \quad (2)$$

Where

$$Net\ effect = Effects - Efforts \quad (3)$$

In the framework of an investment project, the efforts represent the total expenses during life of the project, effects represents total gross income, and net effect represents net income. So, a project becomes feasible if:

$$ATI > ATE \quad (4)$$

$$ANI = ATI - ATE \quad (5)$$

It results that:

$$ANI > 0 \quad (6)$$

Where:

ATI – represents actualized total gross income
ATE – represents actualized total expenses
ANI – represents actualized net income

Efforts and effects evaluation suppose to take into account following aspects:

- period of studying (life time of equipments T=10 … 20 years);
- actualization process using an actualization rate;
- opportunity cost;
- the reality of errors;

Cost/benefit analysis suppose a system of some indicators such as: actualized net income, internal efficiency rate, actualized total expenses, recuperation time (period) aso. The optimization of these methods consists in maximizing actualized net income, maximizing internal efficiency rate, minimizing actualized total expenses, minimizing yearly expenses, and maximum in safety of consumers' supplying.

3.3. Actualized Net Income

The most important aspect is profitability. This is measured using actualized net income. Therefore:

$$NI_t = TI_t - TE_t \quad (7)$$

Where

NI_t - represents net income estimated for year *t;*

TI_t - represents gross income estimated for year *t*;

TE_t - represents total expenses (costs) estimated for year *t*, including investment costs (I_t) and exploitation cost (C_t), exclusively the amortization sum.

$$TE_t = I_t + C_t \tag{8}$$

For energy source the gross income (TI_t) represents the gains obtained from process to produce energy.

$$TI_t = W_t \cdot C_W \tag{9}$$

Where:

W_t - represents the volume of produced energy

C_W - represents the opportunity cost for one kWh of produced energy.

Furthermore, actualized net income (ANI) represents yearly benefit. For the period of time we study (the life time of energy equipments – T) it is determined by adding yearly actualized net income:

$$ANI = \sum_{t=1}^{T} NI_t (1+r)^{\theta - t} \tag{10}$$

Where:

T – represents the period of time of the investment;
r – represents the actualization rate (inflation rate or debt rate)
θ - actualization year

Using equation (10) in (7) we obtain this equation (11) and (12):

$$ATI = \sum_{t=1}^{T} TI_t (1+r)^{\theta - t} \tag{11}$$

$$ATE = \sum_{t=1}^{T} \left(I_t + C_t\right) \cdot \left(1-r\right)^{\theta - t} \tag{12}$$

For a ERS project with initial investment cost I_0, the period of time T, ANI is:

$$ANI = \sum_{t=1}^{T} \frac{CF_t}{(1+r)^t} - I_0 \tag{13}$$

Where:

CF – represents cash-flow, numeral flows foreseen.

If

$$CF_1 = CF_2 = ... = CF_T \tag{14}$$

Then:

$$ANI = CF_t \frac{1-(1+r)^{-T}}{r} - I_0 \tag{15}$$

ANI is one of the most important efficiency indicators in market economy, where to obtain a more and more profit is a main objective for investors. In this context, a solution for optimization the profitability of an ERS project is to maximize ANI criterion.

4. CONCLUSIONS

Sustainable development assurance determines increasing the human welfare and the ecosystems conservation, that suppose the integration of economic, social and environment objectives. These objectives cannot be achieved until the people will understand to enhance the mutual relationships and their relation with the ecosystem they live.

In order to conserve the energy and to give the possibility for future generation to have access to natural resources, because of the limitation of nonrenewable energy sources on Earth, it is very important to conserve our current supply, our damaging habits or to use renewable sources. Also, energy conservation is important because consumption of nonrenewable sources have impact on the environment (Barde, 1992). So, the use of fossil fuels leads to air and water pollution. For instance, carbon dioxide is produced when oil, coal, and gas is combusting (in industry systems, or car engines), and it acts in the atmosphere as a transparent blanket, that contributes to the global warming of the earth, or "greenhouse effect". There is the possibility that this global warming could significantly influence our weather with major impact on human health, environment (rising sea levels can damage coastal areas, also the vegetation can support more changes and could cause some plant and animal species to become extinct). Another effect of pollution is the reaction of water and oxygen and sulfur dioxide (emitted into the air when coal is burned, also) in the clouds and form precipitation known as "acid rain" with grave effects: killing fish and trees and damage limestone buildings and statues.

The lack of accord in strategies for conserve the environment, in technique and economic solutions are the main obstacles in integration the specified objective. It is necessary to establish some strategies to resolve unitarily the economic, social and environment problems, changing or enforcing the values, knowledge, technologies and institutions in order to preserve the inheritance and have what to give to our offspring.

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