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Socio-Economic and Environmental Impact of Renewable Energy

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INTRODUCTION

Continuously rising energy demand combined with increasingly limited natural resources are challenging energy suppliers, either for industry or consumers impose to rethink how we produce and use energy.

Renewable energy implies naturally replenished, It is energy which comes from renewable natural resources such as sunlight, wind, rain, tides, and geothermal heat. About 16% of global final energy consumption comes from renewables, with 10% coming from traditional biomass, which is mainly used for heating, and 3.4% from hydroelectricity. New renewables (small hydro, modern biomass, wind, solar, geothermal, and biofuels) accounted for another 3% and are growing very rapidly. The share of renewables in electricity generation is around 19%, with 16% of global electricity coming from hydroelectricity and 3% from other new renewables.

This article is a case study to present the socio-economc impacts of itroduction of reneable energy to replace the conventional feul sources. The later is a depletable natural resource and its usage cause much harmful impact on environment The conventional energy sources are petrolium oil and/or coal.

Environmental impacts of the renewable energy arise from the externalities of the individual projects that adopt such technology. Externalities could be positive (benefits) or negative (costs), however they are not considered through the regular market mechanism. These externalities refer to the utilization of the resources and the public goods, where not all economic agents act as price takers and not all economic agents have complete information. This condition is called a market failure. It is, also, due to that there are not well-defined private property rights in all inputs to and outputs from production and consumption activities..

Once, the prices emerging in markets cannot, generally, be taken to express the relative social valuations required for efficient allocation of resources. Then, there is a role for social appraisal of any approporiate technology package introduced to the economy. For example, establishment a factory in a small town definitely generates income to its enterpriser and could be appreciayed by the local community, as it provides some job opprtunities. Howevr, no body care about the pollution stems from somke of fuel compustion and/or the plant's disposal going to water, land or air. Thereore, the owner does not compensate the society for either the mordidity or the probable premature death due to pollution.

Replacement of conventional fuel for hydroelectrical energy to operate a certain processing plant creates external benefits as providing clean energy that will protect people from the probable premature death, due to the combustion of the conventional fuel. Therof, Inclusion of the environmental impacts in the project evaluation is a must, using the social appraisal by appling the cost benefit analysis. It is ,in its appropriate term, the procedure to concider the benfits and costs generated by the externalities of development. This does not assume that project appraisal can never proceeds based on valuation and aggregation at market prices. However, under the theme of the sustainable development, with its four dimensions (economic, technological, environmental, and human development) any conceivable project requires to be subjected to a cost benefit analysis. In words almost all projects include some of its consequences undrr either external costs or benefits, Where market prices are regarded as inappropriate and the cost benefit analysis should be applied using the appropriate social prices.

This study generates a case study model for social project appraisal that simulates the socio-economic evaluation of a depletable resource and environment protection from pollution effects. The model evaluates a project that generates an "environmental friendly electrical energy" using "Hydroelectric". The external costs avoided by substitution of non-polluting hydroelectricity for fuel-fired electricity are benefits to be attributed to the project, as are the depleted fuel resource savings. It was quantified in the model in terms of.:

Access a cheap clean rebeable source of energy,

Save a deplrtable natural resource (conventionl feul), and

Reduces the moebidity and/or premature death probability of the local community.

It alo, preserves water for irrigating additional newly reclaimed land for agricultural production. Even though, the model in this study is restricted to evaluate to the feasibility and validity of the first three outcomes.

It should be mentioned that The applied appraisal model concerns the relative prices, rather than the absolute prices. If the general price level is constant, absolute and relative prices are the same. Therefore, in cost benefit analysis, any anticipated movements in the general price level, but not in relative price, should be ignored.

Direct Costs of Renewable Energy

The quantities of inputs, which are required during construction, at all stages, are valuated using market prices. It is assumed that in terms of inputs for construction, maintenance, and shutdown, the market prices are appropriate for social valuation. This assumption would not necessarily be appropriate in all conceivable circumstances. For example if the project was established on a "natural reserve region".

Estimates of the construction costs are $200 million for the first 5 years. The running and maintenance costs at market price reach $0.5 million a year over the successive 45 years after establishment. The average electricity output will be 6,570 GW//h. GW/h stands for gaga watt/hour. A watt is a unit of power, equal to 0.293 Btu "British Thermal Unit" per hour, which is the amount of energy required to raise the temperature of one pound of water one degree from 3 to 4UC. Giga stands for 10 watts. The planning assumption is to create such volume of electricity a year for 45 years. However, the investment costs are not fully allocated for electricity generation, it is mainly for saving water for additional aricultural establishmet.

Direct Benefit from saving the Conventional Fuel Costs

By building a hydroelectric plant the electricity supply system reduces its fuel costs for meeting the given demand for electricity to the extent that output from the hydroelectric plant would be of zero fuel cost ,when displaced from conventional energy plant (oil) and allocated to hydroelectric energy. In practice, determining the quantities of savings of the conventional fuel attributable to the hydroelectric plant should involve the modeling of the entire electricity supply system.

Then the output from the proposed plant displaces oil, implied valuation of the depletable resource savings. The quantity of the saved oil input depends on the thermal efficiency of the burning power stations. A widely used ready reckoned factor as a conversion factor was used.

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External Benefit from Saving a Depletable Resource

The market price of petrolum oil is not the appropriate social valuation per ton of input saved. There are two reasons for this assumption: (1) petrolum oil is a non-renewable resource, (2) Burning petrolium oil to generate electricity, gives rise to external costs. The natural resources economic concept implies that such continuous consumption of a depletable resource (petrolium oil) would increase sharply its scarcity.

It implies that efficiency in inter-temporal allocation requires that the price of a non-renewable resource rises over time at a proportional rate equal to the interest rate, assuming constant marginal' extraction costs. Since the cost benefit analysis is concerned with efficiency in allocation, the value of coal saving in each year of the project's life should be at the price corresponding to efficient inter-temporal allocation.

Although, during the most probable outcome of this model, the price of petrolum oil rises at a proportional rate equal to the interest rate, in more detail model other dimetions should be considered. These are:

(a) The change in interest rate,

(b) The extraction costs, and/or,

(c) The vast new petrolum oil deposits that may discovered

The Coal price is assumed to rise annually at a proportional rate equal to 5 percent interest rate. The following equation is used to generate the annual coal price in the successive future years:

Pt = P0 (1+r) T.

Where, Pt = Coal price in the target year t,

P0 = the price in the onset year,

T is the number of years between P_0 and P_t

Therefore:

Pt = $40 (1+0.05) T

Avoidance of pollution is a positive externality

It is well known that burning conventional fuel to generate electricity gives rise to pollution problems especially atmospheric pollution. Qualification of arising benefit is so difficult. The atmospheric pollution from compustion of the conventional fuel such as petrolum products has adverse effects on material structures giving rise to corrosion and to the burden of required cleaning costs. it has also, adverse effects on plants and animals including man. In quantitative terms, most research attention has focused on the effects on human health. This is should not to be taken to imply that the other effects of atmospheric pollution due to coal combustion are trivial, but, clearly, there is much uncertainty involved. The impacts of acid-rain problem is a clear evidence.

considering human health effects, the estimating costs attributable to the burning of Solar fuel to produce electricity is two-stage process:

(1) To quantify the health effect:

Such stage includes much uncertainty and it requires a great deal of research effort. The health effects express increasing morbidity (disease incidence) and mortality due to fuel combustion. Relatively little is known about the former, accordingly, the study regards only here the probability of increased mortality as the only estimate that has significant published research output.

Estimate of health effect is based upon the mortality effects of the various pollutants emitted from conventional fuel combustion. Thereof, it was derived from the emissions from a typical one GW/h plant operating at 75% load-factor, which means that the plant is running 75% of the year.

The applied estimate was 80 extra deaths per year attributable to plant operation. However, the range of estimates for the excess mortality, attributable to such a plant, in the literature, was from 10 to 100 persons a year. Since there are 365 days in the year and *24* hours in a day, one GW/h plant operating at 75% load-factor sends out 6570 GWT per year. This is the estimated average yearly output of the hydro plant, which would mean 80 fewer premature deaths per year.

(2) Social valuation of Reduction in Mortality:

The second stage is Putting a value on human life. It is a difficult area for discussion. The basic principle here is as elsewhere that social valuation should reflect willingness to pay. Now clearly, if an individual is asked what he would be willing to pay to prevent his owns certain prospect death, his answer will be the largest sum of money on which he can lay his hands. However, development plans do not give rise to the prospects of certain life or death for specific individuals. Rather they give rise of decrease or increase in mortality rates of the whole populations, and hence to changes in the probability of death for individual members of that population. Individuals can and do make choices which involve changes in the probability of death, as for example, when they travel by car rather than walk in urban areas, demonstrating that they value time saved more than the increased probability of death. In principle, then, one can infer willingness to pay for changes in the probability of death from observed behavior. The implementation of this principle is difficult.

One approach, which has been adopted, is to look at wage rate differentials across occupations of varying degrees of riskiness. Other things equal, it is an observable fact that wage rates are higher for riskier jobs. Although few studies about this subject have been done, the range of variation in the values they estimated for a human life is rather large. Although it is a difficult and contentious problem, it is a vial appraisal for environmental impacts of development. Accordingly, it is impossible to be avoded.

If a project appraisal does not involve changes in the probability of premature death for members of the population of the beneficiaries, then it is implicitly ingnored valuing human life. The net benefit of such project does not consider premature death as social costs. It is in fact reflects the society willing to accept such net benefits as a trade off against the expected premature deaths of a certain numbers of its population. If the argument is that premature deaths cannot be traded off against benefits to society under any circumstances, it means that this project should be rejected, what ever the large net benefit is. As positive way of thinking to pay an amount of funds accepted by the society to protect population from premature death attributed to the project implementation, such it should be less than the project's net benefits.

The study used an average across countries and across occupations, of the increase in the annual wage due to the probability of premature death, although the range of variation in the estimated values is rather large. Thereof, the study derived an adjusted scale that deffrintiate between the skill requirements and unpleasant working conditions.It is that an increase in the risk of premature death of 0.001 in the probability of premature death is associated with an increase in the annual wage of $100 (the literature estimates ranged from $28 to $5,000). It is assumed that this $100 is the compensation required by a typical individual for an increase of 0.001 in the probability of premature death. Therefore, the total willingness of 1,000 people to pay for a 0.001 reduction in the probability of death would be $100,000. Consequently, it means one fewer premature death. Then $100,000 would be taken as the social valuation of the saving of one life.. Accordingly, for 80 expected premature death attributed to the fuel compustion for 1-GW/h of electricity production, means $8 million dollars a year.

Summary & CONCLUSION

The study provides the basic parameters and technical coefficients of the cost benefit analysis model for the socio-economic and environmental impact of introducing a renewable energy source (Hydroelectric) that replaced the conventional depleted fuel source. The study applied this model for quantitative profile of the socio-economic and environmental impact as net present value of replacement the conventional depleted fuel for a renewable energy source. It shows that the avoidance of premature mortality is the main source of benefits, even though it is an external benefit, which in most feasibility studies is ignored

Table 1 Basic Parameters and Technical coefficients of the Cost Benefit analysis Model:

Technical Coefficient	Value	Unit
Running costs/year	0.5	Million $
Reckoner conversion factor	500	Tons
Electricity out put/year	6,570	Giga Watt/h
Reduction in conventional fuel burn/year	2.628	(000) tons
Price/ton of coal	40	$
Interest rate	5%	%
Load factor of electrical plant	75%	%
Plant operating capacity/hour	1	Giga Watt/h
Premature deaths per year*	80	Person
An increase in the annual wage due to the probability of premature death	100	$
The social valuation of the saving of one life	100,000	$

Table 2 A Profile of the Cost Benefit Analysis of Utilization of the Renewable Energy

Item	Present Value
Fuel savings*	3.379
Pre Mature Mortality Reduction	111
Total benefits	114.379
Costs of Hydroelectric Energy	19.2
Net Present Value	**95.179**
B/C Ratio	**5.96**

* such value includes not only the direct cost but also the additional external costs which reflect the depletion charctristic of th conventional fuel (Petrolim or Coal) as a natural resource.

REFERENCES

Abelson, P., (1979) "Cost Benefit analysis and Environmental Problems" Saxon House Press, UK

Ashley, H. Rudman, R., and Whipple, C. (1976) "Energy and Environment: a risk-thought" Longman press. Sydney, Australia

Collard, D. Pearce, D. W. and Alpha, D "Economics Growth and Sustainable Environments" Macmillan Inc, New York

Common, M., (1988) "Environmental and Resource Economics: An Introduction, Longman Inc., New York

Ferine, J. and Pitkethly, A. S., (1985) "Resources, Environment and Policy" Harper and Row Press, New York

Ministry of Agriculture and Land Reclamation of Egypt (1994) "New Land Development Study" Conducted by Social Studies Consulting Institute and Sponsored by US AID of Cairo

Ministry of Irrigation and Public Work, Egypt (1994) "Unpublished Reports and Studies"

Ibrahim Soliman (1995) "A Model for the Appraisal of the Environmental Impacts of the Projects "Proceedings of the Fifth International Conference on "Environmental Protection Is A Must", P. 536-555, Organized by the National Institute of Oceanography and Fisheries [NOF], United Scientists For Projects and Development [USPD],Social Development Fund [SDF],Europe-Arab Cooperation Center [EVA.], Alexandria on 25-27th of April.

REN21 (2011) "Renewables 2011: Global Status Report". p. 17 and 18 http://www.ren21.net/Portals/97/documents/GSR/GSR2011_Master18