



Power Plant Economics- The Analysis of Social Cost Benefits at Power Plants

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Abstract: Capital is the limited resource in a developing economy like India and must be invested with utmost care. It is a true fact that development of the financial sectors of our country must analyze the overall social cost benefit implication of their investment decisions. This Social cost benefit analysis accounts as a tool used to evaluate a project with respect to the overall society. It indicates the total costs as well as the benefits which the society may endure by the establishment of the proposed project. It governs the feasibility of a power project with respect to sum of economic cost and overall economic benefits. This review paper focuses on the application of Social Cost Benefit Analysis using UNIDO approach on thermal coal based power plant and a hydro power plant and motivates to emphasize on the overall social costs and benefits linked with each power project. It highlights the comparison in between the coal and hydro power projects. The paper suggests several steps that can be taken to make the projects more lucrative.

Keywords—Keywords: Social Cost Benefit Analysis-UNIDO Approach, Coal Plant, Hydro Plant, Power Project

I. INTRODUCTION

Social Cost Benefit Analysis is a study of a power project in term of its feasibility as per the society norms for the evaluation of the proposed project to analyze if this project will provide benefit or extra expenses to the society. So it is a scheme that judges the economic and social viability of a project especially public expenditure project or donor-led programs.

This Social Cost Benefit Analysis model depends upon the welfare economics theory, which states that the society welfare is dependent on the individual utility levels of all members of that society. Today SCBA has become important for private project or investments because there is a chance for this kind of projects to bring adverse impacts on the society. SCBA helps in the evaluation of individual power projects during the planning framework that emphasizes our national economic goals and broaden the resources distribution across different sectors. Hence the social costs benefit analysis is a powerful tool for the comparing of economic alternatives.

II Basic Difference in between CBA and SCBA:-

A project must emphasize on three basic aspects:- Financial, Economic, and Social Appraisal.

a. The Financial Appraisal- it basically governs the money produced by the power project and its direct costing as per the price in the market.

b. The Economic Appraisal- it balances the overall costs as well as profits, that include several indirect consequences of the power projects those are not counted in the cost estimation.

The Social Appraisal- It basically calculates the distribution effects of the project choices at both of the intertemporal time levels (i.e. its effect over a certain time period, today and that in future)

The CBA could perform the financial appraisal just for the project evaluation, whereas, SCBA is capable of performing all the three given appraisals for complete project estimation and judgment.

III Rationality of SCBA:-

In the Social cost Benefit Analysis scheme, our basic focus is over the social cost as well as profits of the project. The difference lies in between the monetary costs and benefits of the power project. The main sources of differences are:-

- Several Market Imperfections:-
The common market imperfections found in developing countries are:
 - (i) Rationing,
 - (ii) Prescription of minimum wage rates, and
 - (iii) Foreign exchange regulation.
- Various Taxes levied and Subsidies offered
- The focus over maximum Savings.

Objectives of SCBA:-

The main objective of the social cost-benefit analysis approach is to provide adequate security and to achieve the value of money in the economic life by calculating the total costs and benefits of alternative economic choices and by selecting such an alternative that offers the highest net profit. So, it can be generalised that the main focus of Social Cost Benefit Analysis is to calculate:-

- a) The Economic benefits of the power projects in terms of a monetary price that reflects its social value.
- b) The effect of the power project on the level of savings and investments in the society;
- c) The effect of the project on the complete distribution of the income in the society.

IV Methodology

The UNIDO method used to determine the Social Cost Benefit Analysis as governed by the United Nation Industrial Development Organization (UNIDO) was initially applied to the thermal coal power plant as well as a hydro plant.

UNIDO APPROACH:-

UNIDO Approach is a five stage methodology:

1. Calculation of financial profitability measured at market prices.
2. To obtain the net benefit of the power project estimated in terms of its economic prices.
3. Adjustment for the Impact of the project on savings and investment.
4. Overall impact of the project on total income distribution.
5. Adjustment for the impact of the project on merit goods and demerit good.

1. Estimation of Financial Profits Measured at Market Prices:-

A proper technical and financial analysis must be done before a meaningful and economic evaluation can be done. Due to this reason, financial profits are compulsory in all cases.

The Financial profits produce an estimate of the power project's financial profit or the net present value of the project when all inputs and outputs are measured at market prices. The first step in stage one is to complete standard tables of income statement, balance-sheet and cash-flow. The Cash flow statement is also important here as the financial income statement only shows the annual profit and disguise investment.

2. Estimating the Impact of the power projects on Savings and Investment:- Many developing countries are facing the capital scarcity. So, the government of the countries are worried about the effect of a project on savings and its value.
3. To Obtain the Net Benefit of the Project Measured in Terms of Economic costs.

Second step of the UNIDO approach is focused on the determination of the net benefit of the project in terms of economic prices, also referred to as shadow prices. Market prices represent shadow prices only under conditions of perfect markets which are almost invariably not fulfilled in developing countries.

4. Adjustment for the Impact of the Project on Income Distribution:-

Many governments regard redistribution in favor of economically weaker sections or economically backward regions as a socially desirable objective. Due to practical difficulties in pursuing the objective of redistribution entirely through the tax, subsidy, and transfer measures of the government, investment projects are also considered as investments for income redistribution and their contribution toward this goal is considered in their evaluation. This results in weighing

the net profit or loss by each group, measured earlier, to reflect the absolute value of income for different groups and by adding them.

Determination of Weights:

If there are only two groups in a society, poor and rich, the determination of weight is just an iterative process between the analysts and the planners. This is called "bottom-up" approach. The marginal utility of income is the weight attached to an income is

$$W_i = (b/c_i)^n$$

Where, w_i = weight of income at c_i level c_i = level of income of group i

b = base level of income that has a weight of 1.00 n = elasticity of the marginal utility of income

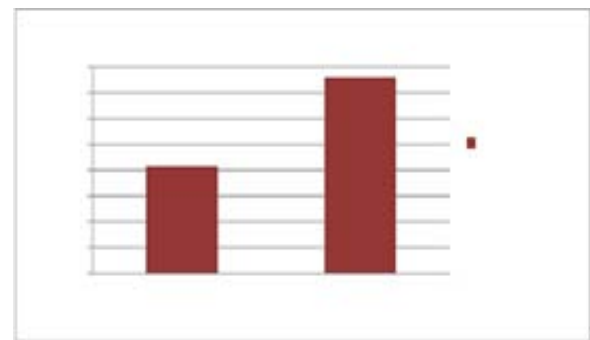
5. Adjustment for the Impact of the Project on Merit Goods and Demerit Goods:-

- Estimating the present economic value
- Calculating the adjustment factor
- Multiplying the economic value by the adjustment factor to obtain the adjusted value
- Adding or subtracting the adjusted value to or from the net present value of the project as calculated in stage four.

Comparative Analysis:-

Government Savings of Unemployment Allowances:-

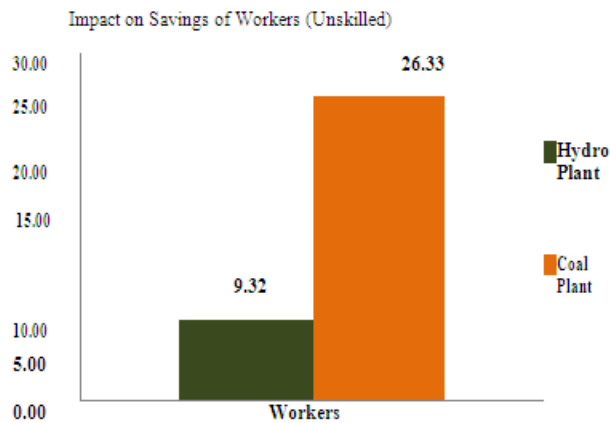
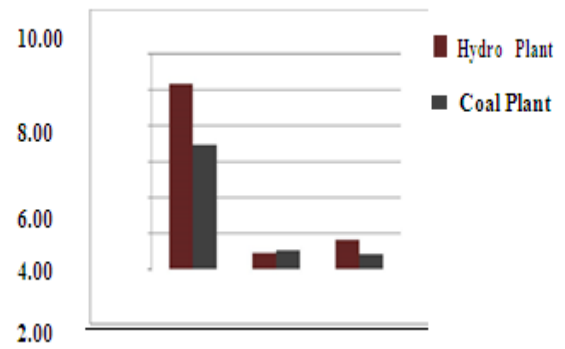
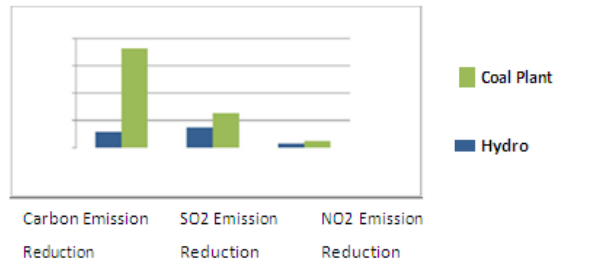
Govt. Savings of Unemployment Allowances



Coal plant Hydro plant

It can be observed from the above graphical data that the government savings and allowances are much higher for the hydro based plants as that compared to the coal plant. This could be led to the fact that many workers are strucked during the construction of hydro power plants. Also, the average wages are assumed to be same for deriving the above results.

Present Value of Emission Reductions



Income Distribution Impact

Workers (Unskilled) Government

Government, NTPC and Workers from both the plants, but the income re-distribution is more pronounced for workers in case of hydro project which is more desirable as income re-distribution concept aims at maximizing the benefits to the weaker income group of the society.

It is clearly evident from above graph that emission reductions are more in case of hydro plant as compared to coal based power plant. The above graph justifies that obvious fact Carbon, SO₂, NO₂ based emissions are very less for a hydro plant than that present in a coal plant, thereby savings are much more in a hydro power plant.. Also, NTPC could make use of decreased emissions from the above plants as emission reduction certificates that could be traded-off with plants whose emissions increase the basic threshold values, thus eliminating the emission norms as a whole.

So the Hydro power plants provides much more benefits as that compared to the Coal based power plant and more focus should be given to development of hydro projects as our country has huge hydro potential and only 25% of it has been explored so far.

The graph shows the impact on savings of workers. It is observed that the overall gains to the workers is achieved from both the plants, but the net gains in savings are more influential in case of coal plant as coal plants generate more employment opportunities for workers as that compared to the hydro plant.

Suggestions:-

- Social Cost Benefit Analysis should be a part of project assessment for projects whose merit needs are more i.e. whose social value exceeds the economic value for instance, electricity.
- By the determination of the social costs and benefits of the socially acceptable projects, several companies could eventually land up with a very low interest rate for financing the power project.
- Coal Washing should be made mandatory for Coal India as currently only 4% of total domestic coal is washed by Coal India. This would result in the reduction of overall will ash content thus causing reduced coal consumption in thermal plants and the use of reduced tariffs for end consumers.
- NTPC should go for manufacturing fly ash bricks at their thermal plant sites or could sell the fly ash produced to the fly ash brick manufacturers thereby leading to efficient utilization of ash and generation of employment.
- NTPC should search different energy efficient methods for reducing water consumption in the thermal plants. For instance, using dry or hybrid cooling technologies in place of traditional wet cooling towers would reduce the water consumption by about 30% - 40%.
- The handling of Wet ash handling by the slurry should be adjusted to dry ash handling by using hydro-bins which separates the water from the ash slurry within the plant and the dry lumps are conveyed to the

ash dykes through conveyer belts. This would significantly reduce the amount of water consumed in ash handling units.

- The Government and power generation utilities like NTPC shall make some advancements and efforts for the betterment of hydro power projects as India has a hydro potential of about 1,48,701 MW of which only 25% i.e. 36878 MW has been utilized so far.

- Wastewater should be treated and recycled to achieve zero discharge and savings on freshwater intake.

- The basic shadow prices of different inputs and outputs used in the power projects must be benchmarked in order to avoid flaws and biasing in the calculation of the economic costs and benefits.

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