THE METHOD OF ESTIMATING INVESTMENT DECISIONS EFFECTIVENESS IN POWER ENGINEERING

Waldemar Kamrat

Technical University of Gdańsk

Poland

Summary

The paper presents a proposal of a new concept of estimating investment decisions effectiveness. The proposed model can be used in evaluation of power plants investment effectiveness.

Key words index: Energy Economy, Power Engineering, Making Decisions Process

1. Introduction

The results of research concerning the capital expenditure on building and modernization of power plants have been presented in paper. The introduced model of investment effectiveness evaluating covers the well-known annual costs model, which became complete by investment risk cost. One usually hears risk defined as the chance of loss, and this definition fits with the negative connotation of the term. Nevertheless, a better definition is to say that risk is synonymous with uncertainty. When risk is equated with uncertainty, it logically follows that it is time-dependent: uncertainty always grows, the farther we project an estimate into the future.

For example, we feel reasonably confident in estimating next month's inflation rate within narrow limits, but our estimate for next year's surely needs expanded limits to afford us with same confidence. And the rate five or ten years in the future shrouded in virtual darkness: uncertainty is total.

2. Modified Annual Costs Model

Planners and decisions makers must deal with a set of complex problems when assessing investment decisions in the power sector. These problems have the following characteristics:

* a broad range of options, including demand-side options as well as traditional generation,
* a high degree of uncertainty associated with many of the main planning parameters, such as demand growth, capital costs, fuel prices,
* a multiple and often conflicting objectives.

Te traditional power planning approach emphasized a single economic objective, i.e. to minimize cost. However, there is increasing awareness and understanding among policy makers and planners of other effects associated with power investment decisions, such as on environmental quality.

Power planning, as well as the planning of many other sectors, is a multi-option, multi-objective decision process carried out within an uncertain environment. The decision process involves assessing conflicting objectives, such as economic development, financial viability and environmental protection, to find plans where the trade-off between these objectives is reasonable, i.e. to find an acceptable compromise solution.

Annual costs can be calculated by formulae:

$$K_a = K_f + K_v \, , \qquad (1)$$

where:

* K_a - annual costs,
* K_f - annual fixed costs,
* K_v - annual variables costs

Annual fixed costs K_f sum annual capital carrying charges that are computed by applying the levelized capital carrying charge rate to the total capital requirement and annual fixed operating costs.

3. Effort of forecasting the investment risk factor for power plants

This factor was created on the basis of the application of some elements of taxonometric method with a high level of estimation probability. All characteristic features of this method can be found in previous author's publication. This report is limited only to the most important problems. The essential problem is the selection of the risk investment variables. The proposed model can be used with the series of variables x_j that are variables of following types:

* economic,
* financial,
* technical,
* social,
* political,
* legal

The investment variables from mentioned above groups create a multidimensional space. For series of typical power plants, a so-called "ideal" model of the power plant is created (taking into account, e.g., capacity, type, fuel used). One point in the above mentioned multidimensional space represents a power plant.

For the evaluation of the investment risk factor of the i-th plant, a multidimensional risk factor is created. It can be expressed as:

$$e_i = 1 - \frac{d_i}{\|D\|} \qquad (4)$$

where:

$$d_i = \sqrt{\Sigma_{j=1}^{m} (x_{ij} - q_j)^2} \qquad (5)$$

* x_{ij} - standardized value of j-th variable at i-th power plant in the series and
* $\|D\|$ - expresses maximum distance between extremal (min., max.) power plants in the given series of such plants:

$$\|D\| = \sqrt{\Sigma_{i=1}^{m} (p_j - q_i)^2} \qquad (6)$$

Total Capital Requirement (TCR) consists of following costs:

* total plant investment (including allowance for funds used during construction),
* prepaid royalities,
* preproduction costs,
* inventory capital,
* initial cost for catalyst and chemicals,
* land

Annual fixed operating costs cover operating and maintenance labour and materials and overhead charges.

Annual variable costs (K_v) consist of consumables (the cost of steam, electricity, water, chemicals, waste products, that are consumed in proportion to unit operation) and byproducts credits.

All characteristic feature of evaluating the annual costs can be found in previous papers [4,5,6,7]. In this paper author gives a modification of formulae (1) by adding annual risk costs (K_r), which should be evaluated before-and during power plant construction.

Now modified annual costs can be expressed as:

$$K_a = K_f + K_v + K_r, \qquad (2)$$

where:

* K_r - annual risk costs

The annual risk costs can be calculated by formulae:

$$K_r = e_i * K_{od}, \qquad (3)$$

where:

* e_i - investment risk factor,
* K_{od} - levelized capital investment

The selection of the decision variables can be carried out according to the standards typical for the specified concrete investment conditions (e.g., for the specific conditions).
The values of the synthetic risk factor e_i lie within $< 0,1 >$ limit and make it possible to rank the planned plants in the series according to the estimated level of risk (the investments are ranked in the descending order, i.e., the investment with the lowest value of e_i is ranked as 1, etc.).
The range of investment risk factor $e_i \in < 0,1 >$ can be divided to five of risk groups: A,B,C,D,E as below:

*	$A \in < 0,0 ; 0,2)$	(lowest; very good),
*	$B \in < 0,2 ; 0,4)$	(below average; good average)
*	$C \in < 0,4 ; 0,6)$	(average; average)
*	$D \in < 0,6 ; 0,8)$	(above average; poor average)
*	$E \in < 0,8 ; 1,0 >$	(highest; bad)

From this can be concluded that if closer to 1 is value of e_i than more risky is the i-th power plant investment. The procedure enables the ranking risk of investments that are extremaly important in the conditions of limited resources. The major issue here is the value of expected level of profitability from the investment.

4. Conclusions

- The presented method is effort to performance of the difficulty level when it comes to the decision on investment

- The method can be useful for the sectoral research/investigations on investment effectiveness in different branches of industry

- The method can be useful for evaluation of risk investment in power engineering