# THEORETICAL APPROCHES REGARDING THE EVALUATION OF INVESTMENT PROJECTS FOR GREEN ENERGY BASED ON REAL OPTIONS ANALYSIS

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***Abstract:*** *This article considers real options and their importance as an alternative assessment for green energy infrastructure investments. Article foregrounds methodology of real options and financial options theory as a tool frequently useful. Based on the concept of choice, the article deals with investments through the concept of option and argue their usefulness. Furthermore, the paper summarizes the advantages and disadvantages of real options and the risks involved in strategic planning context; It proposes ways to address and simulation models.*

***Cuvinte cheie:*** *Real options, investment decisions, simulation models.*

***J.E.L. Classification :*** *H54, R42, Q13, P28, Q56.*

## 1. Introduction to evaluation based on Real Options Analysis [5]

Real options methodology introduces a very useful approach to help in making decisions, taking into account all financial knowledge. It will allow to manage the margin of doubt in the evaluations. Financial Option Theory is a very common and useful in financial and commodity markets and options theory developed on this basis. One option [1] is the right but not the obligation, to take action in the future, and its value depends on the level of uncertainty. Based on the concept of option we ask what is the investment approach of real options method.

Real options are comprehensive and integrated solutions (using financial theory, economic analysis, management science, decision science, statistical and econometric modeling) to apply options theory of investment projects, to improve the decision-making process. A dynamic and uncertain business environment requires flexible approach to business decision in order to evaluate business opportunities. The higher the complexity of a project is, the more useful it becomes the real options approach. Real options are connected through different types of business by investment situations.

Strategic planning [11] requires flexible and dynamic approach. Present value calculations are needed for a strategic review under the standard techniques for determining discounted cash flows will tend to understate the option value attached to profitable business growth. Decisions on innovation initiatives require real options approach. This approach is not always necessary, given that decisions are not complicated.

Traditional tools such as discounted cash flow works well when there are not significant options or when uncertainty is very small. On the other hand, the analysis of real options may be useful when [7], there is no alternative way of accurately may determine the type of shot, the uncertainty is sufficiently large, and the pending investment is more sensitive to information, thus avoiding irreversible regret investment if the value seems to be caught in future growth opportunities rather than current cash flow when will be project updates and corrections to the strategy map .

From the foregoing, we identify a number of advantages of real options that allow the development of dynamic analysis, integration in project evaluation and time value of flexibility, defining optimal decision taken in innovation projects, simulation and incorporating of evaluation management decisions in project, simulation of decision-making process over the life of the project.

## 2. Solving real option

There are several ways to calculate the value of an option [5]. For applications where the input elements are appropriately structured, all methods will give similar results. From some general methods to obtain a solution we remember Partial Differential Equation Approach (PDE), which equals the change in value of the option with the value portfolio change, with optimal simulation approach of value strategy from the decision macking for thousands of possible outcomes and dynamic programming approach which setting the possible outcomes of the future value of the optimal strategy.

## 3. Simulation models

### 3.1 Monte Carlo model

Simulation models launched hundreds of possible evolutionary paths of the underlying asset from today until the final decision. Typically it is used Monte Carlo model [7] which determines the optimal investment strategy, at the end of every possibility determining the calculated gain. The current value of the option is found by averaging the rewards and then by updating the media back to the present. Furthermore, the inclusion of new uncertainty sources in a simulation analysis is less cumbersome than using numerical methods.

### 3.2 Dynamic programming and binomial evaluation of option

Dynamic programming solves the problem of optimal decisions when the current decision affects future rewards. This method gives the possible values of the underlying asset when the option is active, and then generates the best decisions in the future.

Dynamic programming is based on Bellman's principle [3] which defines an optimal strategy as a strategy that would be chosen if the entire analysis should begin in the next period. Solution solves the optimal strategy in a recursive way, discounted cash flows and values and their stowing in current decision. Thus, an optimal solution can be guaranteed.

Dynamic programming can handle complex decision structures (including constraints), several relations between the option value and the underlying and complicated forms of leakage, such as those that vary over time. These advantages are present in the binomial model of option valuation. Binomial model [3] for evaluation of the option is based on a simple representation of the value and the evolution of the underlying asset. Each time the underlying asset can take only one or two possible values.

**Making optimal decisions using real options method**
**Figure no. 1 – Assessment of Innovation Projects**




Source: Borison A., *Real Options Analysis: Where are the Emperor's Clothes?, Stanford University,* Presented at Real Options Conference, Washington DC, July, 2003.

Each innovation project should be different from the others, according to various media, technologies, objectives etc. This does not mean that a common structure could not be applied to any project - in fact, they usually follow the same sequence of steps[5]:

- Pre-project: design project phases, milestones, calendar, goals etc.
- viability studies: financial evaluation model, rate of return etc.
- Initiation: choice energy pilot plants, pilot projects, tests, etc.
- Performance: developing alternative strategies, plans etc.
- Transfer: sharing knowledge

The entrepreneur must identify, know and understand the various issues that may affect the development of innovation projects in order to manage the uncertainties and risks. Some key points [5] must be taken into account:

- Identify key variables: income, costs (investment and expense), volatile energy prices (electricity, natural gas, oil)
- Understanding the potential development of the project, cash flow forecast, etc.
- Maintain an overall view of the project, phases and the steps of the project.

A financial study is needed to understand the economic implications of the stages of the innovation project. Each step must be represented by more than one possibility, although various possibilities are always available. In order to determine a decision tree [5], certain information and certain computations are to be taken into account:

- Revenue: revenue forecasts, financial relations with supplier, etc.
- Costs: initial investment costs, capital expenditures, depreciation etc.
- Liabilities: Long-term loans, interest rates, debt etc.
- Estimates: net profit, working capital, cash flow, etc.

Building a decision tree helps to arrange earlier decision allowing a better management and intelligent design. Tree structure should be the result of a comprehensive understanding of the system that reflects the potential of innovative project development for each critical moment. Using previous results of financial study (NPV, probability, volatility), decision tree [5] should be constructed following the steps:

- Determination of the decision and the probability of decision nodes.
- Arranging for different decisions
- Assigning probabilities for each decision node and probability.
- Solving the decision tree

Results should be carefully studied as an important element in decision making. However, it should be noted that this process must be supported by knowledge in the innovation [8], the correct analysis of the market, and the common sense of the executive. Although the real options approach gathers important financial information, with management decisions, volatility and probable facts, it is a complete and comprehensive method to analyze any investment project.

Defining an assessment and control model is required using this methodology.[5]. During the application of real options approach may appear more things that could affect the final result, as follows:

- Control: tracking all numerical calculations, assumptions, technical assumptions and any other parts that may affect the proper development of the project.
- Rating: be implemented continuous monitoring at each stage to enable a dynamic model in which are possible changes in every moment for a correct final result. Receiving feedback and redesign the model on these conclusions, in order to obtain optimum results.

**4. Conclusions**

Innovation projects in the energy industry are characterized by high volatility in future cash flows. The contractor is obliged to face certain risks that innovation agencies in other sectors they can not assume their activities, and in addition to technical and technological risks related to all innovation processes, there are other relevant topics which should be taken into account. First, one aspect is the volatility of energy prices. Electricity, gas and oil are some of the products with the highest volatility. Innovation processes are profitable when the promoter decided to develop the project - however, future changes in energy market prices could have an impact on the rate of return. A second issue is the regulatory risk. Most innovation projects in the energy sector are affected by income, incentives and rules embedded in the regulatory framework (eg, renewable energy, improvements on environmental issues, transport and distribution). Continuous changes in the regulatory system creates great uncertainty about the development of these projects.A third aspect involves the acceptance of new solutions on the market. In some cases, new energy technologies involve changes in consumer behavior and needs of infrastructure development of ancillary services, and these requirements could be an impediment to innovation processes. Traditional financial methodologies analyzes the investment projects in terms of static, but nevertheless, innovation projects in the energy sector requires dynamic assessment.

When discussing risk is often interpreted as a reflection of the variability of potential outcomes of the project. The greater the change is, the higher risk involved. Generally speaking, the degree of risk that is associated with a particular asset is properly measured by the so-called covariance of benefits that are made, based on that package of goods, of which it is part. When we look at risk from this perspective, almost all environ mental projects are low risk or no risk because the majority of the projects benefits and costs are dispersed and uncorrelated, or have a negative correlation with respect to future revenues and other aspects of economic welfare. However, in a broader context, projects can become risky, and in this case the discount rate should be modified with additional risk that may reflect the uncertainties of the future.

However, the procedure is not a correct one because the discount rate reflects both the risk of future recovery and time to materialize it. So, in order to correctly calculate the risk of cost-benefit analysis, the first step should be to assess the risk of the project in terms of portfolio assets of the organization as a whole. For those investments without risk, the estimated benefits and costs will be subject to direct update using a risk free interest rate. Environmental investments raises a number of issues, which two are principal concerning actualisation rate: it's the very large time intergenerational implications, until appear the countless benefits non- quantifiable in monetary terms. More than that, analyszing the interest rate on very long periods of time can create various inaccuracies of wealth and its distribution to the several generations.

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