RENEWABLE ENERGY PROJECT APPRAISAL USING THE REAL OPTIONS METHODOLOGY

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Abstract

Renewable energy sources (RES) are characterized as clean forms of energy and come directly or indirectly from the impact of solar energy on the environment. The overall process of planning, designing, constructing, and operating renewable energy projects involves complex uncertainties and risks, which are difficult to analyze and evaluate effectively through traditional investment appraisal methods. Each RES project presents different types of uncertainties, which are categorized as external and internal. The Real Options (RO) theory for evaluating investments in RES projects can provide additional investment options at different stages of the projects, enhancing flexibility and improving the decision-making ability of a company's management.

This paper summarizes the specifics governing RES projects, the main characteristics of the RO methodology, and an overall framework for its application to RES projects. This framework is used to evaluate an investment in a 500kWp photovoltaic (PV) park in Greece. The uncertainties selected for the analysis of the RO methodology are the electricity sales price and the production from the specific PV project. In addition, the options/rights of the investor that are considered, are to continue or abandon the investment in each phase of the project implementation. The results, based on the current data and have included the possible fluctuation in the values of the two aforementioned uncertainties, show that investing in a PV project of similar size and technology in Greece is advantageous and worth undertaking. The intention to finance a large proportion of the investment by the banks plays an important role in this.

Keywords: project appraisal methods, real options theory, renewable energy projects, risk and uncertainty analysis, construction project management

JEL classification: R3, R5, R38,

1. Introduction

In recent times, the developments taking place in the energy sector have been rapid, and energy has always been one of the most important factors for the socioeconomic development of various communities (Ongoma, 2017). At the same time, factors such as global warming and the need to reduce carbon dioxide emissions make are necessary to use cleaner forms of energy, such as Renewable Energy Sources (RES) (Chang, et al., 2013). Renewable energy projects, unlike conventional power plants, present complex uncertainties (Stratigea et al., 2011; Liu, et al., 2019), which can be categorized into internal (e.g. wind speed) and external (e.g. electricity sales price), and affect each renewable energy project differently (Papadaki, 2012; Cesena, et al., 2013). As a result, the use of traditional methods for evaluating investments in RES projects, such as Net Present Value (NPV), is not appropriate and does not include the changes that may occur in the regulatory frameworks governing these projects (Trigeorgis, 1993; Herath and Park, 2007). The Real Options (RO) method is recognized to enhance the value of projects under uncertainty and can provide investment options at the

individual stages of projects during a) planning, b) design, and c) commissioning (Cesena, et al., 2013). In addition, it provides a company's management with considerable flexibility and the ability to adapt to changes in the surrounding technology and market (Yeo and Qiu, 2003).

In this paper, the theory of RO and its application for the evaluation of an investment in a 500kWp photovoltaic (PV) project that can be built in Greece is presented. The influence of two main uncertainties prevalent in renewable energy projects, namely the selling price of electricity and the variation in the production of electricity from the PV park in question, is examined. Finally, two options that an investor has, through the RO methodology, for continuing or abandoning the project, in each of its implementation phases, are analyzed.

The remainder of this paper is structured as follows: In section 2 a brief reference is made to the main characteristics of RES projects and the methodologies for evaluating investments. Then, the main concepts of RO methodology and the most important techniques for its exploitation are analyzed. In the third section, the most recent applications of RO theory to RES projects are listed from the existing literature, taking into account the main uncertainties arising from the various environmental and policy regulations, which have been widely implemented in many countries. Then, a concrete framework for the application of RO theory that has been implemented in a hydropower project in Indonesia is presented. The fourth section includes the case study, where the RO methodology is applied to evaluate an investment in a 500kWp PV power plant in Greece. Finally, in the fifth section, the conclusion is given.

2. Literature review

Project appraisal is a key element of investment planning, both at the national and regional level (Alexiadis and Ladias, 2011; Myakshin and Petrov, 2019; Pnevmatikos et al, 2019; Polyzos and Sofios, 2008, Polyzos, 2019). It has a major significance for projects related to solving the energy problem, the size of which is constantly increasing. The origin of RES is mainly based on solar energy, which is directly or indirectly harnessed to create various forms of renewable energy (Perdios, 2011). Renewable energy includes bioenergy, solar, wind, ocean, geothermal, and hydropower (Owusu and Sarkodie, 2016). RES projects include three features: Firstly, the viability of each project relies to a significant extent on the sale price of the energy produced, an uncertainty that is not in the full control of the investor. Secondly, the use of natural resources for energy production is subject to considerable risk, as their supply is not stable and varies throughout the life of the project. Thirdly, due to the particular expertise required to complete the construction of renewable energy projects, it is usual to conclude single contracts between investors and contractors, which together comprise (a) engineering study, (b) procurement of equipment and materials, and (c) construction of the project (EPC). All of the above characteristics shape the risk profile of RES projects and need to be carefully analyzed when making financial and investment decisions (Mun, 2002; Chang, 2013).

Every business needs to realize successful investments, since on the one hand, they include any benefits, costs, or sacrifices, and on the other hand, they are a milestone for its sustainability and future course (Nijkamp, 2011; Polyzos, 2018; Polyzos, 2019; Arkhipova, 2020). Businesses usually apply static indicators and methodologies for the financial evaluation of projects, using discounted cash flows and realizing calculations such as NPV and internal rate of return (IRR). In these types of approaches, there is an assumption that revenues, costs, and taxes are not subject to change, and a specific project schedule and budget is followed from the beginning to the end of the investment (De Abreu and Neto, 2008). For the most part, the investments of any company involve risks, so their basic evaluation is mainly carried out under conditions of uncertainty (Polyzos, 2018). Although many managers consider uncertainty as a problem that should be avoided in business, instead, uncertainty creates value and can lead a firm to market leadership (Amram and Kulatilaka, 1999). Utilizing investment appraisal through RO, the value of learning and additional information acquisition is recognized. Consequently, the decision on the total investment need not be made immediately, but instead, the opportunity is given to wait for the investment to be completed until the uncertainty at hand is resolved (Leslie and Michaels, 1997). RO theory is based on the same principles that underlie financial options and includes the ownership of real and existing assets (Frayer and Uludere, 2001). An option is the right, but not the obligation, to take action in the future and is characterized by nonlinear returns that are appropriate in

complex and sophisticated environments (Amram and Kulatilaka, 1999; Kogut and Kulatilaka, 2001). Seven different types of options can be exploited (Trigeorgis, 1996):

- The option to delay investment.
- The option of staging, where an investment or a large project can be divided into sub-phases.
- The option to grade an investment, retaining the flexibility to expand or shrink a project during its design or operation.
- The option to abandon an investment, preserving the ability to obtain salvage value.
- The option to change the use of a project.
- The option to terminate and restart a project.
- The option to develop an investment, where a variety of possibilities for future opportunities are created.

The main types of options include the American and the European options: The American option can be exercised at any time until expiration, while the European option is only exercised at expiration (Cox and Rubinstein, 1985). Actual projects are closer to American options as they can be expanded, delayed, or stopped if conditions are not favorable and their value is not optimized (De Abreu and Neto, 2008). Three main techniques are available for the evaluation of options: (a) partial differential equations; (b) simulations; and (c) lattices. The methodologies included in the partial differential equations (Miyata, 2012) are the Black-Scholes model, numerical methods (such as finite differences), and analytical approaches. Simulations (Shibusawa and Miyata, 2011) include a Monte Carlo approach, and the lattices (Tsiotas, 2017, Tsiotas and Polyzos, 2018; Tsiotas, 2019, 2021) can have a binomial, trinomial, or polynomial structure (Kodukula and Papudesu, 2006).

3. . The Real Options method in renewable energy projects

The main studies on investment in RES projects started in the early twenty-first century and differ from each other depending on the emphasis on the analysis of the value and time of investment and the impact of uncertainty factors (Liu et al., 2019). In the existing literature, the application of the RO method to RES projects has focused more on hydropower, wind, and PV projects. For hydropower projects, the most recent publications include applications of RO, examining as main uncertainties the certified emission reduction price, the generation and sale price of electricity, and the project's operation and maintenance costs (Kim et al., 2017b; Lee et al., 2013; Zavodov, 2012; Khryseva et al., 2018). For wind projects, the most recent applications of RO analyze as main uncertainties the generation and sale price of electricity (Stratigea and Grammatikogiannis, 2012; Boomsma et al., 2012; Reuter et al., 2012; Abadie and Chamorro, 2014; Kroniger and Madlener, 2014). For PV projects, the main uncertainties studied in recent articles include electricity generation and sale price, the borrowing rate, and the risk-free rate (Kim et al., 2016; Jeon et al., 2015; Martinez-Cesena et al., 2012). In addition, several studies have analyzed the application of ROs to renewable energy projects, examining the impact of environmental regulations and government support frameworks to promote investments. The main factors of environmental regulations that have been considered are the fuel price with its corresponding demand and supply, the influence of the carbon price, the initial investment capital, the available technologies, and the market structure (Venetsanos et al., 2002; Herve-Mignucci, 2010). The most important determinants of the supporting regulations that have been analyzed are the fixed electricity sales price, the consumer price index, the total investment costs, and the general market situation (Yu et al., 2006; Reuter et al., 2012; Monjas-Barroso and Balibrea-Iniesta, 2013).

Kim et al. (2017a) proposed a framework for the application of RO, regarding the evaluation of an investment for the construction of a hydropower project in developing countries. This implementation framework consists of four main steps, as illustrated below.

Step 1: At the beginning, the project financing scenario is recorded, where the individual phases (such as planning, design, construction, and operation) are separated by their respective implementation periods, depending on the defined time of realization of the cash outputs by the investor.

Step 2: Calculate the project's financial flows and select the main uncertainties that can significantly affect the total investment. Then, the future financial flows of the project are estimated.

Step 3: Calculate the volatility of the project value through the three-point estimation method (pessimistic, most likely, and optimistic scenario estimation). More specifically, the authors used the market asset disclaimer (MAD) approach in combination with the three-point estimation method to calculate the value of the project through the present value of the most likely scenario of financial flows. The most likely scenario lies between the worst (pessimistic) and the best (optimistic) possible scenario. All three of these scenarios are derived from the respective combination (worst, moderate, best) of uncertainties that may occur over the lifetime of the project. Consequently, the volatility in the value of the project can be calculated from the following equation, assuming that the cash flows follow a log-normal distribution.

$$\sigma = \frac{\ln(\frac{S_{opt}}{S_{pes}})}{4\sqrt{t}} \quad (1)$$

Where:

S_{opt} and S_{pes} are the values of the project for the optimistic and pessimistic scenarios respectively, and t is the operation period of the project. Subsequently, the parameters of the options are calculated from the binomial structure of a lattice, for each phase of investment implementation.

$$u = e^{\sigma\sqrt{\Delta t}} \quad (2)$$

Where u is the up movement;

$$d = e^{-s\sqrt{\Delta t}} = \frac{1}{u} \quad (3)$$

Where d is the down movement;

$$q = \frac{e^{rt} - d}{u - d} \quad (4)$$

Where q is the risk-neutral probability and r is the risk-free interest rate or risk-adjusted discount rate;

$$C = e^{rt}[qC_u + (1-q)C_d] \quad (5)$$

Where C is the value of the option; and C_u and C_d are the values of the option associated with the upward and downward movements respectively.

Step 4: The above results are evaluated and a decision is made on whether or not to proceed with the investment for each separate phase of the project. The specific RO application framework will be used in the case study of the next chapter, for the evaluation of an investment in a 500kWp PV project that can be built and operated in Greece.

4. Application of the Real Options method to a 500kWp photovoltaic project

4.1. Basic characteristics of the implementation of the Photovoltaic park

This PV project of 500kWp is to be built in the area of Nea Magnesia, Regional Unit of Fthiotida, Greece, and connected to the local network of the Hellenic Electricity Distribution Network Operator (HEDNO). The available technologies for the construction of a PV station

are mainly based on the support system of the PV panels and the type of PV panels to be used. More specifically, there are the fixed support systems and the uniaxial or biaxial tracker, while the type of PV panels includes monofacial or bifacial, which generate energy from one or both sides respectively. In the case study, the fixed mounting system and the bifacial PV panel have been selected. The individual phases of the project implementation are presented in Table 1 and include the planning and preliminary design for the request for an offer of grid connection conditions from the HEDNO, the final design and implementation study of the project (in case the request for an offer of grid connection conditions is accepted by the HEDNO), the construction and operation of the project.

Table 1 Completion Time of the Individual Phases of the 500kWp PV Plant

Planning Period	1 Year
Implementation Study Period	1 Year
Construction period	1 Year
Operational period	20 Years

The most important uncertainties that occur in similar projects in Greece have been identified to be the borrowing rate, the risk-free interest rate, the inflation, the bid price of the terms of connection to the HEDNO network, the fluctuation in energy production, the selling price of electricity, the cost of supply of PV panels and the total cost of construction of the project.

4.2. Application of the Proposed Real Options Methodology

In this case study, the uncertainties about the annual electricity production and its selling price are analyzed. The reason why these two variables were chosen is that power generation is one of the main factors for the choice of design and technology of renewable energy projects, while the selling price for similar-sized PV parks can be secured through various options. These options for an investor are to contract for (a) a fixed and predetermined price, (b) a fixed price determined through a tender for all RES projects, and (c) a variable price resulting from participation in the wholesale electricity market model (target model).

Table 2 lists the values that the two variables can take for the three scenarios (worst, medium, best). Regarding the annual production, the values have been selected based on relevant studies and empirical data for similar projects, while the variation in the sales price has been modeled according to the data that have been valid in the Greek market in recent years and are constantly changing. In more detail, the most probable initial annual production for the 500kWp PV park with the specific equipment, materials, and geographical area of installation and operation is estimated to be 820,000 kWh. The optimistic scenario includes a 10% increase in annual production, while the pessimistic scenario includes a 10% decrease. The fixed and default electricity sales price for PV projects of similar installed capacity is 0.065 €/kWh at present. Its range of variation is estimated at a 30% increase and decrease for the positive and negative scenarios respectively, depending on the type of contract concluded.

Table 2 Selected Values of the Main Uncertainties for the Three Scenarios

Main Uncertainties	Optimistic Scenario	Moderate Scenario	Pessimistic Scenario
Annual Electricity Production (kWh)	902,000	820,000	738,000
Electricity Sales Price (€/kWh)	0.0845	0.065	0.0455

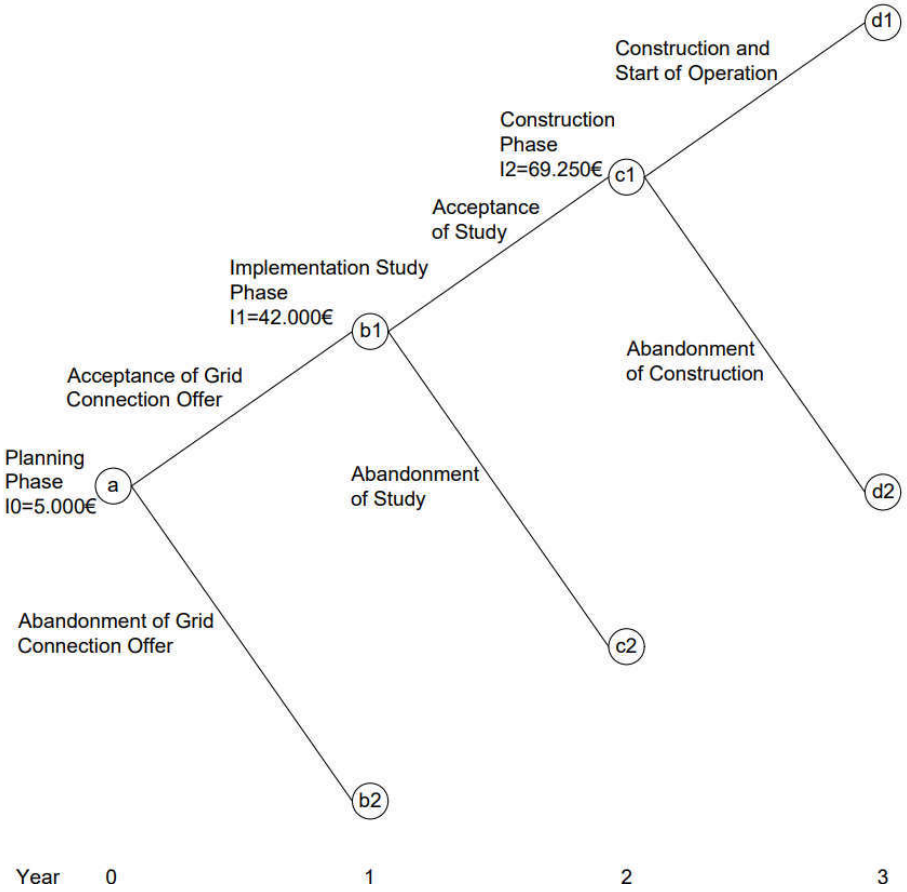
Table 3 lists the data regarding the estimated costs for the planning, design, and construction of the project. The bid price for the terms of connection to the HEDNO network has been assumed to be 40,000.00€.

Table 3 Planning, Implementation Study, and Construction Costs of the 500kWp PV Plant

Planning	Preliminary Design and Examination of the HEDNO Application File for Grid Connection Conditions	3,000.00 €
	Initial Company Management Expenses	2,000.00 €
	Terms and Conditions of Grid Connection with HEDNO	40.000,00 €
Implementation Study	Final Design and Study	2,000.00 €
Construction	Support System	32,000.00 €
	Photovoltaic Panels	148,000.00 €
	Production Substation and Inverters	45,000.00 €
	Cables and Other Electrical Materials	17,000.00 €
	Transport of Materials	5,000.00 €
	Construction and Cargo Insurance	1,500.00 €
	Earthworks and Civil Engineering Works	9,000.00 €
	Electromechanical Works	17,000.00 €
	General Site Expenses	3,000.00 €
	Inspections and Tests for Operation	1,000.00 €
	Interconnection Works	500.00 €
	Contingency Costs	4,000.00 €
	Total Construction Cost	285,000.00 €
	Grand Total Cost of PV Plant 500kWp	330,000.00 €

Figure 1 illustrates the composite options model for the investment in the 500kWp PV plant. The investor, at the beginning of each phase, can choose whether to proceed to the next phase by paying the corresponding amount or whether to abandon the investment altogether, influenced by the resolution or not of each considered uncertainty at the given moment. The planning phase includes the collection of the initial construction drawings and relevant documents for the submission of the application file to the HEDNO as well as the costs of starting and managing the company. The implementation study period can commence if the above costs are paid and the offer price of the grid connection terms is accepted. Similarly, the construction period can start if the costs for the grid connection terms and the implementation study are paid. Finally, the project can be put into operation and electricity generation if the investor decides to complete the total costs for its construction.

Fig.1. The Composite Options Model for the 500kWp PV Plant Investment



Considering the calculation of the financial flows, it should be mentioned that for the construction of PV projects in Greece during this period, banks often provide loans for a significant part of the total construction costs. Usually, the total loan repayment time is 10 years from the start of the project operation and the interest rate of the loan reaches 4.40%, while the bank's participation in the total investment cost of construction is close to 75%. In addition, the average tax rate for the annual revenue from the operation of the project has been estimated to be 30%. The rate for the capital cost of the investment has been estimated to be 6%. Finally, for the calculation of the annual energy production from the PV panels, an aging factor of 0.80% per year has been retained, which is usually given by the panel manufacturers and is due to the deterioration of the construction elements of the panels. All of the above assumptions have been made to obtain the baseline data for calculating the financial flows over the 20 years of the project's operation. Table 4 shows in detail and on an annual basis the individual revenues and costs for the most likely scenario of electricity production and sales price.

Table 4 Financial Analysis of a 500kWp PV Plant for 20 Years of Operation

Year of Operation	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Production (kWh)	820,000	813,440	806,932	800,477	794,073	787,721	781,419	775,168	768,966	762,814
Revenue from Sales (€)	53,300	52,874	52,451	52,031	51,615	51,202	50,792	50,386	49,983	49,583
Part of Installments for Capital (€)	26,616	26,616	26,616	26,616	26,616	26,616	26,616	26,616	26,616	26,616
Project Operation & Maintenance Costs (€)	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500
Total Expenses (€)	31,116	31,116	31,116	31,116	31,116	31,116	31,116	31,116	31,116	31,116
Profit (excluding equity) (€)	22,184	21,757	21,334	20,915	20,498	20,085	19,676	19,269	18,866	18,466
Profit after Tax (excluding equity) (€)	15,528	15,230	14,934	14,640	14,349	14,060	13,773	13,489	13,206	12,927

Year of Operation	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
Production (kWh)	756,712	750,658	744,653	738,696	732,786	726,924	721,108	715,340	709,617	703,940
Revenue from Sales (€)	49,186	48,793	48,402	48,015	47,631	47,250	46,872	46,497	46,125	45,756
Part of Installments for Capital (€)	0	0	0	0	0	0	0	0	0	0
Project Operation & Maintenance Costs (€)	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500
Total Expenses (€)	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500
Profit (excluding equity) (€)	44,686	44,293	43,902	43,515	43,131	42,750	42,372	41,997	41,625	41,256
Profit after Tax (excluding equity) (€)	31,280	31,005	30,732	30,461	30,192	29,925	29,660	29,398	29,138	28,879

The annual costs for the operation and maintenance of the PV park are valued at 4,500€ and include the cleaning of the PV panels and the deforestation of the field every year, the maintenance of the internet account, and the monitoring of the project's proper operation. Also included in the same amount are the company's administration and accounting support costs, the use of closed-circuit television (CCTV), and the project's insurance in case of damage that may be caused by vandalism, fire, or natural disasters. The loan installments for the first 10 years are calculated using the bank's participation rate and applying equations (6) and (7) to obtain the capital recovery factor (CRF) (Polyzos, 2018):

$$CRF = \left(\frac{i(1+i)^n}{(1+i)^n - 1}\right) \quad \textbf{(6)}$$

Where i is the borrowing rate; and n is the years of repayment of the loan.

$$R = CRF * P) \quad \textbf{(7)}$$

Where R is the annual installments; and P is the present value of the loan.

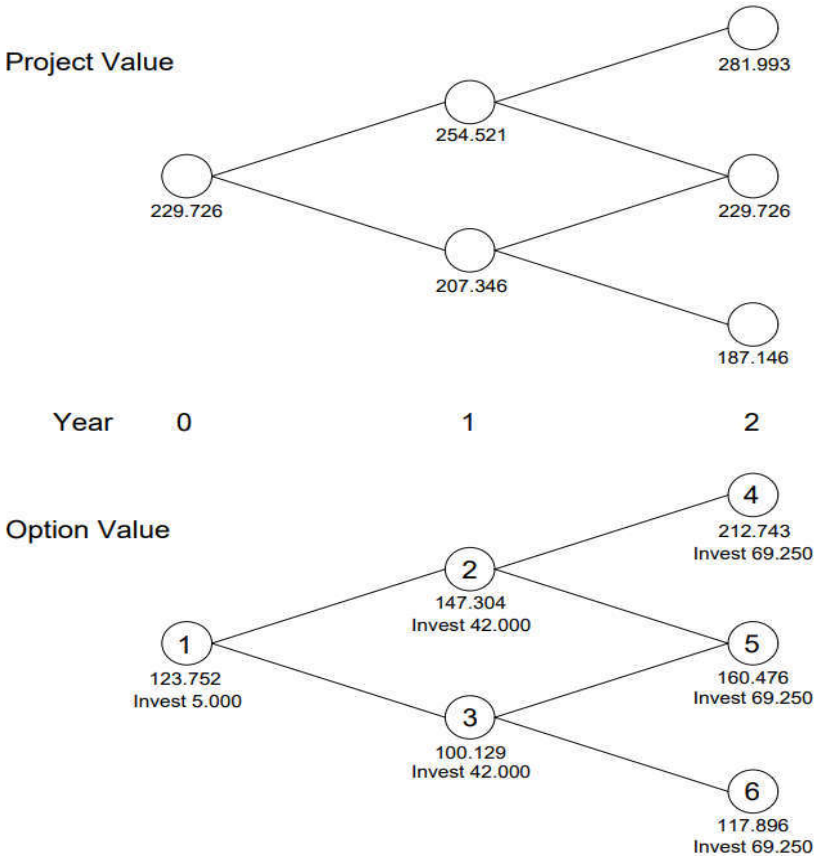
Next, the annual profit is calculated excluding the amount of the investor's equity and after the upcoming 30% tax, followed by the NPV of the project. For the most likely cash flow scenario, the project value has been calculated to be 229,726.00€ and the NPV 113,476.00€. Similarly, for the optimistic scenario, the NPV is 286,759.00€. For the pessimistic scenario, the NPV is -35,629.00€, which when considered in isolation is a deterrent to undertaking this investment. Table 5 lists the most important results for the evaluation of the investment in 20 years of the project's operation, taking into account all three different cases.

Table 5 Aggregate Investment Evaluation Data for the Three Scenarios

Key Investment Characteristics	Optimistic Scenario	Moderate Scenario	Pessimistic Scenario
Total Equity (€)			116,250
Total Gross Revenue (€)	1,413,904	988,744	622,909
Total Expenses (€)			356,165
Total Net Profit (€)	1,057,739	632,579	266,744
Total Net Profit Less Equity (€)	941,489	516,329	150,494
Net Present Value (€)	286,759	113,476	-35,629

Following the proposed methodology, the volatility in project performance has been calculated by equation (1) to be 10.25%. Through equations (2) and (3), the upward and downward movements of the binomial lattice have been obtained at 1.1079 and 0.9026 respectively. Moreover, the risk-neutral probability is calculated by equation (4) to be 0.7755. Using the binomial lattice structure and equation (5), the value of the project's option or the strategic NPV (SNPV) is 123,752.00€. The option premium is equal to 10,276.00€ and can be obtained by subtracting from the SNPV, the NPV calculated for the most likely scenario. Figure 2 illustrates the RO analysis of the project investment.

Fig.2. The RO Model for the 500kWp PV Plant Investment



4.3. Discussion on the Applicability of the Real Options Methodology

According to the RO model, in nodes where the cost of the investment is higher than the value of the option and the uncertainty is not yet resolved, it is recommended that the investor should abandon the continuation of the project financing. In the current situation (year 0), the cost of 5,000.00€ for the investment in the planning phase is less than the option value of 123,752.00€ and therefore the investment is worth making. In nodes 2 and 3, the total investment cost for the payment of the grid connection conditions with the HEDNO and the completion of the implementation study is less than the values of the options of 147,304.00€ and 100,129.00€ respectively. Therefore, the investment is worthwhile to be implemented also at this stage, creating the next option for the construction of the project. Looking at nodes 4, 5, and 6, it can be seen that the investment cost of 69,250.00€ to complete the construction is also less than the values of the options in all 3 of these nodes so the investment is worth completing until the construction is completed and the project is operational.

These results lead to two main conclusions. The first is that through the presented methodology of RO theory, investment is recommended to be carried out in all phases of the PV project implementation, even when the two uncertainties considered are not fully resolved. This is in stark contrast to the decision that would have to be taken by the investor if only the NPV in the worst case scenario was analyzed and taken into account, which is -35,629.00€, and therefore the investment should be rejected from the beginning. The second conclusion that follows from the application of RO theory in this application study is that because a large part of the investment (75%) is financed by the bank and completed during the construction period, the cost of the investor's participation in the construction phase is proportionally low (69,250.00€) and lower than the value of the option in all 3 nodes of the binomial lattice. Therefore, overall investment is encouraged in all phases of the project implementation.

5. Conclusion

In this paper, a presentation and application of the RO theory to a RES project were made. In the beginning, the main characteristics that affect the construction and operation of RES projects are listed. Then, a brief reference is made to the investment appraisal methodologies and RO theory. Referring to the different application models available for the RO evaluation, a specific methodology that has been proposed for the valuation of an investment in a hydropower project in Indonesia is discussed. Subsequently, this methodology is applied to a 500kWp PV project that can be constructed in Greece.

The results and contribution of this study can be summarized in three points. Firstly, the process and the cost of the individual services and materials required for the implementation of a PV project in Greece are presented. In this way, a potential investor can be assisted in the construction of a PV power plant of similar installed capacity, knowing from the outset the uncertainties, approximate costs, and the set of actions that need to be carried out in all the separate phases of the project. Secondly, the application of the RO methodology gives an investor the ability and flexibility to exercise his options (to continue the investment or to abandon it, for this case study) in each phase of the PV project and taking into account the possibility of occurrence or resolution of uncertainty. The specific methodology followed is simple, without the need for advanced mathematical or economic knowledge, so that it can be easily used by investors or the management of a company. Thirdly, since a large part of the financing (close to 75%) for similar PV projects in Greece is usually provided by banks, the investment based on the current data turns out to be advantageous, as reflected by the results of this article.

On the other hand, the uncertainties that have been considered in the case study include the variation in the electricity selling price and the production performance of the PV plant. However, other uncertainties such as the consumer price index, the borrowing rate, the bid price of the grid connection conditions, and those variables generally associated with the prevailing socio-economic situation in Greece, have not been taken into account. In addition, the costs for the construction of the project have been assumed to be constant, without considering any revaluation of materials and delays in all phases of the project, which may further increase the total cost of the investment. Nevertheless, this article can be an important basis for understanding the main processes surrounding PV projects and the potential uncertainties that can occur and dramatically affect the overall investment. Finally, the investment appraisal methodology used can be applied not only to PV projects, but also to other RES projects, both in Greece and in other countries, always taking into account the respective political and environmental regulations that can create various uncertainties.

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