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The Energy Services Company as business model for entrepreneurship – A case study of Greece

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The Energy Services Company as business model for entrepreneurship – A case study of Greece

Keywords: energy efficiency, ESCOs, Energy Efficiency Directive, market, financial methods

Abstract

The Europe 2020 strategy is the EU's agenda for growth and jobs for the current decade. It emphasizes smart, sustainable and inclusive growth as a way to strengthen the EU economy and prepare its structure for the challenges of the next decade. Europe has set targets for different areas, such as employment, research and development (R&D), climate change and energy, education and poverty and social exclusion. The improvement of energy efficiency is one of the most significant pillars of a sustainable energy policy and a key component of climate change reduction strategies. The Energy Efficiency Directive 2012/27/EU establishes a common framework of measures to promote energy efficiency, in order to ensure the achievement of the Union 2020 target for a 20% improvement in energy efficiency.

The private sector, including energy service companies (ESCOs) can play an important role in improving energy efficiency at the market level. Energy Service Companies (ESCOs) are specialized energy companies with sufficient know-how and experience, with the necessary funds and undertaking interventions aimed at improving energy efficiency and saving energy at end-user facilities. Their value of ESCOs in unlocking the energy saving potential in the market is recognized by various EU directives and initiatives in the European context, such as the Energy Efficiency Directive (2012/27/EU; EED), which sets explicit requirements to promote the market of energy services through its Article 18.

The scope of this master thesis is to identify clearly the legislative framework of both Europe and Greece around the ESCOs and the market barriers and to consider all the possible ways of financing that exist. It analyses a case of Greece, which concerns the technical intervention of the ESCO to another company, and by selecting the Third-Party financing, the NPV and IRR indicators, that determine the profitability of the investment, are calculated. In addition, some case scenarios are considered, such as the variation of electricity price, WACC and tax rate, as they significantly identify the sustainability of investment plan. Taking into account all mentioned above, master thesis presents some conclusions and recommendations for further research on the ESCOs' establishment, which has not been extensively developed at national level, enhancing their importance in Greek entrepreneurship and therefore in Greek economy.

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1. INTRODUCTION

1.1. European legislative framework

European Union is daily faced with challenges due to the increased dependence on imports and the limited supply of energy resources. Reducing energy consumption and waste is becoming increasingly important in the EU. The European Union (EU) has introduced a framework for achieving climate goals and striving towards a low-carbon economy by 2050 (Blumberga, Cilinskis, Armands, Blumberga, & Svarckopfa, 2018). The Member States need to make crucial decisions on finding the most energy efficient and economically feasible measures to reach the comprehensive goal of reducing greenhouse gas (GHG) emissions by 80–95% compared to the 1990 levels. It is estimated that the EU building sector accounts for about 36% of total CO2 emissions and 40% of consumed energy (European Comission, 2014). Irrespective of other considerations, such as carbon emission reduction requirements or import dependence, there is a clear case on efficiency grounds alone for the EU to use less energy. EU leaders set a target of reducing the EU's annual energy consumption by 20% by 2020 (European Comission, 2014). Energy efficiency measures are increasingly recognized as an instrument, not only to achieve sustainable energy supply, reduce greenhouse gas emissions, improve security of supply and reduce import costs, but also to promote EU competitiveness. Energy Efficiency, consequently, is a strategic priority for the Energy Union and the EU promote the principle of "priority to energy efficiency". More specific, energy efficiency contributes to the reduction of greenhouse gas emissions in a cost-effective way and thereby mitigating climate change. Therefore, European Union, by contributing to the transition to an energy-efficient economy, reaffirms the importance of the energy efficiency objective through its legislative framework. In particular, Directive 2012/27, which entered into force on 4 December 2012, establishes a common framework of measures to promote energy efficiency within the EU to ensure that the Union's primary energy reduction target of 20% is achieved and further improvements energy efficiency after 2020. The Energy Efficiency Plan, sets out a set of energy policies and energy measures that cover the entire energy chain, including energy generation, transmission and distribution, public sector leadership in energy efficiency, buildings and appliances, as well as the need for end-users to manage their energy consumption.

Some of these obligatory parties are energy distributors and/ or energy retailers, as well as non-SMEs, which have to contribute to the achievement of Energy Efficiency Directive objectives. Energy audits and energy management systems are recognized as important instruments to improve energy efficiency. By introducing Article 8 of its Energy Efficiency Directive (EED), the European Commission has made regular energy audits an obligation for large companies. Its transposition into national legislation by the EU-28 Member States (MS) results in different national implementations (Nabitz & Hirzel, 2019).

According to the definitions of Directive 2012/27 (European Parliament, 2012), the term 'energy distributor' means the natural/ legal person, including the distribution system operator responsible for the transmission of energy, for the purpose of delivering to end consumers or distribution stations that sell energy to the final consumers, while as an 'energy retailer', the natural/ legal entity that sells energy to final consumers. As regards the definition of small and medium-sized enterprises (SMEs), as set out in the Title I of the Annex to Commission Recommendation 2003/361/EC of 6 May 2003 (European Comission , 2003) , a small and medium-sized enterprise is defined as an enterprise with less than 250 employees and whose annual turnover does not exceed EUR 50 million or the annual balance does not exceed EUR 43 million.

Financial barriers are regularly reported as the core obstacle to achieve the full potential of EE projects, especially for SMEs in the tertiary sector. Unfortunately, budget limitations in combination with the current economic stagnation, often block the realization of energy saving measures. One of the solutions often suggested as an optimal instrument to overcome the financial and technical barriers is the Energy Performance Contracting. EPC incorporates the financing, planning, execution, and supervision of energy saving measures (Tsoutsos, et al., 2017).

1.2. National legislative framework

As part of the implementation process, each Member State must set national targets and how to achieve the above objectives set by the European Union. Particularly, for the case of Greece, energy policy with a focus on energy efficiency has the potential to significantly contribute to the country's economic recovery, reduce energy poverty, and further strengthen and empower vulnerable communities of the country, by promoting competitiveness and sustainability (Forouli, et al., 2019) Accordingly, Greek law is harmonized with Directive 2012/27, through Law 4342/2015 (Parliament of Greece, 2015), which sets national targets for 20% reduction of energy consumption by 2020. Law 4342/2015 institutes the framework to promote energy efficiency so that the Greece contributes to the achievement of the Union's 2020 primary target of 20 percent (20%) on energy efficiency and to pave the way for further energy efficiency improvements beyond the aforementioned date. Furthermore, it establishes indicative national energy efficiency targets for 2020, measures to promote them and rules designed to overcome energy market failures that impede energy supply and use efficiency are set.

Article 9 of Law 4342/2015 introduces the concept of enforcement regimes energy efficiency obligation, according to which from 1 January 2017, it should be ensured that energy distributors and/ or energy retailers achieve a cumulative energy savings target by 31/12/2020. In addition, in accordance with the provisions of Article 10, non – SMEs are obliged to carry out energy audits, carried out by specialized energy auditors. The specialized energy auditors are registered on the online platform of the Ministry of the Environment, and their class is based on criteria set out in the Ministerial Decision 175275/2018. The energy audit defines a systematic process to obtain a sufficient knowledge of the existing set of energy consumption characteristics of a building or industry, identifying cost-effective energy savings opportunities and compiling a report of results, in accordance with the article 3 of Law 4342/2015. Energy audits shall meet the minimum criteria set out in Annex VI of Law 4342/2015 and shall be carried out in accordance with European standards of EN 16247 on energy audits, as applicable (Ministry of Environment, 2017). Energy audit results reports are submitted by energy auditors to the Energy Audits Archive, which is compiled in the form of an information system supported by an electronic database. Consequently, companies that are either active in the sale of energy or are designated as non-SMEs are burdened with the obligation of implementing measures aimed at reducing energy consumption and thereby achieving the national target by 2020.

1.3. Promoting energy efficiency in Greece

In Greece, the third national energy efficiency plan was submitted in December 2014, which was considered as the first national action plan in compliance with Directive 2012/27/EU. The 2020 national target for energy efficiency, in accordance with European Union’s target, was set at 18.4 MTOE of final energy consumption, 24.7 MTOE of primary energy consumption and 0.081 and 0.109 kTOE/€ of energy intensity of final and primary energy consumption respectively.

The national energy savings target for the years 2018 – 2020 is set equal to 1.819 kTOE; calculated after taking into account the following (Forouli, et al., 2019):

(i) the overall target of 3.332 kTOE for the period 2014 – 2020, as determined in the third National Energy Efficiency Action Plan;
(ii) energy savings that have already been accomplished within the period 2014 – 2017 (1281 kTOE); and
(iii) the predefined contribution of the measure of “energy efficiency obligation schemes - EEOs”, for the years 2018 – 2020, which equals to 232 kTOE.

Policy instruments include, inter alia:

- The EXOIKONOMO project, which is being implemented in Greece, involves the development and implementation of municipal investment projects aimed at sustainable energy development in urban areas. However, some of the investment funds are covered by the government and most municipalities have serious difficulties in successfully participating in this initiative. (Patlitzianas, 2011)
- Energy Upgrading through Energy Service Providers (ESCOs), which intends to further develop the market for energy service companies through energy efficiency contracts. It has an advantageous lending framework through subsidized interest rates or by providing ESCO-specific insurance, and aims to implement energy efficiency improvement actions for business purposes. In this case, the loan amount is gradually paid out through the energy savings achieved and in accordance with the contract.
- Energy upgrade of public buildings, that regards energy saving interventions in existing public buildings. These interventions refer to energy upgrades of the building shell, the Electrical and Mechanical (E/M) installations, natural and artificial lighting systems, and installations of energy management systems.
- Energy Efficiency and demonstration projects in small-medium enterprises (SMEs)
- Replacement of old private passenger vehicles
- Energy Performance Certificates (EPCs)

2. ESCOs

2.1. ESCO Scheme – Market Share

Energy Service Companies (ESCOs) are specialized companies in energy issues with sufficient expertise and experience, with the required funds and undertake interventions to improve energy efficiency and energy savings at final consumers' premises. The company's remuneration is mainly derived from the energy savings (which should be verified) and hence the reduction in the cost of the customer's cost. For a pre-agreed time, e.g. for some years, the customer pays to the company (ESCO) an amount related to the amount of the cost savings. A prerequisite for the implementation of such a project is the signing of an Energy Performance Contract. The Energy Efficiency Convention is the "contractual agreement between the beneficiary (customer) and the provider of the energy efficiency improvement measure, which is verified and monitored throughout the duration of the contract. Investments (works, supplies or services) to this measure are paid in relation to the conventional agreed level of energy efficiency improvement or other agreed energy efficiency criterion, such as saving money. ESCOs can handle projects, manage or mobilize financial resources, undertake installation and maintenance work as well as collaborate with other market players.

When providing Energy Performance Contracting (EPC), ESCOs share the unique characteristic to assume performance risks by linking their compensation to the performance of their implemented projects, thus incentivising themselves to deliver savings-oriented solutions. Their value in unlocking the energy saving potential in the market is recognized by various EU directives and initiatives in the European context. The principal EU legislation is the Energy Efficiency Directive (2012/27/EU; EED), which sets explicit requirements to promote the market of energy services through its Article 18.

The remuneration of the company is mainly due to the energy savings (which need to be verified) and therefore to the reduction of the client's spent financial costs. For a pre-agreed time, the customer pays the company (ESCO) an amount related to the amount of cost savings. A prerequisite for the implementation of such a project is the signing of an Energy Performance Contract. Energy Performance Contracting (EPC) is such a mechanism, which, by definition, offers an integrated solution to the final user, including planning, financing, installation and monitoring of systems, helping to

overcome barriers such as access to financing for project developers, lack of certification schemes, insufficient public support (Frangou, Aryblia, Tournaki, & Tsoutsos, 2018) .
When providing Energy Performance Contract (EPC), ESCOs prove their characteristic to assume performance risks by linking their compensation to the performance of their implemented projects, thus incentivizing themselves to deliver savings-oriented solutions.

An EPC utilizes cost reductions in order to fund energy upgrades. Under a contract of this kind, a third-party organisation (usually an ESCO) uses the income from the implementation of an energy efficiency project due to the reduction in energy consumption to repay the project's up-front costs. In order the energy-using company to receive payments, the applied measures have to deliver the forecasted energy savings.

The concept of EPC financing is demonstrated in the figure below:

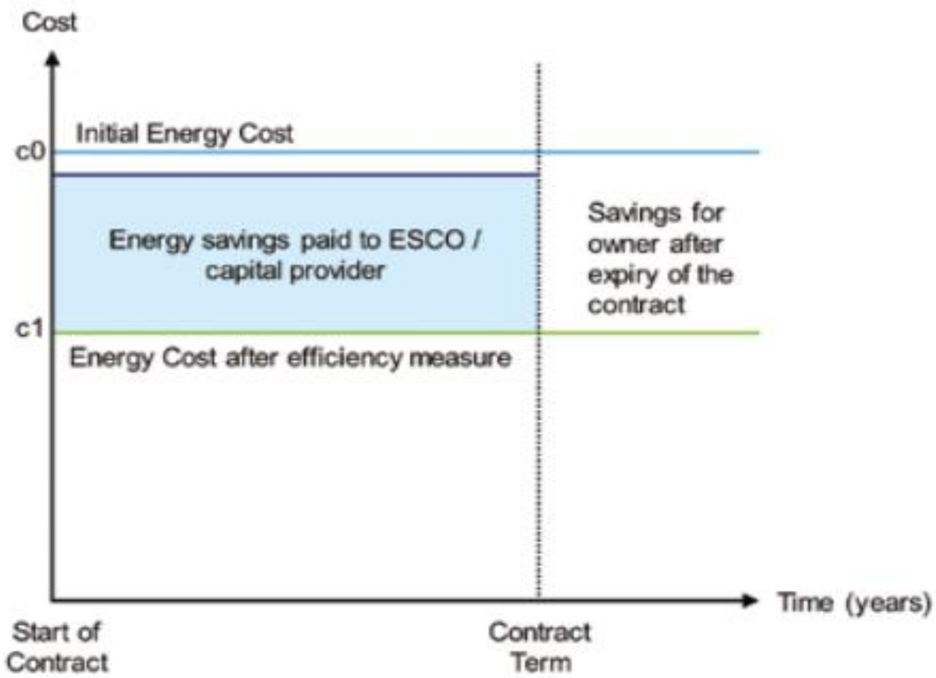

Figure 2.1-1: EPC Scheme

Source: *(Deloitte)*

2.2. Examples of Different Service Company (ESCO) Business Model

An ESCO can provide a wide range of services, depending on the demands of each customer (Sigh, Limaye, Henderson, & Xiaoyu). The list of provided services ranges from the full service/ high – risk contracts to low service / risk, as indicated below:

2.2.1. Full service ESCO

The ESCO is responsible for designing, financing, implementing the project, verifying the energy savings and sharing an agreed part of them, over a set period, with the customer. This is approach is also known as “shared savings”.

2.2.2. End-Use Outsourcing

The ESCO operates and maintains the equipment and sells the end product (i.e., steam, cooling or heating, lighting) to the customer at an agreed monetary value. The ESCO is responsible for all the equipment upgrades and repairs, but the customer typically continues to be the owner. This concept is sometimes referred to as “energy supply contracting.”

2.2.3. ESCO with Third-Party Financing

The ESCO designs and executes the project but does not fund its implementation, even though it may arrange for or facilitate funding. It assures that the energy benefit will be adequate to facilitate debt service payments. This method is also known as the “guaranteed savings” method.

2.2.4. ESCO Variable Term Contract

This bears similarities to the full-service ESCO, apart from the fact that the contract term can vary as a function of the actual savings. In case that the actual savings are not as high as originally predicted, an extension of the contract can be granted so that the ESCO can recover its approved payment.

2.2.5. Technical Consultant (with Performance-Based Payments)

This approach shares similarities to the full-service ESCO, apart from the fact that the contract term can diverge based on real savings. If expected savings are greater than the actual ones, an extension to the contract can be granted in order for the ESCO to receive its agreed payment. The “first-out” model is a variation, in which all the energy savings benefits are taken by the ESCO until it has reached its agreed payment.

2.2.6. Technical Consultant (with Fixed Payments)

The ESCO coordinates an audit, designs the project, and either helps the customer with the project’s implementation or simply offers advisory services to the customer for a fixed price.

2.3. ESCO Market Overview in Greece

Given the very small size of the existing ESCOs in Greece, there is much more potential for partnerships (i.e industrial and manufacturing associations) than competition. The ESCO market in Greece remains to be negligible (Boza-Kiss, Bertolidi, & Economidou, 2017). Recently, various policy developments have been put in place, addressing some important barriers. Successful package was introduced in Greece, such as Law 3855/2010 which describes the context and principles of an EPC, provides a model contract, and prescribes the allocation of obligations and responsibilities between the ESCO and the client (Bertoldi & Boza-Kiss, 2017) and Ministerial Decision D6/13280/07.06.2011 on Operation, Register, Code of Conduct and related provisions for energy service providers and new financial support measures promoting the use of ESCOs. Despite these developments, the Greek ESCO market remains stagnant, with very few projects implemented.

A registry of ESCOs is available at www.escoregistry.gr, managed by the Directorate of Energy Policy and Energy Efficiency of the Ministry of Environment, Energy and Climate Change. The registry contains information on ESCOs, either as natural or legal persons. Regarding legal persons, three categories exist:

- ESCOs with completed or in progress projects with a budget of at least 300.000,00€ over the last five years,
- ESCOs with completed or in progress projects with a budget of at least €1,000,000 over the last five years,
- all other ESCO companies.

As a remark, many ESCOs have shown interest in improving energy efficiency through EPCs by implementing relevant interventions. 101 application forms have been submitted by businesses, while 209 application processes are in progress.

In order to boost the market, pilot projects are planned, and the involvement of JESSICA is foreseen. In this context, the JESSICA is a modern financial engineering instrument, and its scope is the ‘‘recyclability” of Structural Funds’ financial resources through a mechanism which will provide funding – equity, loans and guarantees – to eligible urban development projects, and will utilize the returns – for instance loan repayments – to reinvest in new urban development projects, thereby bolstering sustainability . Energy efficiency improvements seems to be one of the areas that JESSICA should focus on in the case of Greece, considering that energy efficiency constitutes a major component of sustainable urban development (Patlitzianas, 2011).

Support and monitoring of these projects will be provided in order to standardize procedures and remove regulatory barriers to the implementation of energy efficiency measures in public sector buildings through energy performance contracting (EPC).

Most commonly adopted and promising marketing strategies in the Energy Efficiency Service (EES) market include:

- Increase dissemination of potential ESCO services and projects
- A suitable accreditation system for reliable and qualified ESCO
- Development of financing schemes by banks in their line of services
- Standardise Savings Measurement and Verification
- Government support through clear and straightforward legal framework
- Public buildings to lead by examples
- Enforcement of international agreements on environmental issues (Copenhagen 2010)

Potential needs for Energy Efficiency Services relate both to the public sector (educational institutions, public buildings, hospitals) and the private one (industries commercial establishments, office buildings, hotels, swimming pools, houses etc). The market is widely open for development, taking into account the provisions of the legislative framework.

In the EES market there is strong competition between the manufacturers/ wholesalers/ installers when offering the same products/ technologies. Strong competition also exists between the energy consultancies companies, which offer the same services connected to EES. EES provider companies cooperate when offering different partial services and this collaboration could be enhanced as the energy service market will be growing. Utilities/ Power companies haven't yet started providing energy services, although they are planning to provide them.

ESCOs try to offer EPC to the industrial market which so far was served by the EES provider companies. The raised interest of this market to implement services, which aim to reduce energy consumption has also raised the competition between the EES providers. ESCOs may also be involved in these fields, as well as in new activities involving energy efficiency of public buildings, the private tertiary and the housing sector, which so far have been untouched.

2.4. ESCOs Marketing Strategy

The most promising marketing strategies in the Greek EES market relate to:

- Increased dissemination of potential ESCO services and projects. Increasing the dissemination of information about energy-efficiency projects and services offered by ESCOs will advance the understanding of the way ESCOs work and the benefits arising from the EPC.
- A suitable accreditation system for reliable and qualified ESCOs. The creation of a suitable accreditation system for the qualified ESCO will increase the ESCO and EES reliability to the customers.
- Development of financing schemes by banks in their line of services. In Greece, banks have not included EES financing in their line of services. Additionally, customers are extremely hesitant to allocate resources for investments on energy efficiency projects. TPF schemes can overcome this impediment, but these are not very much known. Also, in the case of TPF schemes, the bank with which an ESCO is cooperating is also called upon to inform its customers of the services provided by the ESCO. A demonstration project is a crucial factor in convincing the customer to proceed with such an investment.
- Standardised Measurement and Verification of energy savings.
- Government support through clear and straightforward legal framework.
- Public buildings to lead by examples. Demonstration projects are needed to convince the customer of the feasibility of such projects. Energy Efficiency at public buildings could be a very good example for the future clients to follow. Marketing is usually done by word-of-mouth, presentations at national

conventions, seminars and workshops, and relevant articles in magazines, newspapers etc.

- Enforcement of international agreements on environmental issues (Copenhagen 2010).

The aforementioned strategies are usually low-cost but require a significant number of man-hours. Their success is gauged by the number of enquiries regarding TPF financing schemes. EESs are mainly provided “stand-alone”, although efforts are also being made to cooperate with manufacturers of specific EE equipment. Given the small number of ESCOs in Greece offering “stand-alone” services for energy efficiency projects, there is significant potential to develop a fruitful and fair competition with energy companies.

2.5. Funding methods

As in every business, the start-up phase of an Energy Efficiency Services business (development, market introduction and marketing) can be costly and has to be pre-financed before the sales generate sufficient income to cover these costs. Then, often the provision of ESCOs is a capital-intensive business, where the degree of capital intensity depends on:

- Level of transaction costs
- Position of the EES in the value chain
- If the EES includes pre-financing of the investment

However, as in other business, ESCOs have a wide range of possibilities for project financing: credit financing, leasing, forfeiting, etc. The main EES financing typologies used are: Energy user/ customer financing, ESCO and Manufacturer/ Wholesaler financing, and Third-party financing by banks for large projects (Change Best).

2.5.1. Energy user /customer financing

Energy-user/customer financing, financing through own funds, may also be associated with financing with credits if the customer can meet the creditworthiness of banks. Energy-user/customer financing usually requires an energy savings guarantee provided by the ESCO.

2.5.2. ESCO and Manufacturer /Wholesaler financing

ESCO financing refers to financing with internal funds of the ESCO and may involve use of its own capital or funding through other debt or lease instruments. The newly established Greek ESCOs try to obtain financing mainly from banks, they rarely use equity for financing, due to the limited own funds as these options would limit their capability of implementing projects on a sustainable basis. The contract typically stipulated by ESCOs is an Energy Performance Contract (EPC) with guaranteed savings (whereby the EES provider assumes the entire design, savings performance risks and outsource the installation to private manufactures, but does not assume credit risk of repayment by the customer).

2.5.3. Third-party financing (TPF)

Third Party Financing (TPF) refers solely to debt financing. As its name suggests, project financing comes from a third party, e.g. The EES provider cooperates with a bank who loans the financial resources necessary for project implementation to the customer backed by an energy savings guarantee agreement, showing that the energy savings achieved will certainly cover the debt repayment. The finance institution may also assume the rights to take a security interest in the project equipment (WEEA 1999) (Rose, 2015). There are two conceptually different TPF arrangements associated with EPC; the key difference between them is which party borrows the money: the ESCO or the client. The market is under-development and it is difficult to reach agreements with banks for TPF schemes. Banks don't evaluate small projects size (budget under 100.000€) considering them as non-economically advantageous. Energy interventions in hotels and industries could be interesting projects, as far as the total budget amount is concerned, and should stimulate banks to finance them. However, as there are no similar projects undertaken by the Greek ESCOs, the hotel and industries owners cannot be convinced for the success of this kind of contracts and the payback time. The conditions and the factors that allowed EES market development are private initiative by the interested companies, resulting from high energy bills and the wish to save energy. The lack of capital, or their hesitancy, gears them towards the use of Third-Party Financing schemes from banks.

3. CASE STUDY

The case study relates to the obligation to carry out an energy audit of an enterprise, which is housed in a building constructed in 1980. As stated in previous sections, according to Article 10 of Law 4342/2015, companies that are not classified as SMEs, are required to be audited in an independent and cost-effective manner by energy auditors and thereafter undergo a new audit within a period of not more than four years from the date of the auditor's appointment. energy audit. As a result, ESCO will undertake energy audits to analyze the total energy consumption in order to identify appropriate energy saving measures.

In view of the above, ESCO will conclude an Energy Efficiency Contract (EPC) with the enterprise including:

- the design and management of the energy service and energy project the methodology for estimating the energy savings and estimating the total economic benefit that results
- the purchase, installation and commissioning of the necessary energy equipment to improve end-use energy efficiency;
- the management, operation and maintenance of the equipment
- the total cost of the project, which consists of the cost of procuring and installing the necessary equipment, operating and maintenance costs, financing costs and ESCO fees
- the process of evaluating the energy benefit and the way and time of repayment

3.1. Project steps

3.1.1. Scope

The scope of energy audit is defined as the extent of the activities and facilities that are included in the energy audit and is the extent of the energy audit as a percentage of total energy consumption.

The scope of energy audit includes the analysis of energy consumption, that derives from the head office of 1.645,5 m^2 in Chalandri, which includes employee offices, meeting rooms, common areas, warehouse and computer room.

3.1.2. Identification of energy sources

The energy auditors will carry out an energy audit, which follows the following guidelines:

- Based on up-to-date, measurable detectable operational data on energy consumption and (on electricity) load characteristics.
- Include a detailed overview of the energy consumption characteristics of a building or group of buildings, an industrial activity or installation as well as transport.
- They are proportionate and sufficiently representative to provide a reliable picture of overall energy efficiency and to reliably address the most important opportunities for improvement.

Thus, after the study in building energy consumption, it was found that the main sources of energy consumption are lighting, as well as the operation of the heating and cooling system.

Therefore, the technical measures to be taken will involve the change of lighting and the heating and cooling system, in order to reduce the total energy consumption. The ESCO is going to be provided with the building electricity bills for a calendar year, in order to calculate the current energy consumption. Thus, after taking the necessary measures, then it will be calculated the energy savings rate regarding the electricity bills in order to compare the energy consumption made.

3.1.3. Implementation of technical measures to achieve energy savings

3.1.3.1. Replacement of lighting

At the premises, there is employee offices, meeting rooms, common areas, warehouse and computer room. At these 1.645,5 m^2 there are, 48 lamps of T8 16W Led, 15 lamps of HIGH BAY 100W Led, 20 lamps of panel led 60X60 36watt, 21 fluorescent lamps of 58 watt, 27 fluorescent lamps of 36 watt, 2 fluorescent lamps of 16 watt, 1 fluorescent lamp of 8 watt, 2 type-bell lamps of 300 watt and 2 type-bell lamps of 200 watt. Therefore, the total installed lighting power is 6.362,0 W.

The purpose is to create a comfortable working environment, where the staff can be more productive, while they can simultaneously relax in the premises.

3.1.3.2. Replacement of heating and cooling system

The heating and cooling system will be replaced by indoor ceiling cassette units. These units have flexible size and can be mounted on suspended ceilings of limited high. The modern multi-output panels guarantee uniform air distribution offering a constant temperature throughout the office. The units that will be used cover the 1.645,5 m^2 of the office, as they are available in bumpers ranging from 42,000 to 54,000 Btu per h (three-phase). Centralized controls with multiple capabilities and extra features are specially designed to meet the particular requirements.

3.1.4. Monitoring and control of measures

After the replacement of the equipment, the ESCO will monitor the office electricity bills per month, in order to evaluate the effectiveness of the measures taken and the energy savings and to ensure the repayment of the investment.

Furthermore, ESCO will organize educational seminars that will appeal to office executives, so as to obtain energy conscious awareness.

3.2. Technical Analysis

3.2.1. Replacement of lighting

As it is previously aforementioned the space that ESCO is called to update in order to achieve energy efficiency will be of 1.645,5 m^2. This specific space is comprised by employee offices, meeting rooms, common areas, warehouse and a computer room. The current situation of lamps and their rated power is presented in the table below:

Table 3.2-1: Total installed lighting power

Lamp Type	Pieces	Space	Rated Power (W) per piece	Total Power (W)
T8 16W Led	48	Employee Offices	16,00	768,00
HIGH BAY 100W Led	15	Employee Offices	100,00	1.500,00
panel led 60X60 36watt	20	Employee Offices	36,00	720,00
Fluorescent lamps	12	Employee Offices	80,00	960,00
Fluorescent lamps	4	Training Room	58,00	232,00
Fluorescent lamps	4	Training Room	36,00	144,00
Fluorescent lamps	5	Common area	58,00	290,00
Fluorescent lamps	1	Common area	58,00	58,00
Fluorescent lamps	2	Kitchen	36,00	72,00
Fluorescent lamps	3	WC	36,00	108,00
Fluorescent lamps	2	WC	16,00	32,00
Fluorescent lamps	1	WC	8,00	8,00
Fluorescent lamps	2	Corridor	36,00	72,00
Fluorescent lamps	1	Common area	36,00	36,00
Fluorescent lamps	2	Corridor	36,00	72,00
Bell-type lamp	2	Training Room	300,00	600,00
Bell-type lamp	2	Training Room	200,00	400,00
Fluorescent lamps	9	Warehouse	36,00	324,00
Fluorescent lamps	4	Training Room	58,00	232,00
Fluorescent lamps	4	Training Room	36,00	144,00
Fluorescent lamps	4	Meeting Room	58,00	232,00
Fluorescent lamps	4	Meeting Room	36,00	144,00

Therefore, the total installed lighting power is **7.148,0 kW.**

3.2.1.1. Estimation of electricity consumption by lighting

Taking into account, the working hours of the enterprise, that are 8 hours per day and five days per week, and the 251 working days of the year, it has been calculated yearly electricity consumption derives from lighting, as following:

Table 3.2-2: Estimation of yearly electricity consumption by lighting

Lamp Type	Pieces	Space	Rated Power (kW) per piece	Working hours (h/day)	Working days per year (day)	Estimation of electricity consumption (kWh) per year
T8 16W Led	48	Employee Offices	0,016	9	251	1.734,91
HIGH BAY 100W Led	15	Employee Offices	0,1	9	251	3.388,5
panel led 60X60 36watt	20	Employee Offices	0,036	9	251	1.626,48
Fluorescent lamps	12	Employee Offices	0,080	9	251	2.168,64
Fluorescent lamps	4	Training Room	0,058	2	251	116,46
Fluorescent lamps	4	Training Room	0,036	2	251	72,29
Fluorescent lamps	5	Common area	0,058	5	251	363,95
Fluorescent lamps	1	Common area	0,058	5	251	72,79
Fluorescent lamps	2	Kitchen	0,036	3	251	54,22
Fluorescent lamps	3	WC	0,036	3	251	81,32

Fluorescent lamps	2	WC	0,016	3	251	24,10
Fluorescent lamps	1	WC	0,008	3	251	6,02
Fluorescent lamps	2	Corridor	0,036	5	251	90,36
Fluorescent lamps	1	Common area	0,036	5	251	45,18
Fluorescent lamps	2	Corridor	0,036	5	251	90,36
Bell-type lamp	2	Training Room	0,300	2	251	301,20
Bell-type lamp	2	Training Room	0,200	2	251	200,80
Fluorescent lamps	9	Warehouse	0,036	1	251	81,32
Fluorescent lamps	4	Training Room	0,058	2	251	116,46
Fluorescent lamps	4	Training Room	0,036	2	251	72,29
Fluorescent lamps	4	Meeting Room	0,058	2	251	116,46
Fluorescent lamps	4	Meeting Room	0,036	2	251	72,29
TOTAL						**10.896,41 kWh**

As for the fluorescent lamps, the total electricity consumption is **4.146,52 kWh** per year.

3.2.1.2. Replacement of fluorescent lamps with LED

As it previously aforementioned, there are many fluorescent lamps, which consume an important amount of electricity. Thus, after ESCO's study, it was found that the replacement of these lamps with LED, will lead to decrease of energy consumption and consequently, the enterprise will save money. In the table below, the characteristics of the LED lamps are analysed in contrast with the fluorescent lamps:

Table 3.2-3: Characteristics of fluoresecent and LED lamps

Space	Pieces	Power of fluorescent lamps (W) per piece	Power of LED lamp (W) per piece
Employee Offices	12	80,00	20,00
Training Room	4	58,00	20,00
Training Room	4	36,00	16,00
Common area	5	58,00	20,00
Common area	1	58,00	20,00
Kitchen	2	36,00	16,00
WC	3	36,00	16,00
WC	2	16,00	8,00
WC	1	8,00	4,00
Corridor	2	36,00	16,00
Common area	1	36,00	16,00
Corridor	2	36,00	16,00
Training Room	2	300,00	100
Training Room	2	200,00	50
Warehouse	9	36,00	16,00
Training Room	4	58,00	20,00
Training Room	4	36,00	16,00
Meeting Room	4	58,00	20,00
Meeting Room	4	36,00	16,00

The following table is an estimation of the electricity consumption after replacing existing fluorescent lamps with LED:

Table 3.2-4: Estimation of electricity consumption of LED

Space	Pieces	LED Power (W) per piece	Working hours (h/day)	Working days per year	Electricity consumption (kWh) per year
Employee Offices	12	20,00	9	251	542,16
Training Room	4	20,00	9	251	180,72
Training Room	4	16,00	9	251	144,57
Common area	5	20,00	9	251	225,9
Common area	1	20,00	2	251	10,04
Kitchen	2	16,00	2	251	16,06
WC	3	16,00	5	251	60,24
WC	2	8,00	5	251	20,08
WC	1	4,00	3	251	3,012
Corridor	2	16,00	3	251	24,10
Common area	1	16,00	3	251	12,05
Corridor	2	16,00	3	251	24,10
Training Room	2	100	5	251	251,0
Training Room	2	50	5	251	125,5
Warehouse	9	16,00	5	251	180,72
Training Room	4	20,00	2	251	40,16
Training Room	4	16,00	2	251	32,13
Meeting Room	4	20,00	1	251	20,08
Meeting Room	4	16,00	2	251	32,13
TOTAL					**1.944,78**

The estimated energy savings after the replacement of fluorescent lamps is **2.201,74 kWh per year.**

Consequently, considering that the company will be consuming 1.574,27 kWh each year less than the current situation, the total annual money savings are:

$$\text{Money Savings} = 1.574{,}27 * 0{,}12 \frac{€}{\text{kWh}} = 188{,}912\ €$$

In the table below, the total cost of fluorescent lamps' replacement is calculated:

Table 3.2-5: Total Cost of LED

LED Lamp (W)	Pieces	Cost (€) per piece	Total Cost (€)
100	2	95,0	190,0
50	2	65,0	130,0
20	30	12,53	375,9
16	31	9,40	291,4
8	2	6,26	12,5
4	1	4,10	4,1
TOTAL			**1.003,9 €**

As the total update costs is 1.003,9 € and according to the equation:

$$\text{Break Even Point} = \frac{\text{Initial investment}}{\text{Cash Flow per period}} = \frac{1.003{,}9}{188{,}912} = 5{,}3\ \text{Years}$$

Understanding that the average life span of a LED light is 30000 hours and the average working hours are 273,5 per year, the average life of a LED lamp or panel is:

$$\text{Average LED light Life Span} = \frac{30000}{1109{,}7} = 27\ \text{Years}$$

$$\text{Total Savings by LEDs} = 27 * 188{,}912 = 5.100{,}624\ €$$

$$\text{ROI} = \frac{\text{Savings} - \text{Initial investment}}{\text{Initial investment}} = \frac{5.100{,}6 - 1.003{,}9}{1.003{,}9} = \ 4{,}08 \text{ or } 408\%$$

Which roughly translates that the company’s investment will turn back to them almost four times higher in the form of cost reduction in 27 years.

3.2.2. Replacement of heating and cooling system

The office is located in Athens, in a building constructed until 1980, so it corresponds to climate zone B (Technical Chamber of Greece, 2010). The building did not include oil heating system, so it had been established cooling and heating system, that consume high amount of electricity per year. After the necessary calculations, it has been found that the replacement of the current heating and cooling system with indoor ceiling cassette units, will reduce significantly the total power consumption. The specific indoor ceiling cassette units that are going to be used are:

- (10) units of the V4MCI-24UR/U4MRS-24 model with thermal efficiency of 26.000 Btu/h and cooling efficiency of 24.000 Btu/h which will cover the kitchen, the waiting lobby and the corridors. Each unit costs 1.549€.
- (4) units of the V4MCI-36UR/U4MRS-36 model with thermal efficiency of 38.000 Btu/h and cooling efficiency of 36.000 Btu/h which will cover the meeting rooms and training rooms. The unit costs 2.209€.
- (2) units of the V4MCRI-18/U4MRS-18 model with thermal efficiency of 19.000 Btu/h and cooling efficiency of 18.000 Btu/h which will cover the warehouse. The unit costs 1.239€.
- (3) units of the V4MCI-50UR/U4MRT-50 model with thermal efficiency of 55.000 Btu/h and cooling efficiency of 48.000 Btu/h which will cover the working spaces. Each unit costs 2.539€.
- (2) units of the V4MCI-18/U4MRS-18 model with thermal efficiency of 19.000 Btu/h and cooling efficiency of 18.000 Btu/h which will cover the 2 toilets whom each surface is 25 m2. Each unit costs 1.239€.

The table below shows the parameters that have been used:

Table 3.2-6: Data for heating system

Parameters	Value
SHD (kWh/m^2)	20,3
$SCOP_{Ref}$	1,7
$SCOP_{Eff}$	5,1
A (m^2)	1.645,5

Where,

- SHD: The average energy required for heating in office buildings of the tertiary sector prior to the implementation of the intervention. Specifically, to our case the SHD factor refers to buildings constructed before 1980.
- $SCOP_{Ref}$: The Minimum Seasonal Performance Coefficient for heating systems installed until 1980.
- $SCOP_{Eff}$: The performance coefficient of the new heating system.
- A: The heated area of the renovated building.

In order to calculate the total annual energy savings after upgrading the heating system we used the method of expected energy savings, a method designed by the Centre for Renewable Energy Sources and Saving (Centre of Reneable Energy Sources and Saving, 2019):

$$\text{TFES} = \text{A} * \text{SHD} * \left(\frac{1}{\text{SCOP}_{\text{Ref}}} - \frac{1}{\text{SCOP}_{\text{Eff}}}\right) = 13.099{,}471 \text{ kWh/year}$$

Table 3.2-7: Data for cooling system

Parameters	Value
SCD (kWh/m^2)	73,9
$SEER_{Ref}$	1,7
$SEER_{Eff}$	5,92
A (m^2)	1.645,5

Where,

- SCD: The average energy required for cooling in office buildings of the tertiary sector prior to the implementation of the intervention. Specifically, to our case the SCD factor refers to buildings constructed before 1980.
- $SEER_{Ref}$: The Minimum Seasonal Performance Coefficient for cooling systems installed until 1980.
- $SEER_{Eff}$: The performance coefficient of the new cooling system.
- A: The heated area of the renovated building.

In order to calculate the total annual energy savings after upgrading the cooling system we used the method of expected energy savings, a method designed by the Centre for Renewable Energy Sources and *Saving* (Centre of Reneable Energy Sources and Saving, 2019):

$$\mathrm{TFES} = \mathrm{A} * \mathrm{SCD} * \left(\frac{1}{\mathrm{SEER_{Ref}}} - \frac{1}{\mathrm{SEER_{Eff}}}\right) = 50.989{,}899\ \mathrm{kWh}$$

Table 3.2-8: Purchase Cost for heating and cooling devices

Device Type	Pieces	Cost of device (€)	Total cost (€)
V4MCRI-18/U4MRS-18	4	1.239,0	4.956,0
V4MCI-24UR/U4MRS-24	10	1.549,0	15.490,0
V4MCI-36UR/U4MRS-36	4	2.209,0	8.836,0
V4MCI-50UR/U4MRT-50	3	2.539,0	7.617.0
TOTAL			**36.899,0**

Thus, the purchase cost is 36.899,0 €.

In addition to the purchase cost, the installation cost will be added, for the installation of the units, which is 10% of the total purchase cost, that is 3.690,0 €.

So, the total cost for the replacement of heating and cooling system is calculated, as following:

$$\text{Installation Cost (€)} = 10\% * \text{Purchase Cost} = 3.690{,}0\text{ €}$$

$$\text{Total Cost (€)} = \text{Purchase Cost} + \text{Installation Cost} = 40.589{,}0\text{ €}$$

$$\text{Money Savings} = 64.089{,}37\text{ kWh} * 0{,}12\frac{\text{€}}{\text{kWh}} = 7.690{,}72\text{€}$$

$$\text{Break Even Point } \frac{\text{Initial investment}}{\text{Cash Flow per period}} = \frac{40.589{,}0}{7.690{,}72} = 5{,}3\text{ years}$$

If we assume that the life expectancy of cooling and heating system is 12 years, then:

$$Total\ Decade\ Savings\ Of\ the\ upgrade = 64.089{,}37 * 12 = 769.072{,}4\text{€}$$

$$ROI = \frac{Savings - Initial\ investment}{Initial\ investment} = \frac{769.072{,}4 - 40.589{,}0}{40.589{,}0} = 17{,}95\ or\ 1795\%$$

3.3. Financial Analysis

The main criterion for the implementation of an investment project is its feasibility. In the present assessment, feasibility is examined by calculating the following:

- Net Present Value (NPV)
- Internal Rate of Return (IRR)

The aim of the financial analysis is the assessment of the feasibility of the investment plan. Furthermore, it is necessary to be known the net cash flows, that will result from the implementation of the project. As for the calculation of the net cash flows, it is proper to take into consideration the amount of invested capital, the revenues and the depreciation.

The assumptions that were taken, concerning the financial analysis are the following:

- The invested capital that results from the replacement of lighting, and heating and cooling system is equal to 41.592,9 €
- Regarding the loan that is to be taken from the bank, it is noted that the loan share is 100% and the loan interest is 3%
- The loan repayment duration is equal to 5 years
- The tax rate is 20%
- The depreciation is 4%
- As for the operating expenses, the ESCO took into account the wages of the three employees, who will be involved in the office energy upgrade project. Consequently, the operating expenses are 2.400,0€
- The discount rate equals to 8%
- The weighted average cost of capital (WACC) equals to 2,4%

3.3.1. Financial Definitions

3.3.1.1. Net Present Value (NPV)

Net present value (NPV) (Investopedia, 2019) is the difference between the present value of cash inflows and the present value of cash outflows over a period of time. Net Present Value (NPV) is used in capital budgeting and investment planning to analyze the profitability of a projected investment or project.

The following formula is used to calculate NPV:

$$\text{NPV} = \sum_{t=1}^{n} \frac{R_t}{(1+i)^t}$$

Where,

R_t = Net cash inflow – outflows during a single period

i = Discount rate or return that could be earned in alternative investments

t = Number of time periods

A positive Net Present Value indicates that the projected earnings generated by a project or investment - in present dollars - exceeds the anticipated costs, also in present dollars. It is assumed that an investment with a positive NPV will be profitable, and an investment with a negative NPV will result in a net loss. This concept is the basis for the Net Present Value, which dictates that only investments with positive NPV values should be considered.

3.3.1.2. Internal Rate of Return

The internal rate of return (IRR) (Investopedia, 2019) is a metric used in capital budgeting to estimate the profitability of potential investments. The internal rate of return is a discount rate that makes the Net Present Value (NPV) of all cash flows from a particular project equal to zero.

IRR calculations rely on the same formula as NPV does.

It is important for a business to look at the IRR as the plan for future growth and expansion. The formula and calculation used to determine this figure follows:

$$0 = \text{NPV} = \sum_{t=1}^{T} \frac{C_t}{(1 + IRR)^t} - C_0$$

Where,

C_t = Net cash inflow during the period t

C_0 = Total initial investment costs

IRR= The internal rate of return

t = The number of time periods

In general, the higher a project's internal rate of return, the more desirable it is to undertake. IRR is uniform for investments of varying types and, as such, IRR can be used to rank multiple prospective projects on a relatively even basis. Assuming the costs of investment are equal among the various projects, the project with the highest IRR would probably be considered the best and be undertaken first.

IRR is sometimes referred to as "economic rate of return" or "discounted cash flow rate of return." The use of "internal" refers to the omission of external factors, such as the cost of capital or inflation, from the calculation.

3.3.1.3. Weighted Average Cost of Capital (WACC)

The weighted average cost of capital (WACC) (Investopedia, 2019) is a calculation of a firm's cost of capital in which each category of capital is proportionately weighted. All sources of capital, including common stock, preferred stock, bonds, and any other long-term debt, are included in a WACC calculation. A firm’s WACC increases as the rate of return on equity increases because an increase in WACC denotes a decrease in valuation and an increase in risk. By taking a weighted average in this way, it can be determined how much interest a company owes for each dollar it finances.

The formula and calculation used to determine WACC follows:

$$\text{WACC (\%)} = \text{Discount Rate} * (1 - \text{Loan Share}) + \text{Loan Interest} * (1 - \text{Tax}) * \text{Loan Share}$$

A high weighted average cost of capital, or WACC, is typically a signal of the higher risk associated with a firm's operations. Investors tend to require an additional return to neutralize the additional risk.

A company's WACC can be used to estimate the expected costs for all of its financing. This includes payments made on debt obligations (cost of debt financing), and the required rate of return demanded by ownership (or cost of equity financing).

Most publicly listed companies have multiple funding sources. Therefore, WACC attempts to balance out the relative costs of different sources to produce a single cost of capital figure.

3.3.2. Financial Data

Following the cost calculation of the energy upgrade, the ESCO has to draw up a financial plan so that it has a clear picture of the depreciation time of the investment and the degree of profitability. Taking into account, the total amount of investment, the ESCO will cooperate with a bank (Third Party) in order to finance the project, due to lack of capital.

In the table below, there is a financial analysis for the project referred:

Table 3.3-1: Financial Data

Electricity Price [€/kwh]	0,12
Annual Lighting Saving [kwh]	1574,27
Annual Cooling & Heating Saving [kwh]	64089,37

Year	Annual Light Savings [€]	Annual Cooling & Heating Savings [€]	Total Annual Savings [€]	Depreciation	Total CapEx
1	188,91 €	7.690,72 €	7.879,64 €	4%	- 41.592,90 €

Revenues (€)		Expenses	Loan (€)				Taxation (€)				Nominal Values (€)				Present Values (€)			
Year	Gross Revenues	Operating costs	Annual installment+interest	Installment	Interest	Remaining Loan	EBITDA	Depreciation	EBT	Tax	Net Cash Flow	Free Net Cash Flow	Cumulative Net Cash Flow	Discount Factor	Net cash flow	Cumulative Net Cash Flow	IRR (%)	Years of depreciation
0						41.592,90 €					- 41.592,90 €	- 41.592,90 €	-41.592,90 €	1,00	- 41.592,90 €	- 41.592,90 €		
1	7.879,64 €	2.400,00 €	9.082,00 €	7.834,21 €	1.247,79 €	33.758,69 €	5.479,64 €	1.613,16 €	2.618,69 €	523,74 €	- 4.126,10 €	4.955,90 €	-36.637,00 €	1,02	4.839,74 €	- 36.753,16 €	-88%	1
2	7.879,64 €		9.082,00 €	8.069,24 €	1.012,76 €	25.689,45 €	7.879,64 €	1.613,16 €	5.253,72 €	1.050,74 €	- 2.253,11 €	6.828,89 €	-29.808,11 €	1,05	6.512,54 €	- 30.240,61 €	-53%	1
3	7.879,64 €		9.082,00 €	8.311,32 €	770,68 €	17.378,13 €	7.879,64 €	1.613,16 €	5.495,79 €	1.099,16 €	- 2.301,52 €	6.780,48 €	-23.027,63 €	1,07	6.314,81 €	- 23.925,80 €	-31%	1
4	7.879,64 €	400,00 €	9.082,00 €	8.560,66 €	521,34 €	8.817,48 €	7.479,64 €	1.613,16 €	5.345,13 €	1.069,03 €	- 2.671,39 €	6.410,61 €	-16.617,02 €	1,10	5.830,42 €	- 18.095,39 €	-17%	1
5	7.879,64 €		9.082,00 €	8.817,48 €	264,52 €	0,00 €	7.879,64 €	1.613,16 €	6.001,95 €	1.200,39 €	- 2.402,75 €	6.679,25 €	- 9.937,77 €	1,13	5.932,36 €	- 12.163,02 €	-8%	1
6	7.879,64 €		0,00 €	0,00 €	0,00 €	0,00 €	7.879,64 €	1.613,16 €	6.266,48 €	1.253,30 €	6.626,34 €	6.626,34 €	- 3.311,43 €	1,15	5.747,43 €	- 6.415,59 €	-2%	0
7	7.879,64 €	400,00 €	0,00 €	0,00 €	0,00 €	0,00 €	7.479,64 €	1.613,16 €	5.866,48 €	1.173,30 €	6.306,34 €	6.306,34 €	2.994,91 €	1,18	5.341,68 €	- 1.073,91 €	2%	0
8	7.879,64 €		0,00 €	0,00 €	0,00 €	0,00 €	7.879,64 €	1.613,16 €	6.266,48 €	1.253,30 €	6.626,34 €	6.626,34 €	9.621,25 €	1,21	5.481,18 €	4.407,27 €	5%	0
9	7.879,64 €		0,00 €	0,00 €	0,00 €	0,00 €	7.879,64 €	1.613,16 €	6.266,48 €	1.253,30 €	6.626,34 €	6.626,34 €	16.247,59 €	1,24	5.352,72 €	9.759,99 €	7%	0
10	7.879,64 €	400,00 €	0,00 €	0,00 €	0,00 €	0,00 €	7.479,64 €	1.613,16 €	5.866,48 €	1.173,30 €	6.306,34 €	6.306,34 €	22.553,93 €	1,27	4.974,83 €	14.734,81 €	9%	0
Total	78.796,37 €	3.600,00 €	45.410,00 €	41.592,90 €	3.817,10 €	127.236,64 €	75.196,37 €	16.131,60 €	55.247,67 €	11.049,53 €	- 22.856,07 €	22.553,93 €	22.553,93 €		14.734,81 €	14.734,81 €	9%	5

The table above presents the financial plan of ESCO's technical interventions. Given the kWh pricing at 0,12€, it has been estimated that the annual gross revenues will be 7.879,64€ and the total gross revenues for a 10-year period will be 78.796,37€. The annual gross revenues will come from the sum of the annual lighting savings (188,91€) and the annual cooling and heating savings (7.690,72€).

It has been calculated that the operating costs will be 2.400,00€ in total. To come up with this amount we took into consideration that we have employed 2 people for one month. Each of the 2 employees will receive a remuneration of 1.200,00€. Furthermore, an extra employee, is needed, in order to perform a scheduled maintenance every 3 years. The cost of each maintenance will be 400,00€.

The total capital expenditure will be 41.592,9€, which will be funded by a third party. The business loan will be amortized in 5 years with an interest rate of 3%. The annual installment plus interest will be fixed at 9.082,0€.

The total amount of taxes for a 10-year period will be 11.049,53€. To come up with this result we factored in a 4% annual depreciation rate.

According to the financial plan, it is estimated that the NPV at the end of the decade will be 14.734,81€. The NPV derives from the sum of each year's net cash flow in present values minus the total capital expenditure. The annual net cash flow in present values derives from dividing the corresponding annual free net cash flow in nominal values with the annual discount factor.

The course of IRR fluctuation indicates that the business plan will become profitable after the first 6 years of depreciation. Taking into consideration the final rate of IRR (6%), the ESCO should decide to go ahead with the plan which will result in a high profit.

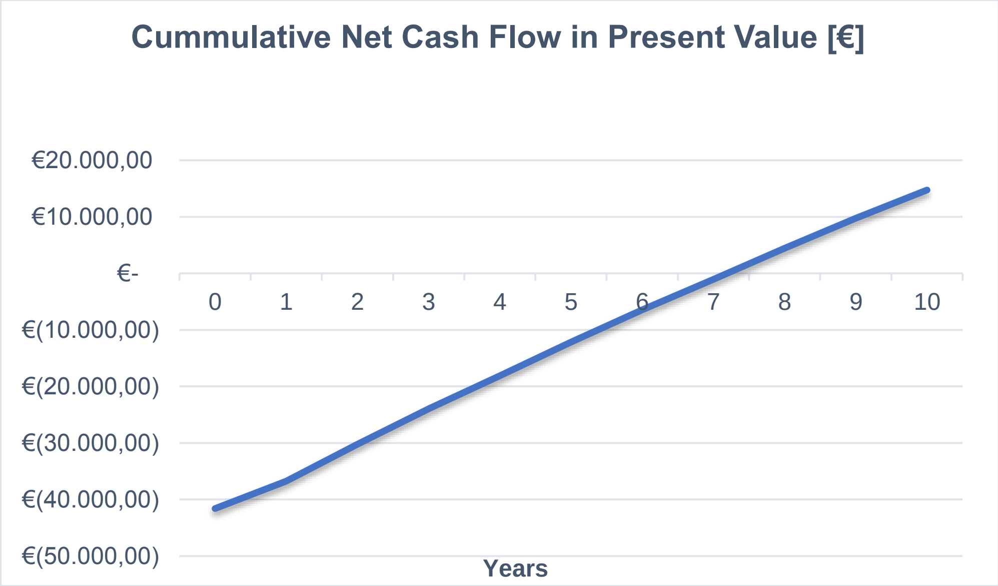

Figure 3.3-1: Net Cash Flow in Present Value

Figure 3.3-2: IRR in relation to years

3.3.3. Scenario Analysis

3.3.3.1. Variance analysis of electricity price

Taking into account that the price of kWh is constantly changing, a scenario analysis is calculated for different prices of kWh. Moreover, we calculated the NPV & IRR values for each price. The table below, shows the fluctuation of NPV and IRR values according to the price of kWh.

Table 3.3-2: Calculation of NPV & IRR in relation to electricity price

Electricity Price (€ per kWh)	Net Present Value (NPV)	Internal Rate of Return (IRR)
0,07	-8.184,20 €	-2%
0,08	-3.397,45 €	1%
0,12	15.264,75 €	9%
0,14	24.595,84 €	12%
0,16	33.926,94 €	16%
0,20	52.589,13 €	22%
0,22	61.920,23 €	25%

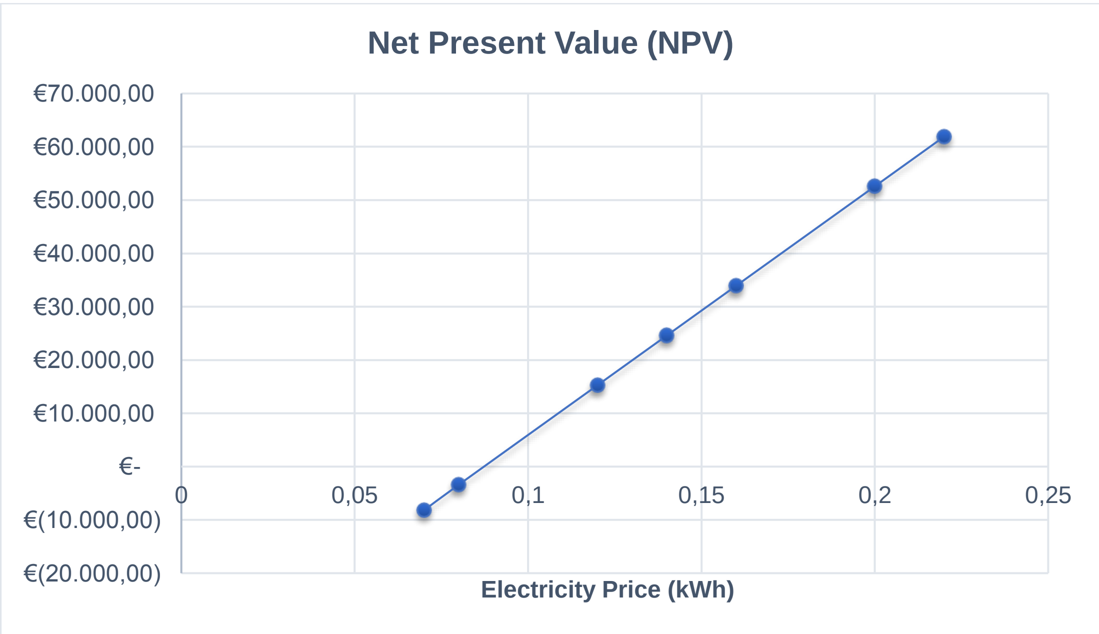

Figure 3.3-3: NPV in relation to electricity price of kWh

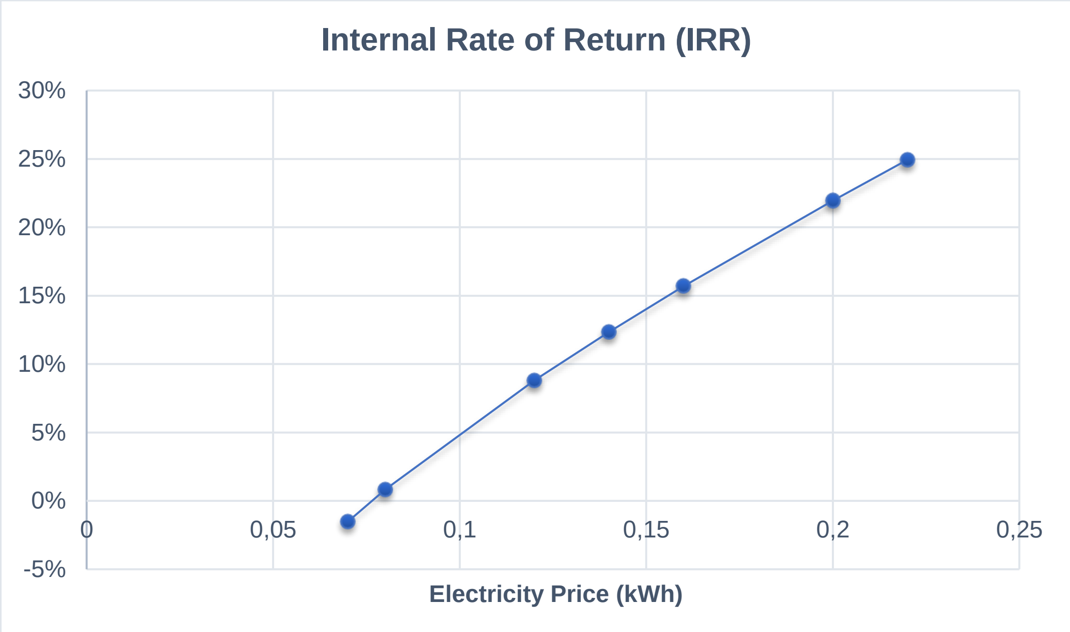

Figure 3.3-4: IRR in relation to electricity price of kWh

3.3.3.2. Variance analysis of WACC

As it was aforementioned at previous section, a high weighted average cost of capital (WACC), is typically a signal of the higher risk associated with a firm's operations. Therefore, a scenario analysis will be carried out, in order to be analysed the WACC figure. The parameters that affect WACC, such as loan interest, tax and discount rate will remain stable, converting only the loan share in the WACC formula. The table below, shows the fluctuation of WACC value according to the loan share.

Table 3.3-3: Calculation of WACC in relation to loan share

Loan Share (%)	Dicount Rate	Loan Interest	Tax	WACC (%)
80	8%	3%	20%	3,52
60	8%	3%	20%	4,64
40	8%	3%	20%	5,76
20	8%	3%	20%	6,88
10	8%	3%	20%	7,44

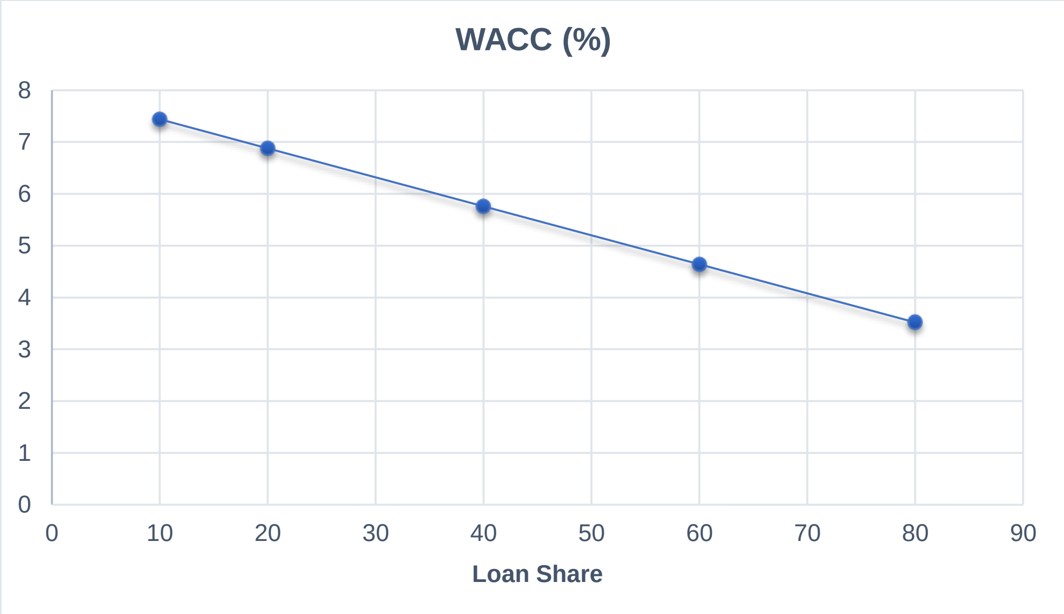

Figure 3.3-5: WACC in relation to loan share

3.3.3.3. Variance analysis of tax

The effective tax rate is the average tax rate paid by the company on its earned income. Net income shows how much revenue a company is able to keep after deducting taxes, and the two preceding line items should identify both revenue and taxes paid. In the financial analysis, the tax was equal to 20%. However, variation of tax needs to be analysed, as NPV, IRR and WACC indicators are linked with the tax rate. The table below, shows the fluctuation of tax rate in accordance with NPV, IRR and WACC.

Table 3.3-4: Tax rate fluctuation

Tax (%)	NPV (€)	IRR	WACC
20	14734,813	9%	2,40%
22	13946,674	8%	2,34%
26	12353,371	7%	2,22%
28	11548,124	7%	2,16%
30	10737,091	7%	2,10%
35	8683,917	6%	1,95%
37	7852,299	5%	1,89%
40	6593,649	5%	1,80%

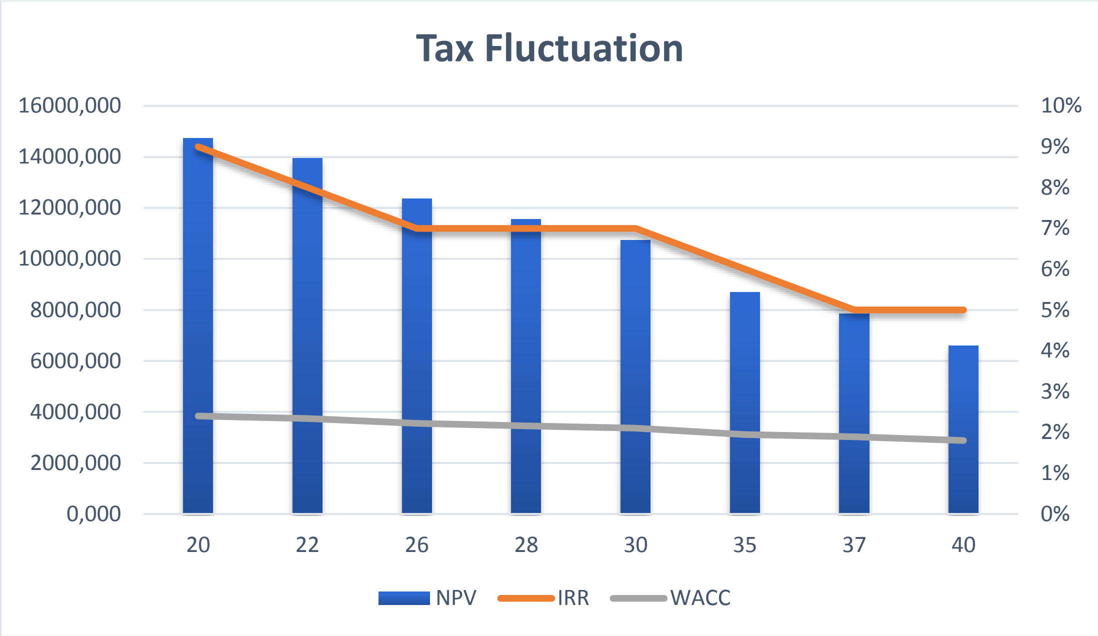

Figure 3.3-6: Tax rate in relation to NPV, IRR and WACC indicators

4. CONCLUSIONS

Regarding the aforementioned, this section presents the conclusions drawn from the technical financial analysis as they have been analysed in the previous chapters.

As far as the technical measurements taken are concerned, it has been found that the replacement of cooling and heating system is the optimal choice, which achieves the maximum possible energy savings. More specifically, 64.089,37 kWh per year are achieved, compared to replacing the lighting of 1.574,27 kWh per year. On the payback side of the investment, however, it is noted that both the replacement of the lamps and the replacement of heating and cooling system have the same repayment. This is proven because the calculated breakeven point is 5,3 years for both technical interventions.

As it was mentioned above, banks do not finance small investment projects (< 100.000 €), as they are considered to be non-economically advantageous. However, the financial analysis includes some strict parameters (discount rate, loan duration and IRR=9), which create credibility, thus reducing the probability of non-repayment of the loan. In addition, the investment plan in this case is considered competitive, as the Net Present Value is positive, making it profitable.

The financial analysis is of particular importance for the ESCO, as its repayment will come from the energy savings calculated and ultimately achieved by the energy audit of the enterprise. As a result, various scenarios have been calculated to prevent ESCO from facing credit risk. These scenarios concern some variable parameters, such as the electricity price and the weighted average cost of capital (WACC).

The assumption in the first scenario regards the constantly changing price of kWh. Observing the fluctuation of the kWh price, for a small charge, such as 0,07€ per kWh, it appears that the investment plan is considered to be unprofitable, as the values of IRR and NPV are negative. On the contrary, increasing the electricity price at 0,22€ per kWh, the investment yields greater profits than the existing price.

The second scenario concerns the calculation of WACC in relation to loan share. Reducing the loan share but keeping the loan interest, discount rate and tax parameter stable, the value of WACC was increasing. In this case, a higher WACC means a signal of higher risk associated with ESCO's operations. Thus, ESCO should analyse all financial ratios, in order to select the plan with the minimum credit risk.

The last scenario investigates the fluctuation of tax rate, which is a critical indicator for the sustainability of the financial plan. Since Greece had not been in a financial stability in recent years, the tax rate factor was subject to constant changes, with its gradual increase. As a result, investment plans for both large and small businesses were sparse, given the country's volatility. Taking into account the aforementioned figure, a reduction in tax rate leads to an increase of NPV and IRR, which are significant indicators of the profitability of a business plan.

4.1. Suggestions for further research

The viability of ESCOs depends very much on the legislative framework and the financial regime. Particularly in Greece, although the institutional framework for the operation of such companies has been defined, competition is relatively small, with large firms having the largest market share. Therefore, SMEs operating in that sector, should be encouraged by financial incentives, in order to gain market share and be able to be competitive in their services.

Both Europe and each Member State, promoting Europe's energy efficiency goals, should use appropriate tools (legal, financial) so as to expand the ESCO market. Taking into account that EU has set stricter targets, according to Renewable Energy Directive II (EU) 2018/2001 (European Parliament, 2018), such as 32% increase in energy efficiency by 2030, competitive opportunities are created for the sustainability of ESCOs.

As far as banks are concerned, they should pay particular attention to the ESCO's business plan as well as their energy saving rate and offer competitive loans with low interest rates and large repayment times. There should be a variety of energy funding upgrading programs, such as JESSICA or ELECTRA, developed through a special account in the Deposits and Loans Fund and financed by the national or co-financed part of the Ministry of Environment and Energy's Public Investment Program (SAP).

Another point to be considered is the fact that the ESCO's amount of profit largely depends on the price of electricity (kWh). This implies that if the price drops too much, the investment plan is considered unprofitable and therefore increases the ESCO's viability risk. Therefore, the need for further research on eliminating this possibility is urgently needed.

Taking into account that ESCOs are closely linked with the energy efficiency, they should have a well-trained staff in the field of energy saving, in order to respond to the complexity of each project and achieve maximum savings. In addition, ESCOs should promote continuous training of staff in energy saving issues, such as ISO 50001 Management System or other related seminars.

The scope of present thesis analyses the Third – Party Financing for the implementation of technical interventions. By far, the most significant tool for financing EPC projects in Greece is debt borrowed by clients (41%) followed by operating leases (29%). As it was studied, debts are a much more common way as they represent top 2 ways of financing while grants and subsidies stand as third option. The explanation is that the small ESCO's currently existing in Greece have no access to financing mainly due to their small size but also due to the prohibitive interest rates being provided by the commercial banks. On the other hand, the larger ESCOs or multinationals that are prospective ESCOs who either have funds and/or access to financing are not willing to invest in such ventures until the country pulls itself out of the recession. Therefore, the preferred option for the implementation of such projects is the financing by the client or the provision of operating leases, a solution that most commercial banks seem to prefer due to its smaller risk (Botzios-Vaskalakis, 2018). However, as it was mentioned in previous chapters, another way of financing, refers to internal funds of ESCO, which could be suitably enhanced by financial tool and become a competitive solution, after further research upon the ESCO financing in Greece.

Last but not least, as it was aforementioned, the purpose of this thesis is to introduce the concept of business model of ESCOs in Greece, which are not particularly developed at national level in contrary with other EU Member States, and to motivate for further research, so as to be found a more effective methodology, which may establish them at a greater extend.

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