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Energy Performance Contracting and Public-Private Partnership: How to Share Risks and Balance Benefits

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Abstract: Public private partnerships (PPPs) are a well-known instrument used worldwide by public administration (PA) to build public infrastructure using private knowhow and financial resources, and sharing risks. In recent years, PPPs have been widely adopted to develop energy efficiency projects between public and private sectors. In this context, a successful project requires a contractual arrangement based on energy performance contracting (EPC) that balances the interests of the two parties. This paper aims to answer two questions: how to share the benefits between the contractual parties and reach an optimal long-term contractual agreement; and which type of contract ensures a consistent risk transfer to the private partner, allowing the PA an "off balance" accounting treatment. The research questions are answered through the development of a mathematical equation able to calculate the optimal percentage of benefits sharing between partners in a long-term contractual agreement. The results are tested with a simulation based on a case study about the energy efficiency project of an Italian hospital. The paper is innovative because it provides suggestions to improve the EPC-PPP contractual structure and realize a balanced agreement between the public and private partners. Moreover, it analyzes the different allocation of risks in EPC contracts to identify the implication for the PA in terms of on-off balance accounting treatment in energy efficiency investment. We show how a successful long-term EPC-PPP can benefit from a mixed contractual structure in which profit-sharing percentage changes during the contract's life to ensure the same net present value (NPV) to both public and private partners. This paper supports public decision making in order to choose contracts that are able to transfer energy and management risks. Moreover, it helps to understand the balance between public and private interests in a long-term EPC-PPP contract.

Keywords: public private partnership; energy performance contracts; risks; performance monitoring technologies; accounting treatment

1. Introduction

Energy performance contracts (EPC) were first developed in the 1970s and gradually become one of the most used approaches to energy savings and emission reduction. Many European and non-European countries use EPC contracts to reach the goal of sustainable development in line with European Commission directives that require matching the objectives fixed in the European energy policy plan 2030 [1]. The target is a share of at least 32% for renewable energy and at least 32.5% in energy efficiency improvement by the end of 2030.

As reported in the "Energy Efficiency Report 2019" [2], the total of investments in energy efficiency in 2018 in Italy were equal to approximately euro 7.1 billion. The trend of the last 5 years has been very positive, recording a CAGR (compound annual growth rate) of 12%. The Home and Building segment leads the investment ranking (with 65% of the total), followed by the industrial sector (overall around euro 2.3 billion, just under 33%) and finally the Public Administration, with 2% of the total investments.

The public administration, although it accounts for only 2% of the total, has the largest increase compared to 2017 (+12%) and, in recent years, many deals have been launched by the PA under PPP schemes.

In general, these deals are arranged by a private entity, usually an energy service company (ESCO), that provides energy audit, energy savings, technological development and performance-based projects to the public administration (PA) [3–7].

These contracts can be classified as public private partnerships (PPPs); nevertheless, the notion of PPPs is not commonly shared [8,9]. Some countries, including Italy, consider any partnership between public and private as PPP. Other countries, in line with Eurostat guidance, consider PPP as the agreements in which the main payer of the services is the PA [10,11]. The EU defines PPPs as "long-term contractual arrangements between a government body and a non-government partner, usually for public service building projects. The partner is responsible for building, operating and maintaining an asset, and in exchange the government body pays regular fees to the partner" [1].

According to the Eurostat decision and international public sector accounting standards (IPSAS), it is possible to consider the investment "off" public accounts (so called "off-balance accounting treatment") only if the main risks of the project are transferred to the private partner. PA has a strong interest in off-balance treatment due to public budget constraints [12–17].

In recent years, the promotion of the energy efficiency of public buildings and environmental and social sustainability became a central issue for public administrations (PA). For this reason, many administrations are signing energy performance contracts (EPC), mainly with energy service companies (ESCO), to perform activities related to the provision of energy services. These services involve investments such as the co-generation of plants, heating systems, air-conditioning plants, the thermal insulation of buildings and the installation of solar panels or led lights [18–21].

The implementation of these energy efficiency systems is normally accompanied by the introduction of technologically advanced systems of performance monitoring [22], which are becoming an important part of the deal.

These systems are based on intelligent buildings and internet of things (IoT), that allow real-time energy monitoring and control in order to improve energy-saving and efficiency [23,24].

These monitoring systems are even more important in the context of PPP because they enable a better allocation of performance risks between partners, allowing PA to develop control activities and performance-based mechanisms.

This type of contract (here called EPC-PPP contracts) presents typical features (mainly fixed price and risks transfer) that perfectly match public–private partnership (PPP) schemes. Nevertheless, the possibility of accounting these contracts' off-balance is not always shared in practice and in the literature.

In 2017 Eurostat clarified how to account EPC contracts in national accounts, specifying that "For an EPC to be recorded off government balance sheet, the EPC contractor must be considered as the economic owner of the assets installed, which means that it will have to be the entity incurring most of the risks and benefitting from most of the rewards related to the EPC contract.". In the past, researchers, operators and the legislator focused on issues such as: (i) the contract life, (ii) the existence of contracts, whether government provides financing or other guarantees to the EPC provider, (iii) on the clauses able to distort the distribution of the risks and rewards in a the EPC contracts.

In addition, it is important to check if the EPC contractor is classified outside the general government sector.

Moreover, the EU commission affirms that "The possibility of off balance sheet recording can make the use of EPCs more attractive, allowing governments to invest in energy savings while complying with the debt and deficit thresholds established in the Maastricht Treaty".

The issue of risk transfer from public-to-private will be consequently examined, showing that there are two main operational risks to allocate: energy performance risks (EPR) and operation performance risks (OPR). For both, advanced monitoring systems have a positive impact on risk allocation and, consequently, on the off-balance treatment.

The paper answers a major problem encountered on the market regarding how to set PPP-EPC deals, which equally share benefits between the public and private partners and can be counted as off-balance by the PA because of an allocation of the projects' risks, consistent with the legal framework.

The goal of the first part of the paper is to identify and discuss the main risks that discourage or limit the adoption of EPC contracts, including on–off balance, accounting for the treatment of the energy investments.

The second part of the paper is focused on the PA decision-making process, in line with some authors [25–27]. We will try to identify a sustainable model for building energy efficiency and, in particular, a model able to minimize the difference between the net profit (NPV) gained by the contractual parties, ensuring a balanced condition [28].

The use of NPV in the evaluation of PPPs is also suggested in the PPP guidelines 2018 by the Italian contract authority (ANAT) that require, in a private proposal, an NPV near zero to avoid extra profit from the investments.

Building upon the model proposed by Carbonara and Pellegrino [28] for "assessing and benchmarking the net benefit of different EPC structures", this paper aimed to identify a new contract structure able to minimize the difference in net present value (NPV) gained by the contractual parties in a long-term agreement.

The paper answers the following research questions.

1. Which kind of "PPP-EPC contracts are able to provide an optimal allocation of the risks ensuring an off balance accounting treatment of the investment?
2. Which contractual structure is able to minimize the difference of the net present value (NPV) gained by the contractual parties' in a long term agreement?

The paper is organized as follows: Section 2 examines risk allocation in PPP-EPC contracts and discusses how to share the benefits of EPC contracts. Section 3 presents the methodology and a numeric simulation on a case study. Section 4 discusses the results obtained. Section 5 presents the conclusions, policy implications and limitations of the paper, identifying future research activities.

2. PPP-EPC Contracts: How to Allocate Risks and Share Benefits

The EPC contracts define parties' obligations and rights and can be based on different models of delivering public energy efficiency projects.

According to the literature, their adoption is still far from its full potential, mainly because of two unresolved issues [28]:

i. "The dilemma of equally sharing the benefits between the public and private parties so as assuring a win-win condition;
ii. The lack of adequate public procedures that support the selection of the most appropriate EPC scheme given certain circumstances and projects' characteristics".

These authors classify, under the EPC contracts umbrella, three different contractual agreements:

i. Guaranteed savings contracts, in which the ESCO designs, implements and manages the project but is not responsible for its financing;
ii. Shared savings contracts, in which the ESCO designs, implements and manages the project and shares an agreed percentage of energy savings with the client. The ESCO also bears the financial risks;

iii. First out contracts, in which the ESCO designs, implements and manages the project, retaining 100% of the energy savings until the end of the contract. In this case, the greater is the savings, the shorter the contract should be. Moreover, the ESCO bears financial risks.

These three contractual models provide a different risk allocation.

A vein of the literature observes that energy performance contracting faces many severe risks that hinder its development [3,29]. These authors identify some key risk factors, and propose some policy actions to decision-makers to promote the harmonious development of EPC.

They focus on 21 risk factors, divided into five categories:

1. External environmental risks;
2. Managerial and operational risks;
3. Financial and market risks;
4. Technical risks;
5. Client risks.

Moreover, some authors [30–32] analyze the advantages of EPC mechanism to deliver energy efficiency projects and explore the critical success factors of EPC [33,34], identifying three main barriers to carrying out these projects in the public sector:

i. Budget constraints;
ii. Absence of an efficient management;
iii. Lack of technical skills.

While many authors focus on the advantages, disadvantages, efficiency and risks of EPC contracts, few authors address the peculiarity of the public procurement process and the ability to choose EPC schemes balancing the private and public sectors' economic and non-economic interests.

The gap in the literature also concerns the analysis of operational risk allocation and its effects on the accounting treatment of EPC-PPPs, particularly when new technologically advanced Systems for Performance Monitoring are provided. Risk transfer is essential for PPP, especially if Eurostat rules apply. For public administrations, the accounting treatment was initially based on the so-called 'risk and reward' criteria, as described in the Eurostat Decision 2004. Later on, the risk assessment in PPPs was regulated by the implementation of ESA 2010 (Manual on Government Deficit and Debt (2016), Chapter IV 5 'Treatment of PPP').

Manual on Government Deficit and Debt (2016) solved the critical question of whether a PPP should be counted as 'on balance' or 'off balance' for the public administration. The 'risks and rewards' criteria drives the decision of how to classify the infrastructure in the public financial statements. Traditional PPPs were criticized for their inability to correctly transfer risk [35,36], producing, as a consequence, an on-balance accounting treatment.

According to Eurostat rules, the assets are non-governmental and counted as "off balance" only if the grantee bears the construction risk, and at least one availability or demand risk.

For the public procurer, "on-balance" investments impact public debts, becoming hardly viable. This is also the case when the public grants exceed 50% of the construction expenditures or when financing risks or guarantees entail that the capital of the private partners is not at risk. Moreover, the assets are counted as "on balance" by the PA when contracts' penalties are considered to be insufficient to move the availability risk for the private partner.

On the contrary, construction risk is transferred to the private partner when the latter capital is at risk during the construction phase and when the availability risk is transferred through severe penalties in case of underperformance.

In the past, some authors criticized PPPs [9,36,37] because their risk transfer was judged "a disaster" as a consequence of the government bearing most of the risk involved in the projects, particularly in projects providing innovation.

This resulted in more cautious attitudes towards risk, especially when associated with innovative solutions. In particular, while some authors consider PPP a suitable instrument for financing innovation [12,38], others [39] consider the private partner as little inclined to assume any additional risk associated with innovation.

In EPC-PPPs contracts, innovation in energy-providing is a starting element of the PPP. In particular, it is contractually stated from the initial phase of the awarding procedure. These schemes must be designed to minimize contractual uncertainties, envisaging a clear risk transfer.

It is then necessary to outline how the mechanisms of risk-sharing can be managed, and to lead to additional operational risk for the private partner. These risks are connected to the innovative solutions adopted.

In EPC-PPPs, the private player can take on construction/regeneration risk (where technology improvement is embedded in the agreement from the beginning) and availability risk related to energy efficiency level and management and maintenance standards. In practice, EPC contracts often do not take maintenance and management risks related to service provision into consideration.

Finally, in EPC-PPP projects, demand risk cannot be transferred and remains on the PA as the main users of the assets where the energy efficiency intervention was carried out (schools, offices, hospitals, etc.).

To answer the first research question of this paper, "(1) Which kind of "PPP- EPC contracts are able to provide an optimal allocation of risks ensuring an off balance accounting treatment of the investments?" the risks of each EPC model are analyzed.

In line with the Eurostat Manual of Government Deficit and Debts [40], we consider the following risks:

i. Construction risks, including financial/credit risk;
ii. Availability risks, considering two main risks: operation performance risk "OPR" managed through technological advanced monitoring and control systems, and energy performance risk "EPR";
iii. Demand risk.

To account for the investments which are "off-balance", since the demand risk always remains on the PA, it is necessary to transfer both the construction and availability risks.

Assessing the construction risks in the different EPC models, it can be seen that [41,42]:

i. In "Guaranteed savings contracts", the energy company is responsible for project 'design and implementation and not for its financing. Normally the ESCO guarantees minimum savings to the PA able to ensure the debt service payments. If the savings are insufficient for debt service, the PA has to pay the difference [43]. In this case, there is not a transfer of construction/financial risk to the private and the essential condition for off-balance accounting is lost. Then, the investments are counted as "on-balance";
ii. In shared savings contracts, the energy company is responsible for project design, implementation and financing, and a pre-arranged percentage of energy savings is shared between the private and public partners during a fixed contractual period. Because the ESCO takes on the financial risk, it is possible to count the investment as off-balance if the availability risk is also transferred;
iii. In first out contracts, the energy company finances the investments and retains all the energy savings over a variable contractual period. In this case, it is also possible to count the investment as off-balance if the availability risk is also transferred.

Assessing the availability risk implies analyzing two categories of performance risks [44,45] and in particular:

1. Energy performance risk (EPR), which refers to the ability to reduce energy consumption and is transferred when energy savings (not costs savings) are guaranteed to the PA;

2. Operational performance risk (OPR), which refers to the management and maintenance costs savings (not energy savings) influenced by the ability to set the temperature, time and other variables. Then, the availability risk is transferred when the service standards are respected without interruptions or malfunctions, and it is possible to count the investments as "off-balance".

In this context, technological monitoring and control systems are very useful to ensure an efficient management of the energy services and make available (for the PA) control systems which are useful in monitoring performance indicators and contractual penalties.

From the previous risk analysis in the EPC models, it emerges that:

- In "guaranteed savings contracts" only the EPR risk is transferred, while the operational risk (OPR) remains on the PA. This type of agreement does not allow for a sufficient transfer of risks, and it is counted in the public accounts c.d. as "on-balance accounting treatment";
- In "Shared savings contracts" the ESCO shares an agreed percentage of cost savings with the PA and could bear (or not) both EPR and OPR risks. If both are transferred, and adequate penalties are provided in the contract, the investment is counted as "off-balance". In this context, the ability to continuously monitor and control energy savings is at the basis of a transparent relationship between partners and the application of contractual penalties. If these risks are not transferred, the investment is counted as on-balance;
- In "first out contracts", the ESCO bears the financial risks. Moreover, if both energy performance risks (EPR) and operational performance risk (OPR) are transferred, the investment is off-balance. A peculiarity of this contract is its duration, influenced by the amount of savings achieved. The more the savings are, the less the contract duration. Nevertheless, in PPP agreements, the years of concession have to be certain and identified by contract.

In conclusion, the main variables at risk are:

- The energy price, an exogenous variable, not under the control of the ESCO. This risk is usually shared with the PA through the contractual definition of a min–max range of variance;
- The energy consumption as consequence of the energy efficiency project, whose risk has to be transferred to the ESCO (EPR risk);
- The energy management and assets maintenance as a consequence of the private management of the services, whose risk has to be transferred to the ESCO (OPR risk).

Guaranteed Saving contracts were, in the past, the most used model. Goldman et. al. [18] observed that 86% of EPCs use Guaranteed Saving contracts, probably because they are less risky from the owner perspective [45]. Nevertheless, a shift toward other contractual models becomes attractive when allowing PA to make new investments while complying with the debt and deficit limits established in the Maastricht Treaty.

The accounting treatment of EPC-PPPs contracts according to risk transfer is represented in Table 1.

Only under the illustrated conditions do EPC contractual models provide a risk transfer that ensures an off-balance accounting treatment. During the procurement phase, the PA has to evaluate which risks are transferred carefully if interested in an off-balance accounting treatment.

The transfer of risks is not the only issue in EPC contracts. Another major warning is about using a sub-optimal contractual structure in public procurement. This warning brought Carbonara and Pellegrino [28] to investigate the "dilemma of equally sharing the benefit between the public and private parties". These authors developed a model to assess and benchmark the different EPC schemes for delivering energy efficiency projects in PPP.

Table 1. Accounting treatment of energy performance contracting (EPC)-public private partnerships (PPPs) contracts according to risk transfer.

Type of Contract	Construction/Financial Risks	Availability Risks	Demand Risk	On-Off Balance
Shared savings	The PA is responsible for the debt service (risk not transferred)	Only energy performance risks (EPR) are transferred	not transferred	On balance
	The PA is responsible for more than 50% the debt service or provides a financial guarantee (risk not transferred)	Both energy performance risks (EPR) and operational performance risks (OPR) are transferred	not transferred	On balance
Guaranteed savings	The ESCO is responsible for the debt service (risk transferred)	Only energy performance risks (EPR) are transferred	not transferred	On balance
	The ESCO is responsible for the debt service (risk transferred)	Both energy performance risks (EPR) and operational performance risks (OPR) are transferred	not transferred	Off balance
First out	The ESCO is responsible for the debt service (risk transferred)	Only energy performance risks (EPR) are transferred	not transferred	On balance
	The ESCO is responsible for the debt service (risk transferred)	Both energy performance risks (EPR) and operational performance risks (OPR) are transferred	not transferred	Off balance

The net present value (NPV) method adopted by these authors can calculate the remuneration for ESCO in different contractual agreements. NPV is a very common and widely used profitability index for investments' evaluation.

They stated that, in guaranteed saving contracts, remuneration for the ESCO is (actual cost savings − guaranteed cost savings) * ESCO's excess saving shared percentage, and public body profit is (actual cost savings − guaranteed cost savings) * PA's excess saving shared percentage [28].

In this scheme, the ESCO gains a profit if the actual savings exceed the minimum guaranteed saving and the amount of ESCO profit will depend upon the agreed excess savings shared percentage (actual cost savings * ESCO's excess saving shared percentage), and public body profit is actual cost savings * PA's excess saving shared percentage [28].

Finally, the "First out contract" transfers the whole amount of savings to the ESCO and the high savings contribute to a faster investment amortization, reducing both the contract duration and the financial costs in case of debt repayment.

These authors look for a scheme in which the contract allows ESCO and the government to simultaneously minimize the difference between the NPVs gained. They provide a simulation of input variables (energy price, revenues and costs) in the three different contractual scenarios.

They concluded that the "First out contract" is better to distribute economic benefit between parties, while the "guaranteed saving contracts" maximizes the benefits for the ESCO and "shared savings contract" maximizes the benefits for the PA.

Moreover, they run two sensitivities on (i) the length of the concession and ii) on the discount rate. The first simulation demonstrated that "first out contract" is no longer the best choice in the long term, while "shared savings contracts" are more advantageous for the PA in the long-run because they allow for an equal distribution of benefit between the two parties.

Moreover, they demonstrated that the "discount rate" does not strongly influence the choice of the appropriate contract. From the interesting conclusion of these authors, new considerations arise.

As seen in a PPP, the administration needs to sign a concession contract with a fixed duration, then "first out contract" becomes sub-optimal when the contract lasts beyond the amortization period of the investment.

Then, we assume that: "The solution for an optimal contractual structure, in a fixed long term contractual agreement, is a "Mixed contract that combines a rapid amortization of investments and a re-balancing of public and private interests after complete amortization".

The rapid amortization of the investments is ensured by (the ESCO), retaining the 100% of energy savings until the project costs are fully paid (first out model). Then, the re-balancing of benefits is ensured by the use of a "shared savings mechanism". This assumption is tested through a case study.

3. Methodology

To test this assumption, an equation is developed and tested.

We use the Carbonara and Pellegrino [28] model as an interpretative lens to understand the net benefits gained by public and private partners through an EPC contract, and demonstrate that a new contractual agreement (which we call "mixed contract") is able to ensure the balance of economic benefits for the parties in a fixed-period, long-term concession.

Let us assume the optimal equilibrium condition as the NPV's ESCO and government (G) difference is equal to zero:

$$\text{NPV(ESCO)} - \text{NPV(G)} = 0$$

Equation (1) is used to calculate the NPV (ESCO) over two different periods. The period "1–n" necessary for investment amortization, the period "(n+1)–z", where z is the end of the concession contract:

$$\text{NPV(ESCO)} = -\text{I}_0 + \sum_{t=1}^{n}\left(\frac{\text{CF ESCO}}{(1+\text{i})^{t}}\right) + \sum_{k=n+1}^{z}\left(\frac{\text{CF ESCO} * \text{x}\%}{(1+\text{i})^{k}}\right) \quad (1)$$

$-\text{I}_0$ = Investment
CF ESCO = cash flow ESCO
x% = percentage of profit sharing ESCO
1−x% = percentage of profit sharing government
n = year of complete amortization of the investment (break even)
z = year of end of the contract
i = discount rate %

Equation (2) is used to calculate the NPV(G) under the same conditions, but assuming the government obtains a value of investment from the partners to repay with energy savings cash flows (CF Gov):

$$\text{NPV(G)} = +\text{I}_0 + \sum_{t=1}^{n}\left(\frac{-\text{CF Gov}}{(1+\text{i})^{t}}\right) + \sum_{k=n+1}^{z}\left(\frac{\text{CF ESCO}*(1-\text{x}\%)}{(1+\text{i})^{k}}\right) \quad (2)$$

where:
$+\text{I}_0$ = Investment achieved
−CF Gov = cash flow paid by government
CF ESCO = cash flow ESCO
x% = percentage of profit sharing ESCO
1−x% = percentage of profit sharing government
n = year of complete amortization of the investment (break even)
z = year of end of the contract
i = discount rate %

Equation (1) quantifies the NPV of the ESCO. It is the sum of the net cash flows earned by the energy company until the amortization of the investment (year n), and the net cash flows earned until the last year of concession (year z), because of the activation of the profit sharing option.

Equation (2) quantifies the NPV of the government by the sum of the net cash flows paid (until year n), and the net cash flows earned until the end of the contract (year z) because of the activation of the profit-sharing option.

Equation (3) quantifies the optimal profit-sharing % in year n + 1, based on the assumption that NPV (ESCO) – NPV (G) equal to 0.

In particular, NPV (ESCO) is given by the investment paid ($-\text{I}_0$) in time zero, as repaid by the 100% of savings (until year n), and by a recognition of a percentage of total savings in the period n + 1 to z (after investment amortization).

The NPV (G) is given by the value of investment achieved ($+I_0$), with less savings paid (or renounced) in favor of the ESCO, plus the % of savings earned after the amortization of the investment. This theoretical NPV is affected by real and figurative outflow (including savings renounced by the PA).

$$\begin{aligned}\left(-I_0+\sum_{t=1}^{n}\left(\frac{\text{CF ESCO}}{(1+i)^t}\right)+\sum_{k=n+1}^{z}\left(\frac{\text{CF ESCO}*x\%}{(1+i)^k}\right)\right)\\ -\left(+I_0+\sum_{t=1}^{n}\left(\frac{-\text{CF Gov}}{(1+i)^t}\right)\right.\\ \left.+\sum_{k=n+1}^{z}\left(\frac{(-\text{CF ESCO}*x)*(\text{CF ESCO}*(1-x\%)}{(1+i)^k}\right)\right)=0\end{aligned} \quad (3)$$

By using the proposed Equation (3), it will be possible to determine the optimal percentage of profit-sharing over a long-term contract or to re-determine this percentage for contract re-balancing when savings are changed during the concession period.

Numeric Simulation on A Case Study

A numerical simulation is used to demonstrate our assumption. Data and general information for the simulation have been collected from internal documents and talks with public officer in charge of the project of energy efficiency of an Italian Hospital. Because the project is still in the tender phase, the name of the hospital is kept confidential and we call it "AL Hospital".

The PPP-EPC-contract of "AL Hospital" has two central elements:

1. Energy efficiency, rationalization and compliance, through investments, partly "guided" by hospital requirements, and partly by the "free" or "free proposal" part of the competing Economic Operator during the tender;
2. The transfer of management and maintenance risks, both in relation to the existing hospital assets.

The project is going to be realized with a PPP-EPC contract, which aims to achieve environmental comfort performance indicators (temperature, relative humidity, air changes, lighting, etc.), with a "control room" for the constant measurement and verification of the compliance with contractually defined objectives.

The contract structure aims to ensure an agreed level of performance through proper management and maintenance of the assets, mainly focusing on energy services (heating and continuous thermal services, cooling/air conditioning, trigeneration of heating, cooling and electrical energy). Because both OPR and EPR are going to be transferred to the private partner, the investment (in the management opinion) will be counted as off-balance.

Nevertheless, as the contract has not been signed yet, a simulation on the NPV achievable by the project under different contractual agreements (shared savings, first out, first out + option of shared savings) is carried out to demonstrate the convenience of a "mixed contract" in a long-term concession contract of 16 years (1 year construction and 15 years management).

As has been seen, the project refers to an EPC-PPP contract for building energy efficiency in the health sector. In particular, the AL (Alessandria) Hospital launched a public procurement to identify a private operator able to realize euro 10 million investments and manage the related energy services for a value of about euro 9.9 million per year.

ESCO retains 100% savings to amortize the investments. Savings amount euro 1.3 million per year on a total expense of euro 9.97 million. The concession is assumed to be 16 years. The discount rate is assumed to be 5%, in line with the European Commission recommendations. The EU suggests using a 5% financial discount rate as a benchmark for financial investment projects who use EU funds. However, values that deviate from the 5% may be accepted due to: (i) specific macroeconomic conditions in the member state, (ii) investor nature (iii) the sector of activity (e.g., hospitals, environment, energy, etc.). Nevertheless, in the literature, Carbonara and Pellegrino [28] demonstrated that the "discount rate" does not strongly influence the choice of the appropriate contract.

The period of analysis and calculation is assumed to be 1 year for construction and 15 years for cash flows.

Actual and "to be" energy and management costs are reported in Table 2.

Table 2. Current and expected expenses for energy services in AL Hospital.

Costs of Energy and Service Management	Current Expenses (€)	Expected Expenses (€)
Management services	-	323,784
Heat (energy component)	4,965,000	3,855,906
Air conditioning (energy component)	3,000,000	2,548,879
Central cogeneration management	1,566,000	1,509,116
Maintenance of electrical systems, generator sets	155,000	190,000
Fire maintenance	80,000	80,500
Sanitary water maintenance	110,000	150,000
Total	9,968,000	8,658,185
Savings		1,309,815

Current expenses are the expenses incurred by the administration before the energy efficiency intervention. Expected expenses are the expenses incurred by the administration after the energy efficiency intervention. Their difference measures the annual savings obtained through Energy efficiency investments.

On the basis of these assumptions, it is possible to calculate the NPV (ESCO) and NPV (G) under the following contractual structures: "shared savings contract", "first out contract" and "mixed contract".

4. Main Findings and Discussion

In the "first out contract" (first column), the NPV (ESCO) is euro 3.4 million due to earnings of euro 1.30 million per year for 15 years, without any sharing mechanism of savings with the government. Because the whole amount of cost savings is paid to the ESCO, we have a fast investment amortization and debt repayment, with the ESCO gaining extra profit equal to the savings from the end of the amortizations of the investments until the end of the concession. The ESCO gets an IRR (internal rate of return) of 10%.

Vice versa, the PA waives a cash flow of 1.3 for 15 years in exchange for an investment of 10 million euro. The NPV of the government is then euro −3.4 million, because the contract period is higher than necessary and extra profits are generated (from year 11) only to the benefit of the ESCO without any re-distribution to the government. Only by setting the end of the contract to be in 10 years can the NPV of the partners be balanced.

In the "sared saving contract" (second column), the NPV (ESCO) is 0.8 million. We assumed the ESCO is gaining 80% of savings (euro 1.05 million) per year for 15 years to amortize an investment of euro 10 million. The government gets 20% of savings (euro 0.26 million), which reduces the amount spent (or virtually spent) every year for the services provision. This means that the PA waives a cash flow of 0.79 million (euro 1.05–euro 0.26) for 15 years in exchange for an investment of euro 10 million. The difference between NPV (ESCO) and NPV (G) is negative because the PA gets an NPV higher than the NPV (ESCO). The NPV (G) is theoretical because it does not involve a real financial outflow towards the PA, but only measures the value for money that the PA forgoes during the concession.

Therefore, this model is more convenient for the PA (compared to the first out contract); nevertheless, it is still sustainable for the ESCO, which is able to amortize the investment in 14 years with an IRR of 6%.

In the "mixed" model (third column), the NPV (ESCO) is euro 1.1 million. The ESCO earns euro 1.30 million for the first 10 years over 15 of management, than the percentage of profit sharing is calculated according to Equation (3). Then, from year 11 until the end of the concession, the ESCO earns only euro 0.43 million. From year 11, energy savings are shared according to Equation (3) in about 32.5% to ESCO and 67.5% to the PA. The equation used to calculate the profit-sharing percentage allows partners to achieve the same NPV at the end of the contract. Moreover, because partners share the savings only after the amortization of the investments, the ESCO is able to: (i) to maximize its internal rate of return and (ii) reduce the amortization period improving the projects' bankability (Table 3).

Table 3. Net present value comparison in EPC contracts.

Simulation and Results	First Out Contract	Shared Savings Contract (80% ESCO – 20% Government)	First Out + Shared Savings "Mixed Contract"
NPV (ESCO) (million euro)	3.4	0.8	1.1
NPV (G) (million euro)	−3.4	1.8	1.1
NPV (ESCO) – NPV (G) (million euro)	6.7	−1.1	0.0
Investment amortization (years)	10	14	10
IRR (ESCO) (%)	10	6	7

Nevertheless, while previous authors identified the "first out contract" as the model that minimizes the difference in the economic benefits of the partners, our findings show that a "mixed contract" (combining "first out" and "shared savings" contracts) avoids the distortion of excessive benefits gained by the ESCO in a longer concession period and ensures benefits to both partners, achieving the goal of an equal NPV (see Appendix A, Tables A1–A3).

Equation (4) can determine the % of savings available to share between the party at year n + 1 to rebalance the contract to an NPV (ESCO) – NPV (G) = 0.

$$\left(-10+\sum_{t=1}^{10}\left(\frac{1.30}{(1+5\%)^{t}}\right)+\sum_{k=11}^{15}\left(\frac{1.30*x\%}{(1+5)^{k}}\right)\right) -\left(+10+\sum_{t=1}^{10}\left(\frac{-1.30}{(1+5\%)^{t}}\right)+\sum_{k=11}^{15}\left(\frac{(-1.30*x)+(1.3*(1-x\%))}{(1+5\%)^{k}}\right)\right)=0 \qquad (4)$$

I_0 = investment = 10 million euro
CF Gov = cash flow government = 1.30 million euro
CF ESCO = cash flow ESCO = 1.30 million euro
n = year of complete amortization of the investment (break even) = 10
z = year of end of the contract = 16
i = discount rate = 5%
x% = percentage of profit sharing ESCO = ?
1−x% = percentage of profit sharing government = ?
Unfolding the equation, we arrive at the following results:
x = 32.5%
1−x = 67.5%

All three types of contract achieve satisfactory profitability ratios for the ESCO (IRR higher than the discount rate that ranges between 10% and 6%). At the same time, all three contracts are theoretically sustainable for the PA, which finances the new investment, with energy savings without additional expenses. Nevertheless, the analysis shows that the mixed model is best able to balance the benefits between partners pursuing the principle of "equally sharing benefits".

In particular, the proposed new contractual model called "mixed contract" ensures that ESCO and PA have the same NPV, allowing the PA to demonstrate the value for money of its choices. Moreover, the ESCO optimizes the amortization period of its investment and is able to rapidly reimburse its debts, reducing financial costs and increasing project bankability (when banking resources have been provided).

5. Conclusions and Policy Implications

The paper can be framed in the public choice theory and, in particular, in a neo-classical approach to economic behavior. These models assume that private operators are motivated primarily by individualism. Institutions and policy makers have to guide the partners toward agreements that equally share the benefits and create value for money for the PA.

Several public guidelines in different countries have been produced which require PA: (i) measuring the value for money achieved in PPPs as a justification for the privatization of public services and (ii) avoiding extra profits, generated during the contract's life, for private operators. In particular, the Italian evolution guideline suggests that extra profit is generated when the IRR of the project is higher than the weighted average cost of capital (WACC) for the investor (ESCO).

The value of this paper is identifying an alternative contractual model for sharing energy savings and proposing a simple but useful equation to calculated profit sharing % after the investment amortization. The model is based on the assumption of "equal NPVs". Although, in coherence with previous studies [28], the "equal NPV" is considered a good measure of equally shared benefits, our results differ from previously published papers because we consider "first out" contracts to be sub-optimal in long-term agreements or when the amortization period of the investments can be defined ex ante with certainty (e.g., energy savings can vary during the contracts).

In addition, the paper answers the first question "which kind of PPP-EPC contracts are able to provide an optimal allocation of the risks ensuring an off balance accounting treatment of the investment?" by identifying theoretical advances in risk-transfer conditions for the off-balance accounting of PPP-EPC contracts. It shows that the "shared savings" contract does not allow "off balance" recording, while "guaranteed savings" and "first out" contracts are more attractive for the PA, allowing (when transferring availability risks) an "off balance accounting" of the investments.

Moreover, the paper suggests solutions to mitigate some of the barriers (identified in the literature) to EPC use [34]. In particular, the transfer of financial and operating risks to a private partner mitigates the public budget constraints while, at the same time, the use of advanced monitoring and control systems mitigates the operational risks, ensuring an efficient management and an easier application of the contract's penalties.

The paper also answers a second question "which contractual structure is able to minimize the difference of the net present value (NPV) gained by the contractual parties in a long term agreement?" In particular, it provides a new model of calculation of shared savings (called mixed contract) with an extended possibility of application in EPC-PPP schemes.

This paper is innovative because it provides additional insight and knowledge, useful to support public decision-making in the use of a new contractual structure (called mixed model), which is able to combine the better elements of the "first out" contract with those of the "shared savings" contract, balancing the public and private benefits of EPC-PPP contracts in long-term concession contracts. In particular, although all three models can be used within the contractual freedom left to the parties, the "mixed contract", is preferable to other models because it ensure a satisfactory IRR to the ESCO and, at the same time, the maximum value for money for the PA.

The results of this paper are also useful to the academic community and practitioners interested in finding solid and fair agreements with the PA.

The interpretation of the results finds is limited in the use of a single case study, which makes it necessary to plan further research activity aimed at testing results under the different conditions of energy savings and a discount rate. Future research avenues should also focus on more standardized contractual solutions for an optimal allocation of risks between partners or aimed at setting up monitoring and control indicators which are useful to apply contractual penalties ensuring: (i) an ongoing monitoring of the project revenues and costs necessary to identify the real amortization period of investments and (ii) a transfer of OPR to count such contracts as off-balance.

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Appendix A

Table A1. First out contract—cash flows.

Years	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Total investment (million euro)	-10.1															
PA payments (million euro)		10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Costs (million euro)		-8.7	-8.7	-8.7	-8.7	-8.7	-8.7	-8.7	-8.7	-8.7	-8.7	-8.7	-8.7	-8.7	-8.7	-8.7
Cash flows (from energy savings) (million euro)	-10.1	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
NPV (ESCO) (million euro)	3.35															
IRR (ESCO) (%)	10															
Years	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Total investment (million euro)	10.1															
Trasferred savings (million euro)		-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3
Cash flows (transferred savings) (million euro)	10.1	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3
NPV (G) (million euro)	−3.35															
NPV (ESCO) – NPV (G) (million euro)	6.7															

Table A2. Shared savings contract—cash flows.

Years	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Total investment (million euro)	-10.1															
Savings (million euro)		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Cash flows (from energy savings) (million euro)	-10	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
NPV (ESCO) (million euro)	0.76															
IRR (ESCO) (%)	6															
Years	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Total investment (million euro)	10.1															
PA payments (million euro)		-8.7	-8.7	-8.7	-8.7	-8.7	-8.7	-8.7	-8.7	-8.7	-8.7	-8.7	-8.7	-8.7	-8.7	-8.7
Savings paid (million euro)		-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
Savings earned (million euro)		0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3

Table A2. *Cont.*

Years	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Costs (million euro)		8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7
Cash flows (transferred savings) (million euro)	10	-0.79	-0.79	-0.79	-0.79	-0.79	-0.79	-0.79	-0.79	-0.79	-0.79	-0.79	-0.79	-0.79	-0.79	-0.79
NPV (G) (million euro)	1.83															
NPV (ESCO) – NPV (G) (million euro)	-1.06															

Table A3. Mixed contract—cash flows.

Years	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Total investment (million euro)	-10.1															
PA payments (million euro)		8.66	8.66	8.66	8.66	8.66	8.66	8.66	8.66	8.66	8.66	8.66	8.66	8.66	8.66	8.66
Costs (million euro)		-8.66	-8.66	-8.66	-8.66	-8.66	-8.66	-8.66	-8.66	-8.66	-8.66	-8.66	-8.66	-8.66	-8.66	-8.66
Savings (million euro)		1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	0.43	0.43	0.43	0.43	0.43
Cash flows (from energy savings) (million euro)	-10	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	0.43	0.43	0.43	0.43	0.43
NPV (ESCO) (million euro)	1.12															
IRR (ESCO) (%)	7															
Years	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Total investment (million euro)	10.1															
PA payments (million euro)		9	9	9	9	9	9	9	9	9	9					
Savings paid (million euro)		-1	-1	-1	-1	-1	-1	-1	-1	-1	-1					
Savings earned (million euro)												1	1	1	1	1
Costs (million euro)		-9	-9	-9	-9	-9	-9	-9	-9	-9	-9					
Cash flows (transferred savings) (million euro)	10	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	0.5	0.5	0.5	0.5	0.5
NPV (G) (million euro)	1.12															
NPV (ESCO)—NPV (G)(million euro)	0															

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