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## Article

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## Barriers to Improving Energy Efficiency: Insights from Energy Services Companies in Jordan

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### ABSTRACT

This work aims to examine the barriers to improving energy efficiency as encountered by Energy Services Companies (ESCOs) in Jordan, based on seven theoretical models and a comprehensive survey. This paper employs a quantitative methodology based on a statistical survey of ESCOs in Jordan during 2018. The survey, which covers 120 firms, explores four sets of measures: technical, functional, corporate image and economic. The empirical results illustrate that energy efficiency improvement contributes to saving of substantial energy hence minimizing the emission of greenhouse gas. The results of the survey showed that 60% of respondents are convinced of the provided services. The highest rate (75%) was for the completion of the transaction which is met the deadlines, the rate for the continuous service amelioration provided by the company is 71%, and 63% for those who believed that public safety is taking into consideration by the company. The results also showed that 60% of the respondent are convinced with an employee's performance, which is appeared from their answers by strongly agree or agree. The highest rate of 70% of respondent believes that the staff are well- behaved and nice to deal with. For government policies, reducing energy use and promoting investment in the technologies of energy efficiency, as viewed by ESCOs, are key factors in improving energy efficiency and reducing barriers.

**Keywords:** Energy Efficiency, Energy Resources, Energy Supply, Jordan

**JEL Classifications:** Q40, Q43, Q48

### 1. INTRODUCTION

Jordan imports most of its energy as petroleum products. Thus, energy preservation means minimal dependence on imports of energy and minimal greenhouse gases emission. The cost of imports of natural gas oil in 2015 constituted about 24% of its GDP. The energy resources used in Jordan are mostly natural gas, crude oil, and solar energy. However, the importation of petroleum products and crude oil represents more than 97% of the annual consumption rate of energy in 2015. The energy service companies provide the overall service package utilized for fulfilling energy-saving investments that include financial and technical services. ESCOs can supply several services to customers.

The ESCOs business model has started in the 1970s and 1980s. Nevertheless, its roots date back to the 19<sup>th</sup> century. The service

model of ESCOs has been applied on a wide scale since the late eighties and early nineties. Despite ESCO's long history model, it has not completely thrived as a foreseeable proposal through ESCO projects has been found to have several advantages. Direct advantages of energy service company projects include minimizing costs of energy and maintenance, while the indirect advantages enhance the output and environmental amelioration, as depicted in Motiva, 2014; Bertoldi et al., 2006; Marino et al., 2010; and Limaye and Limaye, 2009."

The statistics for the Ministry of Energy and Natural Resources (MENR) showed that more than 96% of overall energy resources for the Hashemite Kingdom of Jordan are imported to cover the fast demand for energy in all sectors resulted from the population growth, change of lifestyle and other factors. This is associated with the predominant high prices of gas and oil. This means

that the energy in Jordan is insecure. Also, it highly affects the national budget because of energy subsidizing. It further checks new connotations for both demand and supply. Finally, it lessens the responsibility of both the consumer and the national budget. The strategy of national energy in Jordan attempts to enlarge the resources of renewable energy by 10%, expanded the resources of local energy from oil shale to 14%, raised its support in the total energy mix and petroleum oil exploration, and used nuclear peaceful energy and natural gas from 34% to 37%. The law of energy efficiency and renewable energy was issued and endorsed in 2010. It concentrates on energy-saving improvement and stimulating measures of energy efficiency. It also aims at the launching of new equipment that eases the energy-saving and gives dispensation of the materials and equipment for energy-saving to about 75% over 10 years from the importation year. This is in addition to improve the use of renewable energy sources such as solar thermal, geothermal, bio-energy, and wind energy. This will ultimately encourage the industry of national energy.

The industry of energy services in Jordan is yet in its precocious stages of development. To show this, we will illustrate the business model. It is known that the business model of the energy services companies can improve energy efficiency, save generated cost, and save the environment. Consequently, this work presents the ESCO's role in improving energy efficiency in Jordan. Thus, the need for this work can be induced by:

1. Need for energy-saving companies for the Professional Regulation Commission to attain the targets of energy conservation and to minimize the GHG emission in the globe.
2. Lack of studies presented in the Professional Regulation Commission on the markets of the Energy Service.
3. Shortage of studies focusing on local Energy Saving markets on Jordan.
4. The fast change in Jordan's Energy Saving markets.

This study fills the shortage in the current literature, which is specified as in the followings:

1. Lack of studies in Jordan that discuss ESCOs services, let alone evaluate such services and barriers to them.
2. Lack of comparable studies and case studies, as none examined the quality of service and the client's satisfaction. The study will provide a good guide for the situation of energy service companies in the Jordanian business environment for future discussion.

Most of the studies on energy efficiency and energy service companies' tackle the business conditions in developing and developed countries. However, there are very few studies about the Arab World. Some of these studies identify the development barriers in the energy service companies at a general level. However, and based on our literature survey, there is no thorough research in Jordan conducted about success barriers of the energy service companies. Therefore, the aim of this work is not only to study the people working for service suppliers of energy service companies' but also to examine the views of service receivers and clients of ESCOs. To acquire a comprehensive answer to the main research question, 3 minor research objectives are created:

1. To estimate the existing status of energy service companies' in Jordan. To accomplish this, we have to investigate the following key themes:
  - a. Characteristics of the working energy service companies
  - b. Activities of energy service companies.
  - c. Energy service companies targeted key sectors such as the transportation sector.
  - d. The approximate value of projects proceeded by energy service companies
2. To inspect the most challenging obstacles that the ESCOs industry encounters.
3. To evaluate the economic impact of ESCOs services in Jordan from the customer point of view.

In electricity use, improving energy efficiency has the following benefits:

1. Using the same production capacity of electricity to provide consumers with more electricity, which is predominating the restrictions in most Africa and Asia countries.
2. Minimizing the growth in electricity demands and thus minimizing the investment needs for enlarging the energy power section.

An ESCO provides an extensive experience to design and implement different multiple measures besides the technical issue aspects as well as the performance risk. It acts as project developers. The term of project contract commonly ranges from 7 to 20 years and it depends on the types of installed measures. The major difference between these companies and other energy efficiency contractors is that the ESCOs guarantee the energy savings as set by terms of Energy Savings Performance Contract (ESPC), (Shito, 2003 and Larsen et al., 2012). Because of the rising in the world energy prices and the consciousness of energy preservation, most organizations are working on reducing energy use with sustainable solutions during construction. Also, the governments to offer a mechanism of promotions and incentives have initiated several programs.

## 2. REVIEW OF LITERATURE

Overall, the improvement of energy efficiency for buildings offers a high possibility to minimize the emissions and costs. Both financial motives and regulations are also required to raise the uptake measures of energy efficiency, together with obvious targets for existing buildings renovation rates (Hoffmann, 2014). Services can include, energy management, maintenance and operation, audits and energy analysis, design and implementation of projects evaluating of savings, monitoring energy equipment supply, energy equipment supply and property management, (Bertoldi et al., 2006; Vine, 2005; Marino et al., 2010; Marino et al., 2011; Lee et al., 2003). ESCOs offer the next services: they improve, finance and design of EE projects; install and keep the energy service equipment involved; calculate the risk involved in the foreseeable energy savings amount; and measure, monitor, and verify the projects of EE. Subsequently, they take the risks of technical, financial as well as all other risks, (Bertoldi et al., 2006; Oikonomou, et al., 2009; Okay et al., 2008; Okay and Akman, 2010).

Another strand of literature, in this context, discussed the formulation of modern energy companies in the European Union member states through a decision backing methodology (Patlitzianas and Psarras, 2007) while others dealt with designing a convenient Energy Service Companies environment in the Mediterranean (Patlitzianas et al., 2006). Iazzolino and Gabriele (2016) provided an analysis of financial reliability in ESCO's industry in Italy using the *Z''-score* model. The study found that *Z''-score* increased over the years in most cases while the gain of White Certificates represents an effective tool to promote energy saving. Lin and Hung (2016) investigated the empirical effect of the service supplied by ESCOs on the total energy use in 13 developing countries by the use of a transparent and data-driven statistical methodology. The study found that the ESCOs do a strong energy-saving effect in Ghana, Colombia, South Africa, and Kenya; while a strong energy-using effect is found in Chile. Jafari (2018) applied SWOT analysis to study the case of ESCO in Iran where companies interact with their internal and external environment. The results show higher scores for external factors in comparison with the internal ones. It also indicates that the appropriate strategy for developing the ESCO mechanism is to reduce weaknesses and increase opportunities.

## 2.1. Typical ESCO's Business Models

A typical ESCO business model looks like the following (ESCO, 2014).

In these models, ESCOs are business type companies that supply a full range of services to enhance energy efficiency. It helps the industry and business to improve the energy-saving plan, and thus the cost can be repaid from enhancing energy efficiency in the use. As shown in Figure 1, The Energy Service Performance Contracts (ESPC) aim to provide projects for saving energy to the users to assure reaching to a certain number of the energy-saving amount within a specified period. The major service steps are estimating the Energy Conservation Measure (ECMs) feasibility for clients through the energy-saving services with companies of professional technology. They resolve

the capital and payback periods for the renewal of project reference of energy service promotion (Hoffmann, 2014).

The EPC is a form of "creative financing" for capital enhancement that grants the funding of energy upgrades by decreasing the cost." Through the arrangement of EPC, ESCOs carry out a project for delivering efficiency and use the income stream from the cost-saving including the investment cost. The approach of energy performance contracting is to provide infrastructure enhancements to facilities that have a lack of skills in energy engineering, time management, funding the capital, risk knowledge, and information technology. The customers of credit-worthy are regarded as potential customers. Figure 2 shows these concepts clearly:

## 2.2. ESCO's Financing Models

The new financing models that involve third party lenders or investors are also emerging to address particular requirements of owners and service providers. The energy efficiency projects sources of fund are mainly the energy service company owner who will eventually earn the returns based on the saving in energy bills. Six of these financing models are explained below:

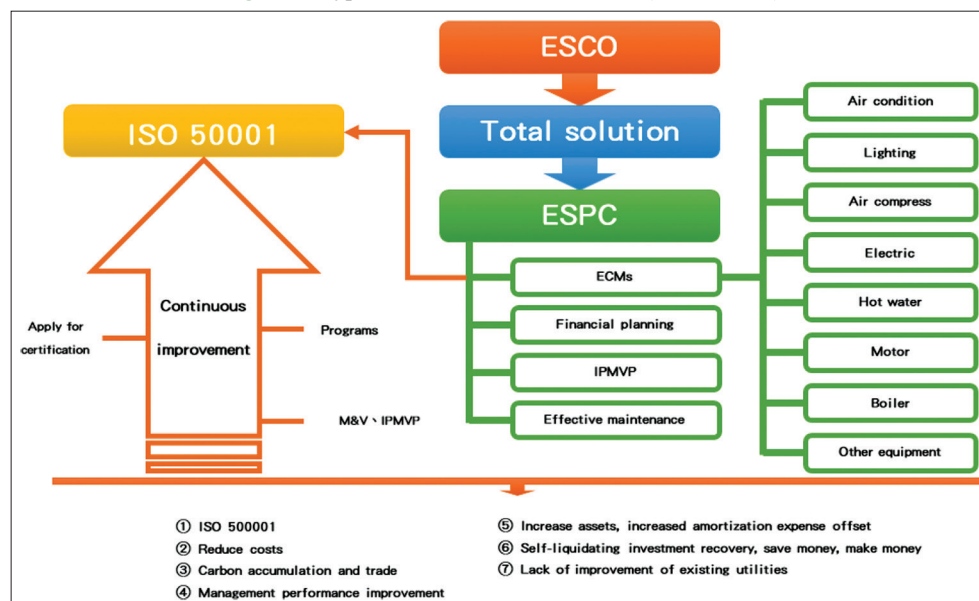
Figure 3 shows the guaranteed saving model, which is described so because the energy service performance contracts involve a performance guarantee by implementing the projects of an energy service company.

The lender (third party) who finances the project and supplies it with recourse to their balance sheet. Thus, the owner creditworthiness is an important condition.

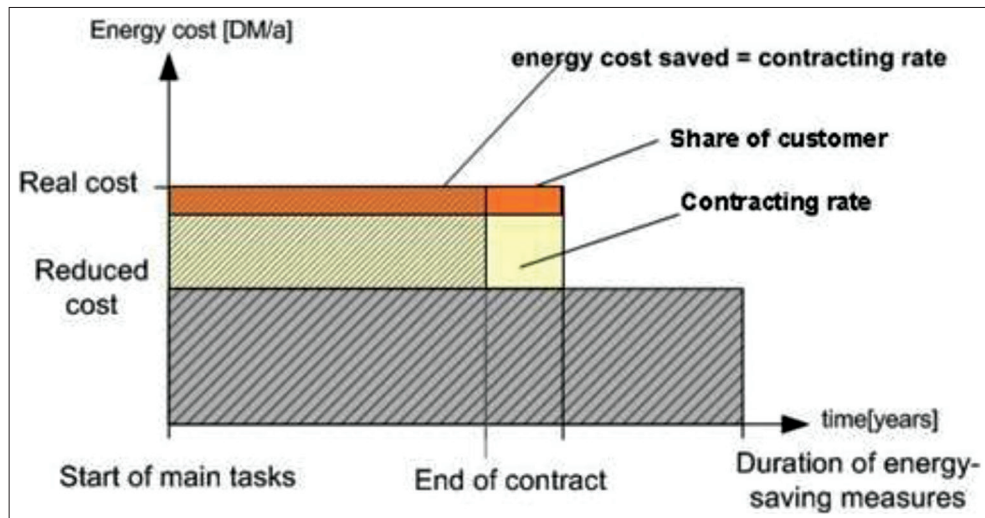
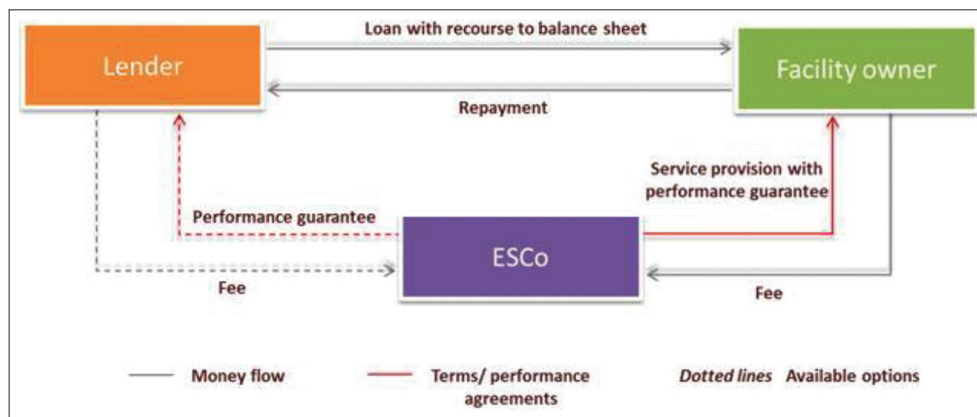
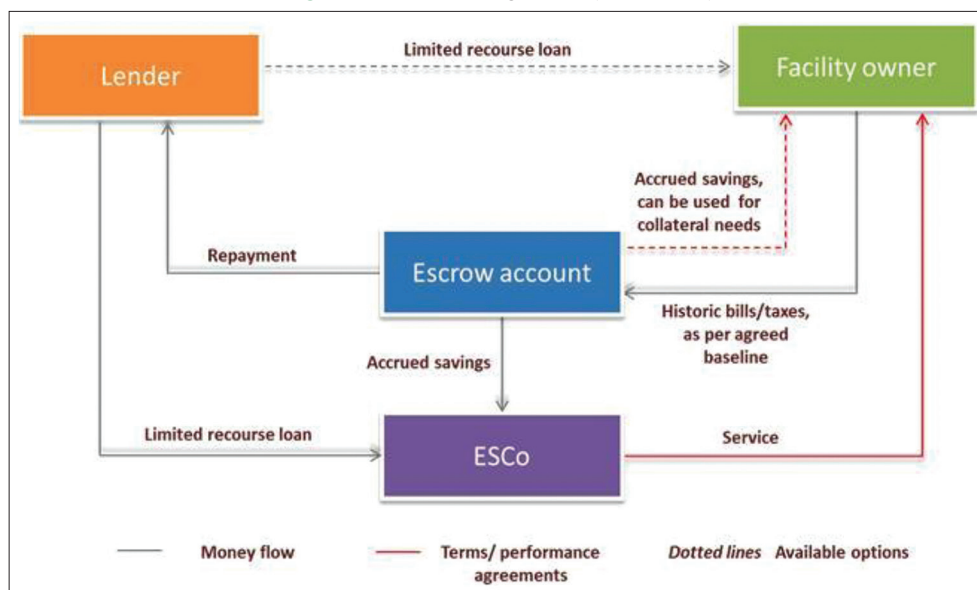
## 2.3. Shared Saving Model

Figure 4 shows the shared saving model, which represents the investing of the energy service companies in the project and assuming a higher risk than the facility owner. This model is specifically helpful in the case of regarding the facility owner creditworthiness an issue (Delio et al., 2010).

Figure 1: Typical ESCO's business models (ESCO, 2014)





**Figure 2:** Performance of energy contracting (Geissler, 2013)**Figure 3:** Guaranteed saving model (Deka, 2012)**Figure 4:** Shared saving model (Deka, 2012)

One alleviation arrangement is to make a separate credential account in the contract. The third-party, who may have loaned the energy service company would generally have the first access

to this account. Unlike the previous model (guaranteed saving model), the last share of accrued savings to the owner is not secured.

## 2.4. Lease Models – ESCOs as the Lessor

If the installation of equipment and tools are within the energy efficiency project, the option of lease finance can be explored with the energy service companies as a lessor (Figure 5). The energy service companies' avails guaranteed loans for buying equipment and tools. The balance of loan repayment and lease rent is its return.

## 2.5. Lease Aggregation Model

Lease aggregation is probable if the individual facilities do not count to remarkable investment. This is shown in Figure 6, ESCOs may float a Special Purpose Vehicle (SPV) which collects the leases. The third-party investor and the manufacturer of equipment may also gain holdings in the special purpose vehicle.

## 2.6. Development Finance Model

The development of finance has an essential turn in heartening energy efficiency marketing. This has specifically been

noticeable in supporting the micro, small, and medium enterprises with entry to soft capital over several refinancing institutions (Figure 7). The owner of the enterprise or facility procures smooth loan under appropriate conditions which help to cover their capital expenses.

## 2.7. Energy Service Agreement Model

This specific model is generally used in relatively mature markets such as for the United States where the investor or lender takes the centre stages in implementation and saving the energy efficiency project. The investor or lender in this model performs an Energy Service Agreement (ESA) with the facility owner to fund their total installation cost of energy-saving, maintenance and up-gradation. On the other hand, the investor or lender executes a performance contract with the energy service companies to provide capital for maintenance and installation services at the owner's facility on an ongoing basis, (see Figure 8).

Figure 5: ESCOs as lessor model (Deka, 2012)

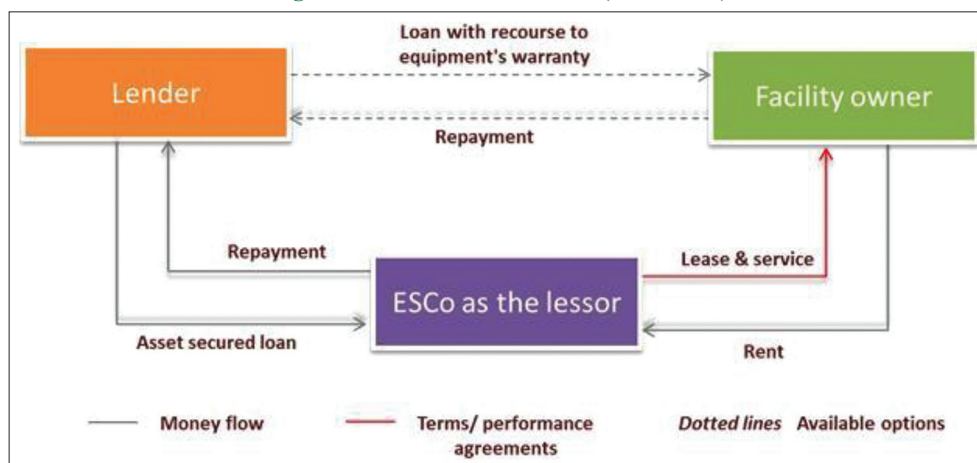
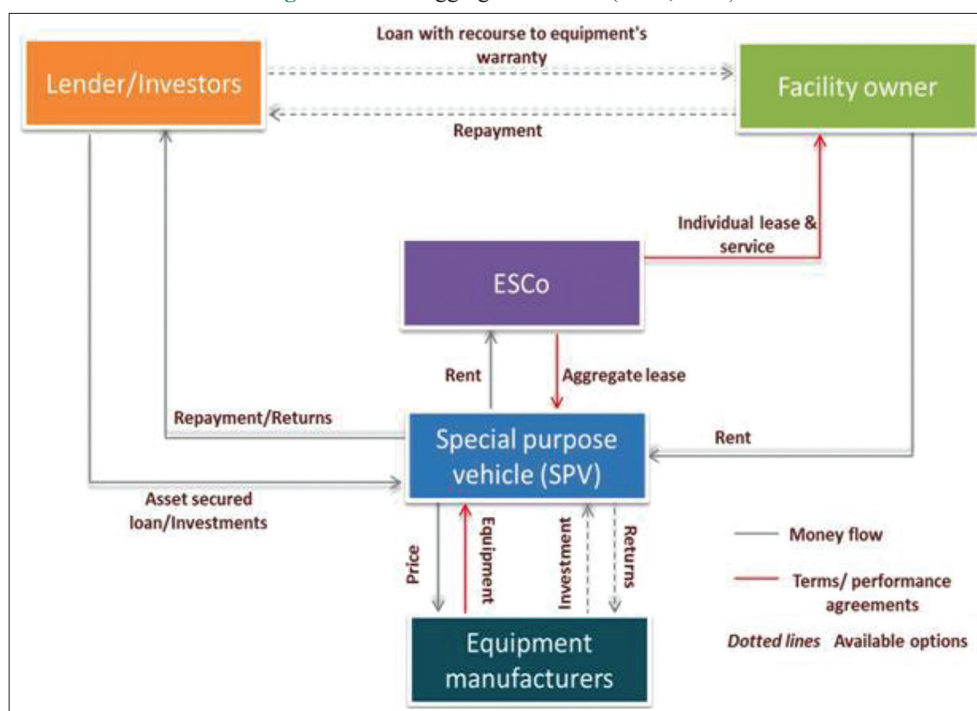
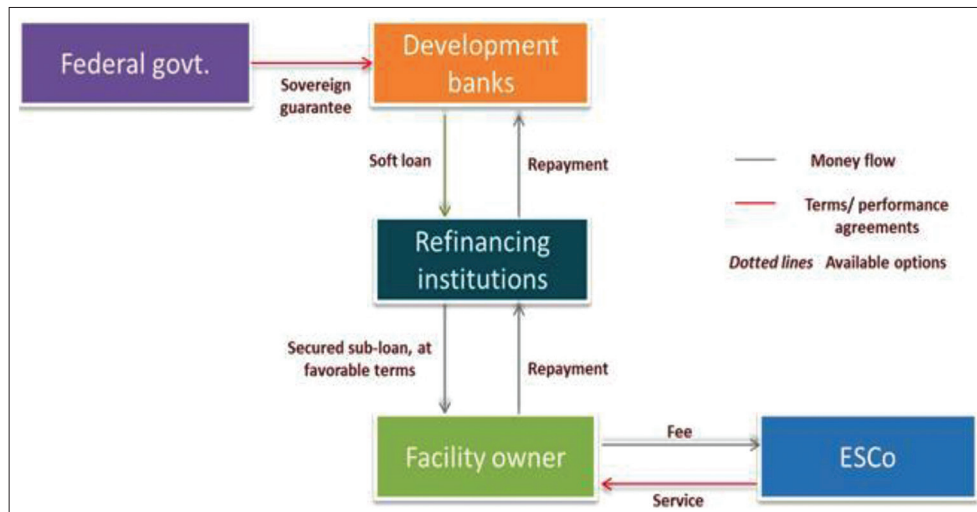
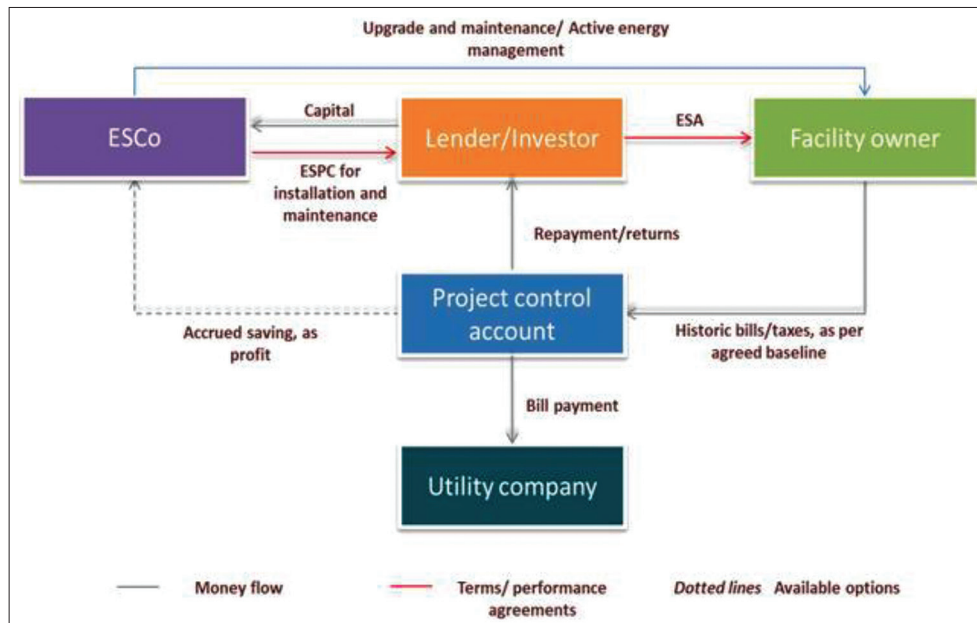


Figure 6: Lease aggregation model (Deka, 2012)



**Figure 7:** Development finance model (Deka, 2012)**Figure 8:** Energy service agreement model (Deka, 2012)

### 3. DATA AND METHODOLOGY

#### 3.1. Data

Two sets of questionnaires were developed in this work. The first was for the management of energy service companies to examine its status, and study the obstacles facing these companies in Jordan, from their point of view. The second was to inspect the attitudes and opinions of the energy service companies' customers to look into the quality of services provided to them from these companies, as well, to examine the economic aspects that the customers realized after finishing the project, and see their response towards the energy service companies' services. The first part of questionnaire consists of several questions such as general information of the company, operations of the company, financial and policy of energy efficiency issues, regulations and governmental support, main barriers facing ESCOs in Jordan. The second part of the questionnaire includes several questions for the clients, such as characterizing the quality

of services and the effect of the energy efficiency activities on the economic, the quality of services and matching between what the clients expect and what they experienced, and thus the questionnaire covers the following points: "

1. Technical measures.
2. Functional measures.
3. Corporate image measures.
4. Impacts of energy efficiency activities on the economy.

The second and the third parts of the energy service company's questionnaire are based on a Likert Scale consisting of five response options (1=Strongly disagree, 2=Disagree, 3=Moderate, 4=Agree, and 5=Strongly agree).

Table 1 provides descriptive statistics of the main variables. A notable result is the median of responses which was (4 out of 5). The mean is a bit lower but still above 3.63 for the four main variables: service provider, employees' performance, quality standards, and economic standards.

### 3.2. Methodology

A research descriptive method is utilized in this investigation. This type of research describes the present condition of ESCOs companies. This method is convenient for such a study since it characterizes the existing condition of energy service companies in Jordan and their role in the energy sector.” The descriptive method mechanism used, is the normative survey evaluation and approach, which is usually used in exploring the respondents’ opinions that represent a whole population. The addresses and information of clients were obtained from visits to the Energy Service companies in Jordan. For considering the available time and the financial factor for this investigation, only 120 clients of the implemented projects were interviewed in the capital Amman.

## 4. RESULTS AND DISCUSSION

### 4.1. Service Provider’s Results

Table 2 shows that there is general consent among respondents related to the providers’ services of solar energy equipment. About 60% of respondents are convinced of the provided services through their answers, which were either agree or strongly agree. The highest rate (75%) was for the completion of the transaction which is met the deadlines, 70.8% for the continual improvement to the services provided by the company, and 62.5% for those who believed that public safety is taking into consideration by the company.

### 4.2. Employees’ Performance Results

It shows in Table 3, that there is a general assent (58.7%) amongst the respondents related to employee performance through their answers by either agreed or strongly agree. The highest percentages were recorded for: the staff is well- behaved and nice to deal with (70%), there is adequate staff for providing services (64.2%), and 61.6% for the ability of staff to answer all questions.

### 4.3. Quality Standards’ Results

Table 4 presents the results of the opinions related to quality standards. About 58% of respondents agreed and satisfied with the quality standards. The highest proportion of respondents convinced of the company’s approaches. This is also true for those who believe that the staff treatment is gently and professionally. The rate of respondents who strongly do not agree on the quality standards level is small (5%). This gives a clear indication that these companies are performing well and doing a good job concerning the standards of the quality and the outstanding energy services provided.

### 4.4. Economic Standards’ Results

One of the important factors of the company provided service is the economic standards (Table 5). The table shows that 61% of respondents are strongly agreed with the economics standards level, while less than 4% only reluctant to it. These results indicate that steps and the style of the procedures for the provided services were clear and good, the rapid transactions when providing and completing all documents.

**Table 1: Summary statistics of the main variables**

Indicator	Services provider	Employees performance	Quality standards	Economic standards
Mean	3.783	3.683	3.63	3.717
Median	4	4	4	4.007
Maximum	5	5	5	5.0007
Minimum	1	1	2	1.0007
Standard deviation	0.937	0.85	0.81	1.0147
Observations	120	120	120	120

**Table 2: Service provider’s results**

Service provider’s performance	Strongly agree	Agree	Neutral	Don’t agree	Strongly don’t agree
Completion of the transaction meets the deadlines	16.5	58.5	9.4	11.5	4.1
Continuous service amelioration provided by the company	20.3	57.5	12.3	6.8	3.2
Continuous development to the company’s performance	16.6	45.9	27.4	8.4	1.7
The company is distinguished by technical efficiency	14.3	45.7	27.6	9.1	3.3
Customer service is the company’s main goal	14.3	42.4	31.8	7.1	4.4
Environmental factors are taken into consideration by the company	12.4	40.1	34.1	12.6	0.8
The company provides distinctive services	10.9	43.2	32.3	9.1	3.5
The company provides services to meet customers’ needs and expectations	14.1	46.8	24.1	11.6	3.4
Working hours provided by the company is convenient	13	45.7	24.7	12.4	4.2
Required information is provided very fast	8.3	42.4	23.4	22.4	3.5
Opinions of the service recipients on provided services are taken into consideration	4.1	37.6	27.1	15.3	5.9
Evidence of the information, documents, and services are provided electronically and on paper to all recipients	19.9	40.9	27.5	10.9	0.8
Methods of submission complaints and suggestions are provided by the company	15.7	43.4	30.2	9.9	0.8
The company can recognize the customers’ needs	10.1	48.2	28.2	11.8	1.7
Public safety is taking into consideration.	15.9	46.6	25.1	10.7	1.7
Average	14.4	45.8	26.1	11.3	2.4



**Table 3: Employees' performance results**

Employees' performance	Strongly agree	Agree	Neutral	Don't agree	Strongly don't agree
There is adequate staff for providing services	10.1	54.1	0	25.1	10.7
Individual's verdicts are recorded for accelerating and developing services	11.6	32.3	42.6	11.6	1.9
The ability of staff to answer all questions	13.2	48.4	24.1	10.9	3.4
Dependable and trustworthy employees	13.4	46.6	28.4	7.4	4.2
Staff are devoted to accomplishing the tasks and patient	9.1	40.1	40.7	5.9	4.2
Employees potency to solve customer's problems	12.4	50.1	22.4	11.8	3.3
Staff are well- behaved and nice to deal with	15.9	54.1	17.6	6.6	5.8
Providing all supports and advises before and during services' delivery	12.4	45.9	25.1	14.1	2.5
Average	12.23	46.45	25.1	11.68	4.5

**Table 4: Quality standards' results**

Quality standards	Strongly agree	Agree	Neutral	Don't agree	Strongly don't agree
Convinced with the company's approaches	11.6	56.8	21.6	8.4	1.6
Receiving suggestions and complains as well as the efforts to find convenient solutions	11.8	46.6	32.4	5.1	4.1
Using the company' webpage to get the required information	15.7	42.6	28.2	11.8	1.6
Easiness of entrance to the service provider	11.8	38.2	33.2	11.6	5
Staff remedy is smooth and professional	13.4	51.6	21.8	10.7	2.5
Your inquires and suggestions are warmly saluted	15	48.4	24.1	8.4	4.1
The employee allocates to help you in your transaction and not busy with any other personal work.	11.6	40.1	26.6	15.9	5.8
The requirements of the service recipients and their needs are taken into consideration.	10	50.9	22.4	13.4	3.2
Dealing with all service recipients in an equal way	9.1	38.4	29.1	17.4	5.9
Easiness of accessing instructions and service demands	10.9	46.6	25	10.9	6.6
Making an appointment to check the action taken	12.4	50.1	18.4	10.7	8.4
Average	12.2	46.39	25.64	11.31	4.44

**Table 5: Economic standards results**

Economic standards	Strongly agree	Agree	Neutral	Don't agree	Strongly don't agree
Providing services is clear	20	52.4	14.3	12.4	0.9
Easiness of bill paying	22.6	39.4	24.3	10.9	2.6
Need further ads to recognize the company	33.2	34.3	24.1	5	3.4
Work's duration is convenient	11.8	46.6	23.4	15.6	2.6
Broaden the needs for future products and services	19.3	41.8	25.1	10.1	3.4
Provided service fees are clear and suitable	13.4	40.9	26.8	13.5	5.1
Diversity of provided services	13.5	48.4	22.6	11.8	3.4
Fast transactions when providing complete documents	12.4	50.9	15.1	16.6	5
Present enactment promote the use of alternative energies	8.4	44.1	23.4	19.1	5
The imposed tax limits the vast of using alternative energies	23.4	35.9	23.2	13.4	4.1
Average	17.8	43.47	22.23	12.85	3.55

## 5. CONCLUSIONS AND RECOMMENDATIONS

### 5.1. Conclusions

The main conclusions of this study are as follows:

1. Nearly 60% of respondents are satisfied with the provided services through their answer by either agree or strongly agree. The highest rate (75%) was for the completion of the transaction, the rate for the continuous service amelioration provided by the company (7.8%), and 62.5 % for those who believed that public safety is taking into consideration by the company
2. There is a general consent amongst the respondents related to the performance, as almost 60% of respondents are satisfied

with the performance of employees and answers either strongly agree or agree. The highest percentages are for: those who believe that the staff are pleasant and well behaved (70%), the number of staff responsible for providing the service is adequate (64.2%).

3. About 58% of respondents satisfied with quality standards provided by the company. The highest rate for correspondents reported satisfaction with the company's approach. This is the same as for those who think that the staff has treated them gently and professionally, while the rate of those who strongly do not agree with the quality standards level is small (5%).
4. Another feedback is the general positive consent amongst the respondents related to the economic standards. About 61% of respondents strongly agree with the economic standards level,

and only 4% opposed this results. These results show clearly that the steps taken for providing the service are clear, and there are fast transactions when completing and providing all documents

5. It has also been found that most of these energy service companies' customers arrange for their project financing, while very few of them arrange for finance by the company. Some other energy service companies and their customers depend on funding agencies to provide sufficient finance for their projects.
6. The size of most energy service companies' projects is small. Thus, real savings implemented projects of energy service companies. They also assure that there are some other benefits provided to the customers of ESCOs besides the direct financial benefits of reducing the cost.
7. It has been found that the small and medium-sized enterprises (SME) sectors, as appears from the energy service company's characteristics, are very promising sectors. This is concluded from the agreement between the clients and respondents on the large energy-saving potential in the SME sector.
8. One of the main barriers found is that the energy service company's projects did not have sufficient subsidies and the laws and policies did not support these companies. In the end, they did not contribute to the development of these companies in Jordan.

## 5.2. Recommendations

In light of the results, the following recommendations are made:

1. Training more employees in the ESCOs to cope with all the developments that take place in this sector.
2. Benefiting from the experience of ESCOs in the developed countries and applying it in the Arab World.
3. Promoting the partnership between the public and private sectors as well as increasing the effective contribution to the Jordanian economic growth and encouraging more investments in ESCOs as it is a promising sector in Jordan.
4. Signing long-term contracts with the public and private sectors as well as the military forces to utilize ESCOs because of the field of energy witness's rapid expansion.
5. Exploiting the surplus of the alternative energy in different projects all over the country such as desalination and exporting which, in turn, contribute to solving the unemployment problems.
6. Obliging big organizations which use big amounts of energy such as the steel company, the cement company and the aluminium company to use ESCOs.
7. Carrying out major changes to the energy policies in Jordan in terms of transparency and accountability to guarantee good use of resources and generate benefits accordingly.
8. Conducting symposiums to introduce ESCOs' services to customers as most of them are unaware of the efficiency of ESCOs and their services.
9. Increasing the number of companies working in alternative energy to escalate competition among them while drafting clearer contracts and action plans for ESCOs.
10. Creating an institution that will overlook and check the work of ESCOs as no current laws are constraining their work as well as promoting research on ESCOs and alternative energy

in the developing countries as there is a clear lack of research in this field.

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