"Opportunities and Challenges in Developing Markets for Energy Service Companies (ESCOs) to Promote Energy Efficiency Programs in Indonesia"

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Declaration

I declare that this dissertation is my own account of my research and contains as its main content work which has not previously been submitted for a degree at any tertiary education institution.

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Abstract

It is predicted that between 2004 and 2030, around 80% of the world's economic growth will be contributed by non-OECD countries (Ellis 2009). Energy Service Companies (ESCOs), could play a vital role in improving energy efficiency in these countries. ESCOs can help energy users, companies, industries, and commercial sectors in improving the efficiency of equipment by providing energy service (energy performance and/or credit risk). ESCOs were implemented quite successfully for promoting energy efficiency (EE) in many European Union (EU) countries and other developed countries such as the USA, Canada, and Japan. However, not many developing countries run ESCO successfully. This raised the question of potential barriers for using ESCO for EE programs in developing countries. To successfully implement and operate ESCO in developing countries like Indonesia, it is crucial to study and understand the opportunities and challenges encountered in running this program.

The aims/objectives of this study are to understand and verify the strengths, weaknesses, opportunities and threats of developing markets for Energy Service Companies (ESCOs) in Indonesia. This will be achieved by surveying the key stakeholders in the industry and identifying significant factors such as regulatory, financial, and awareness aspects for decision makers (governments). The results from this research will aim to provide recommendations for the decision makers, who can then review the significant factors that influence the development of ESCO in Indonesia.

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- Nurcahyanto and Tania Urmee (2017), 'Development of Energy Service Company (ESCO) Market to Promote Energy Efficiency Programs in Developing Countries, **Transition Towards 100% Renewable Energy-Selected Papers from the World Renewable Energy Congress WREC 2017** World Renewable Energy Congress, 2017, February 5-7, Perth, Western Australia. (in Press).

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List of Abbreviations

ABESCO : Brazilian Association of ESCO

ADB : Asian Development Bank

AEPCA : Australasian Energy Performance Contracting Association Limited

AHP : Analytic Hierarchy Process

BELESCO : The Belgian Association of ESCO

BKF : *Badan Kebijakan Fikal* (Fiscal Policy Agency)

BOE : Barrel Oil Equivalent

BUKU : *Bank Umum Kelompok Usaha* (Commercial Bank of Business Group)

CDM : Clean Development Mechanism

CI : Consistency Index

CR : Consistency Ratio

EE : Energy Efficiency

EGAT : Electricity Generating Authority of Thailand

EMCA : China Energy Conservation Service Industry Association

ENCON Fund : Energy Conservation Promotion Fund

EPC : Energy Performance Contracting

ESCOs : Energy Service Companies

ESPC : Energy Savings Performance Contracting

ESC : Energy Supply Contracting

EU : European Union

FGD : Focus Group Discussion

FICCI : The Federation of Indian Chamber of Commerce and Industry

GBCI : Green Building Council Indonesia

GDP : Gross Domestic Product

GEF : Global Environment Facility

HVAC : Heating Ventilation and Air Conditioning

ICPEEB : The Indian Council for Promotion of Energy Efficiency Business

IEA : International Energy Agency

IGA : Investment Grade Audit

ISO : International Organization for Standardization

JAESCO : Japanese Association of Energy Service Companies

JCM : Joint Credit Mechanism

KAESCO : Korean Association of ESCO

LTA : Long Term Agreement

MCDM : Multi-criteria Decision Making

MEMR : Ministry of Energy and Mineral Resources

MoE : Ministry of Energy

MoF : Ministry of Finance

NECIDC : National Energy Conservation Information and Dissemination Centre

OJK : *Otoritas Jasa Keuangan* (Financial Service Authority)

PROCEL : Brazil's National Electricity Conservation Program

RI : Random Index

SAAEs : South Africa Association of ESCOs

SME : Small Medium Enterprises

SWOT : Strengths, Weaknesses, Opportunities, and Threats

TOE : Tonne Oil Equivalent

TPF : Third Party Financing

USAID United States Agency for International Development

List of Definitions

AHP Analytic Hierarchy Process (AHP) is an effective tool for analysing the decision-making criteria that may help the decision maker to make the best decision by setting priorities for the factors/criterion/options. The alternatives options/criterion/factors can be analysed using pairwise comparisons and then synthesising the results.

EPC Energy Performance Contracting (EPC) is a contractual agreement between the client and the ESCO concerning the share in energy savings and its inherent risk based on the energy efficiency project measurement.

ESCOs Energy Service Companies (ESCOs) that provide services such as energy supply and management, finance, consultancy and technical engineering assistance (e.g. audits) to their customers. These companies also supply and install equipment and help with operation and maintenance of this equipment including upgrades, monitoring, measurement and verification for energy savings.

ESCO Model	the ESCO model is defined based on the type of finance or the type of business. The most commonly used business models under ESCO are “guaranteed savings” and “shared savings” or “leasing”.
MCDM	Multi-criteria decision making (MCDM) technique is considered as a complex decision-making methodology that is usually used for approaching and choosing the probable optimal options arising from multiple conflicting objectives.

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First and foremost, I would like to thank Allah, the God Almighty for giving me the strength, health, and the opportunity to undertake this research dissertation. Without his blessing, this achievement would not have been possible.

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Finally, I would like to dedicate this work to my beloved family (my wife Nisa, my little princess Nabila, and my baby boy Nafis) and my parents. Without your support, I would not have been where I am today and what I am today.

Thank you all so much

Cahyo

Chapter 1: Introduction

1.1. Aim and Objectives

This project aims to collect information on the strengths, weaknesses, opportunities and threats of developing ESCO markets through surveying stakeholders and identifying the significant factors for the decision makers. The aims and objectives of this research project are:

- To gain a broad understanding of various barriers and challenges for implementing ESCO in Indonesia.
- To evaluate strengths, weaknesses, opportunities and threats and develop criteria to determine the best strategies for successfully implementing ESCO for energy efficiency in Indonesia.
- To understand Analytic Hierarchy Process (AHP) methods and use them to identify the decision-making criteria for implementing ESCO in Indonesia.
- To understand and plan a survey to collect firsthand information from the field and process the qualitative data.

1.2. Background

Climate change and reducing poverty are the two important issues related to sustainable development goal 7: “ensure access to affordable, reliable, sustainable and modern energy for all”(Wu 2015),(International Energy Agency 2010),(Kenny 2016). Countries need to lower their energy demand, avoid greenhouse gas emission and provide energy access in a sustainable way to address these problems. The global economy is predicted to grow by 150% from 2014 to 2040, and energy efficiency is crucial to limit the world energy demand

to one-third by this year (IEA 2015). Non-OECD countries are projected to contribute to around 80% of the world's economic growth from 2004 to 2030 (Ellis 2009). Here, Energy Service Companies (ESCO) would then play a vital role in improving energy efficiency in these countries. ESCO can help the energy users, customers, companies, industries and commercial sectors in enhancing their energy efficiency by providing technical and financial services (Morgado 2014).

Most countries in the world apply traditional ESCO concepts that were implemented in the USA in the 1980s (Murakoshi and Nakagami 2009). However, Hansen (2003) reported that every country has its uniqueness based on their culture and it is not necessarily possible to replicate or apply an ESCO model used in one country to another country. Therefore, it is essential to understand the ESCO approaches in different countries to glean best practices adopted and lessons learned. ESCO was implemented quite successfully to promote energy efficiency in the many European Union (EU) countries and a few developed countries including the USA, Canada, and Japan (Bertoldi, Rezessy, and Vine 2006), (Vine 2005). However, not many developing countries run ESCO successfully (Ellis 2009). Fang, Miller, and Yeh (2012) stated that ESCO effectively influences energy use in rich countries but raise energy use issues in low-income countries due to ineffective policies. The ESCO scheme has also been used for providing energy services from renewable energy in many countries, e.g. Fiji (Urmee, Harries, and Schlapfer 2009), Kiribati (Dornan 2011), Sri Lanka (Lipp 2001), China and India (Liming 2009).

It is therefore important to review the available ESCO approaches used for energy efficiency promotions, its current situations, and barriers faced during its different stages of growth to find its applicability in developing countries.

This research will provide a comprehensive overview of the success and barriers of implementing ESCO programs for energy efficiency in Indonesia and developing a list of strengths, weaknesses, opportunities and threats (SWOT). The research will then examine the perception of stakeholders on SWOT to guide the further development of the ESCO market and identify the significant factors involved for the decision makers.

1.3. Research Questions

To address the research aim, the following research questions need to be investigated:

- What are the strengths, weaknesses, opportunities and threats (SWOT) in implementing an ESCO?
- What are the barriers in implementing energy efficiency ESCO in developing countries such as Indonesia and ways of overcoming these barriers?

1.4. Scope

The scope area for the research is the ESCO for Energy Efficiency in Indonesia. The ESCOs involved in the analysis in this research are ESCOs that are applied in public and private sectors and are mostly implemented in the building and industrial sectors.

1.5. Importance of the Research

The importance of this research is to develop decision-making tools using the AHP methods along with SWOT analysis for promoting ESCO for energy

efficiency. It will help/enable policy-makers (the government) in Indonesia to identify and prioritise the factors for developing ESCO policies.

The recommendations will also be available to the stakeholders for creating green financing methods for energy efficiency programs. In developing countries, financial institutions are not familiar with green financing for energy efficiency. Therefore, this would be an important step in improving energy efficiency in Indonesia.

Furthermore, ESCO can be potentially implemented in all economic sectors (industrial, building commercial, household, and public/municipal sectors). If markets for ESCO have been created, it can be potentially run as a business to business project opportunities.

1.6. Dissertation Structure

In this research, Chapter 1 will outline the introduction, Chapter 2 will discuss the methodology, Chapter 3 will investigate the literature review, Chapter 4 will present the survey results and analysis, and finally Chapter 5 will provide conclusions and recommendations.

Chapter 2: Methodology

The methodology of this research consists of five (5) steps: conducting a desktop research, identifying research questions, stakeholder surveys, analysis and discussion, and lessons learned and recommendations. Figure 1 shows the flowchart of the overall methodology of the research. The methodology used in this research can be explained as follows:

- Steps 1 and 2: Desktop research and identifying the research questions.

  A desktop research was conducted by reviewing the literature on ESCO approaches in developed and developing countries. From this research, the strengths, weaknesses, opportunities, and threats were identified and the gaps and research questions were proposed.

- Step 3: Survey to get stakeholder perception.

  In this stage, a survey to rank the factors within the strengths, weaknesses, opportunities and threats were conducted. According to Eslamipoor and Sepehriar (2014), the SWOT factors that should be identified and put forward to the participants are as follows:

Strengths	Weaknesses	Opportunities	Threats
$S_1, S_2, S_3, \ldots, S_n$	$W_1, W_2, W_3, \ldots, W_n$	$O_1, O_2, O_3, \ldots, O_n$	$T_1, T_2, T_3, \ldots, T_n$

  The survey confirmed the factors and their importance within SWOT. The survey participants were recruited from the government and ESCO stakeholders. They included people from the Ministry of Energy (MoE), the Ministry of Finance (MoF), the Financial Services Authority, Banks, ESCO

companies and associations, experts in this field and other companies in Indonesia.

- Step 4: Analysis

  In the analysis stage, a SWOT Matrix using an Analytic Hierarchy Process (AHP) Method was developed. AHP was used to determine the level of stakeholder perception of SWOT for ESCO implementation (Saaty 1990). The implementation of AHP carried out a Pairwise Comparison of SWOT factors and a comparison matrix on each group was developed. The matrix resulting from the local priority was then compared to scaling factors for the matrix of strength, weakness, opportunity and threat (SWOT) groups to achieve the global priority. The overall priority (global priority) scope was defined by analysing and calculating all the steps of the methodology as follows: defining SWOT groups, group priority, SWOT factors, factor priority within the group and concluding with an overall priority factor/scope. The details about the SWOT-AHP methodology will be explained in detail in the sub-Chapter 2.1.

- Step 5: Obtaining lessons learned and recommendation

  In this final stage, lessons learned were synthesised and the priority factors established. A recommendation for developing ESCOs in Indonesia was also proposed.

Methodology Flowchart

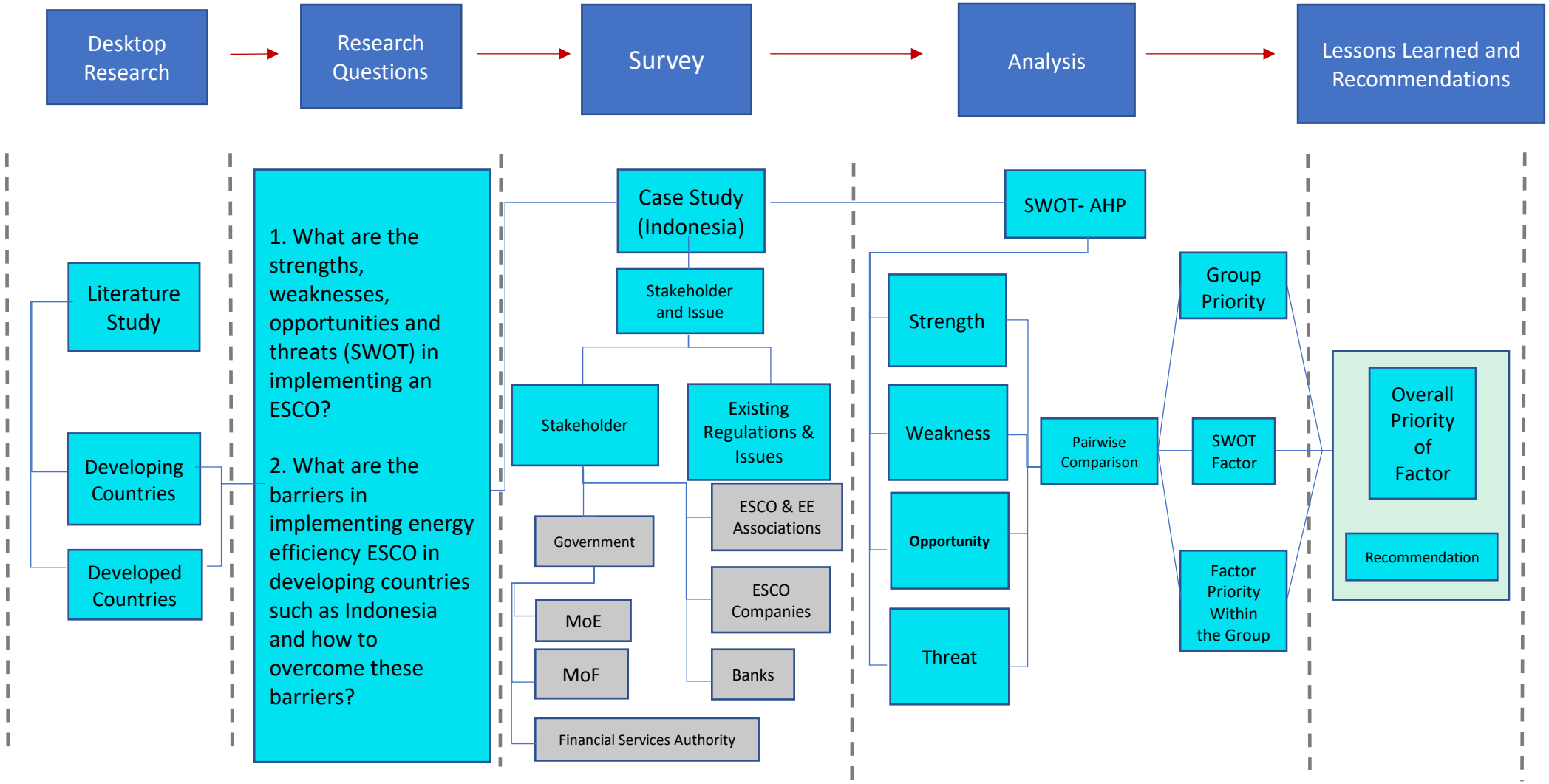


Figure 1. Methodology Flowchart

Contingency Plan in case data could not be sourced.

Secondary data gathered from journals, reports, surveys and case studies from an international organisation and other countries was proposed to be used as a backup plan if the proposed surveys could not be conducted. The secondary data could be utilised by limiting the scope and assumptions.

2.1. SWOT-AHP Methodology Approach

The SWOT (Strengths, Weaknesses, Opportunities, and Threats) approach is a valuable tool that can be broadly used for analysis at an individual, organisational, industry, and country levels (Helms and Nixon 2010). The strengths and weaknesses are mostly derived from internal factors, while the opportunities and threats are mostly derived from external factors that influence the situation of the entity.

The Analytic Hierarchy Process (AHP) is an effective tool for analysing the decision-making criteria that may help the decision maker to make the best decision by setting priorities for the factors/criterion/options. The alternative options/criterion/factors can be analysed using pairwise comparisons and then synthesising the results. The AHP is a commonly used multi-criteria decision making (MCDM) method to determine the final decision (Eslamipoor and Sepehriar 2014).

Multi-criteria Decision Making (MCDM) techniques are complex decision-making methodologies that are usually used for approaching and choosing the probable optimal options arising from multiple conflicting objectives. This method involves establishing the issue, identifying the decision making factors and rating the level of importance of each factor and finally

synthesizing all decision making factors with a number to get the priority/level of importance (Saaty 2008, 1990).

In this research, the purpose of using a combination AHP and SWOT was to evaluate the importance of SWOT factors in the development of ESCOs and rating the intensity of importance using AHP. The value of the SWOT can be obtained by measuring pair-wise comparisons between the SWOT factors with the AHP technique to get the overall priority. In the AHP method, this measurement is very useful as it can convert the intangible factors (qualitative) into numerical factors by giving a rating and evaluating selected factors in the series of comparisons (Saaty 2008, 1990).

The weight of the scaling factors that were used in this research (questionnaire) ranged from 1 to 9. These were defined as 1=least important, 3=moderate importance, 5=strong importance, 9=extreme importance as shown in the figure below:

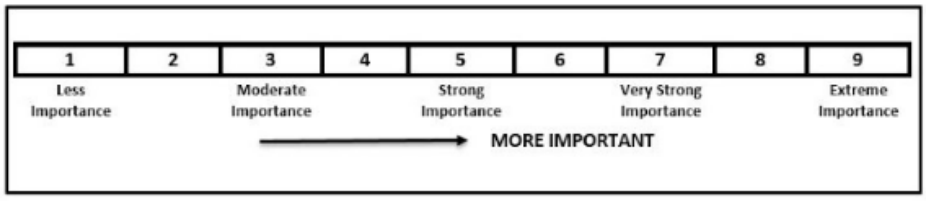


Figure 2. Intensity of Importance Numeric Scale and Definition

After receiving the survey response, the research would get the value of SWOT factors weight that will put in the matrix. The matrix is formed by creating the relative priority of each factor within the individual SWOT as shown in equation 1. The priority ranking as a result of this analysis was shown as a weight of matrix that designated a relative rating/weight to the element a_{ij}.

$$A = (a_{ij}) = \begin{bmatrix} W_1/W_1 & W_1/W_2 & \cdots & W_1/W_N \\ W_2/W_1 & W_2/W_2 & \cdots & W_2/W_N \\ \vdots & \vdots & \vdots & \vdots \\ W_N/W_1 & W_N/W_2 & \cdots & W_N/W_N \end{bmatrix} \quad (1)$$

According to the equation (1) above, the pairwise comparison will produce the relative importance of the value (weight) where the importance of the value is measured using the Eigenvalue technique. The value of all a_{ij} is > 0. If the matrix i=j, a_{ij} = 1, the multiplying of matrix A and the transpose of the vector weights, will produce AW. Thus, the importance of the vector value (AW) is calculated by the formula as shown in equation 2 below.

$$AW = NW = \lambda_{max} W \quad (2)$$

W is the transpose of the vector weights, where λ_{max} is the largest Eigenvalue, and N is the number of rows and columns.

In the AHP methods, the matrix has to be consistent. If there is no consistency, the judgments could be made. The consistency of the matrix could be defined using the following formula 3 and 4 below:

$$CI = (\lambda_{max} - N)/(N-1) \quad (3)$$

$$CR = CI/RI \quad (4)$$

Where CI is the Consistency Index, CR is the Consistency Ratio, RI is the Random Index that is produced for a random matrix of order N. The RI value may be different across the research study. In this research, it used the *Wharton* value which is 0.58 for 3 elements in the pair-comparison matrix and 0.9 for 4 elements in the pair-comparison matrix. The rule of thumb is CR should be maintained less than 0.1 (Chanthawong and Dhakal 2016). If it is above 20% (0.2), re-evaluation and adjustment are needed (Mehmood, Hassannezhad, and Abbas 2014).

The next step is calculating the global priority (overall) priority of each factor. This step can be done by multiplying the local priority (priority value of vector) to the scaling factor for each group of SWOT as shown in formula 5 below. In this research, the scaling factor has been assumed equal (0.25) due to assuming the same weight of 4 factors (Strengths, Weaknesses, Opportunities and Threats).

$$\textit{Global priority factor}_{ij} = (\textit{local priority factor}_{ij}) \times (\textit{scaling value of SWOT category}) \quad (5)$$

The AHP-SWOT method is commonly applied in areas such as tourism, project management, agriculture, and manufacturing (Eslamipoor and Sepehriar 2014). This hybrid method is often used to improve the SWOT analysis as it can convert from qualitative analysis to quantitative analysis by determining the importance of factors in SWOT groups (Kurttila et al. 2000). Therefore, it is a very appropriate tool which can be employed in analysing policies for simple, effective, and inclusive diagnosis of internal and external factors especially for the development of an ESCO.

The SWOT factors analysed in this research were obtained by analysing the Literature review. Then, to determine the AHP-SWOT construction, the Goal, Criteria (Sub-Criteria) and Alternatives factors were defined as shown in figure 3 below. This figure is the example of the flowchart for Regulatory Aspects Sub-Criteria. Another Sub-Criteria flowchart for Financial and Awareness aspects is not shown due to the similar flow chart. The difference is only for the number of Strengths factors which in the Financial and Awareness Aspects sub-criteria is having 4 Strengths factors (S1, S2, S3, S4).

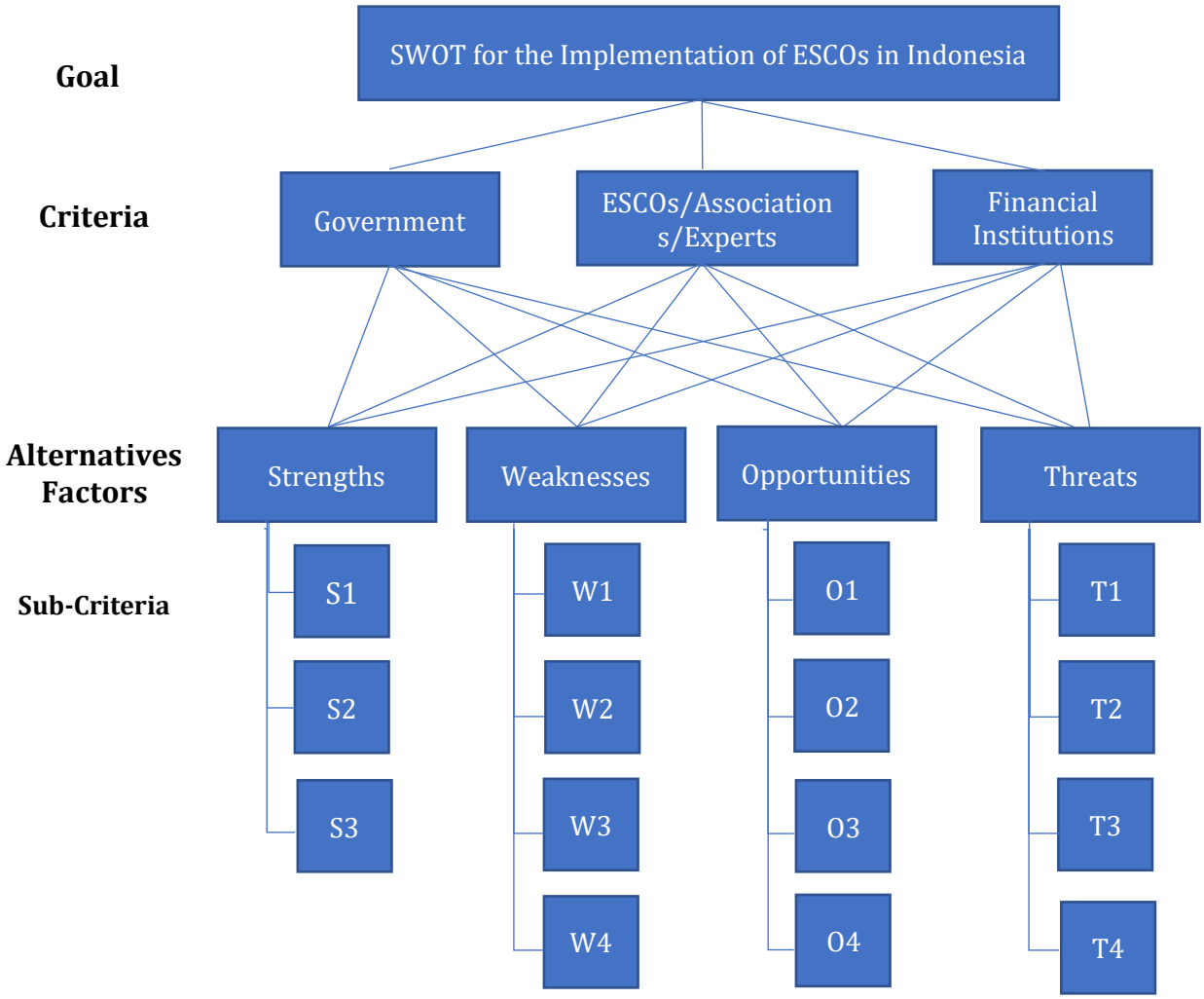


Figure 3. AHP-SWOT Construction Flowchart

AHP-SWOT method will use pairwise comparisons by measuring group priority for the goal, criteria, and alternatives factors as shown in figure 3. Each alternatives factor can be measured using pairwise comparison resulting in the local priority. Once the local priority has been determined, it will continue using the pairwise comparison to measure the criteria to identify the global priority. In this research, the pairwise comparison at the criteria level (government, ESCOs/Associations/Private Sectors, Financial Institutions) will not be used. Therefore, the weight in each criterion will be assumed to be the same (0.333).

2.2. Survey Population and Sample Size

In this research, questionnaires were used to survey the ESCO stakeholders in Indonesia. Several stakeholders were surveyed for their perceptions regarding the AHP-SWOT of ESCOs in Indonesia. The stakeholders in this research included:

- The Indonesian Government
- ESCO Associations/Experts in the area
- ESCO Companies
- Industrial/Building Associations
- Banking regulators
- Banks/Financial Institutions
- Others (private companies, universities, etc.)

For conducting a survey, it is imperative to determine the population and sample sizes to represent all the ESCO stakeholders in Indonesia. According to a statistical calculation by Raosoft (2004), for this research, the conditions of the survey (population and sample sizes) can be explained as shown in equation 6, 7, and 8 below:

The sample size n is calculated by

$$n = {}^{Nx}/_{((N\text{-}1)E^2 + x)} \quad (6)$$

where N is the population size, E is the margin of error, and

$$x = Z({}^{c}/_{100})^2 r(100\text{-}r) \quad (7)$$

Where, Z(c/100) is the critical value for the confidence level c, and r is the fraction of responses interested in. To define the margin error itself (E) can be calculated using the equation 8 below:

$$E=Sqrt\left[\frac{(N-n)x}{n(N-1)}\right] \quad (8)$$

In this study, the total population N was considered as 90. This population included people in government institutions including the Ministry of Energy, the Ministry of Finance, and the Financial Service Authority. Officials from banking Institutions (small, medium, large banks), ESCO Associations, ESCO experts, ESCO companies, Industry and Building Associations were also approached for the survey.

The margin of error was considered as 10%, and confidence level was 90%. Therefore, the sample size required for this survey was 39.

The ESCO scheme is relatively new in Indonesia. Therefore, to minimise the number of unexpected participants who lacked basic knowledge of ESCOs, a certain degree of assumption was used to determine the participants representing all the ESCO stakeholders. Hence, there was a specific criterion for each stakeholder category to determine the size of the population. By analysing the stakeholders, a population size of 90 participants was established to represent the ESCO stakeholders.

The assumptions taken into account to decide the number of participants (population) were the following:

- Government
  - ✓ Ministry of Energy : 8 people

In the Ministry of Energy, the survey only recruited participants who worked in the Energy Conservation Directorate. The designation of the participants was set as the Section Head and/or staff usually in charge of the ESCO policies.

- ✓ Ministry of Finance : 3 People

  In the Ministry of Finance, the participants were recruited from the Fiscal Policy Agency. These people who participated in the survey were all familiar with the fiscal and energy efficiency financing policy in Indonesia.

- ✓ Financial Services Authority : 2 people

  Banking regulators (Financial Service Authority): Participants with knowledge on green financing, ESCO or energy efficiency financing were approached.

- Financial Institutions
  - ✓ Banking Institutions : 46 people

    Participants from various banking institutions were chosen based on the business core investment of the banking institution in Indonesia. The criteria of the banking institutions were based on the size of the business core investment according to the Bank of Indonesia (BUKU1, BUKU2, BUKU3, BUKU 4). The total population of 46 banks was obtained from the number of participants who attended the dissemination information for energy efficiency financing and green financing schemes held by the Ministry of Energy and Financial Service Institution. Not all the banks in Indonesia (120 banks) attended this event and many did not understand

the concept of energy efficiency financing. Therefore, a population size of 46 people from the banks with this knowledge was used in this research.

- ESCO/private companies & ESCO/EE Association
  - ✓ ESCO companies/project companies : 19 people

    ESCO companies and project developers provide the energy efficiency service projects in Indonesia. Since an ESCO is a new concept in Indonesia, the number of companies that can support the ESCO project is very limited. As of June 2017, there were only five ESCO companies registered in Indonesia.
  - ✓ ESCO/EE Associations and experts : 5 people

    People with the knowledge and expertise in the energy efficiency areas and energy efficiency financing in Indonesia were selected. These people are also involved in the development of ESCOs in Indonesia.
  - ✓ Building and Industrial Associations : 7 people

    People from the building and industrial associations or people from companies that represented commercial buildings and industrial companies/factories were selected for the survey. There is a Green Building Council Indonesia (GBCI) that consists of co-founders and several people that contributed in developing ESCOs in Indonesia. Some representatives from GBCI were selected for this survey.

2.3. Data Collection and Survey Procedures for the Participants

Participants were requested to comment on their perception about the implementation of ESCOs in Indonesia, based on their experience.

The participants were asked to follow the link to enter the survey: https://goo.gl/forms/zV4MRoyPzByGUH6b2. The form of the questionnaire is shown in Appendix A.

There were a number of questions for the participants to answer. Participants were also asked to complete the following tasks:

- Provide detailed information about themselves

  (All the information provided is treated as strictly confidential. Participant's names will not be revealed anywhere in the results of survey).
- Rate the level of importance of several strengths, weaknesses, opportunities, and threats (SWOT) in developing markets for Energy Service Companies (ESCO) in Indonesia.
- Comment on the above based on the experience and expertise of the participants.

It was estimated that the survey would take approximately 15-20 minutes. The questions in the survey focused on the strengths, weaknesses, opportunities and threats (SWOT) relating to the implementation of ESCOs in Indonesia. Data from the survey was analysed using Analytic Hierarchy Process (AHP) in Microsoft Excel.

Participation in this study was entirely voluntary. Participants could withdraw at any time without discrimination or prejudice. There was no direct benefit to the participants from this research. However, the knowledge obtained from the participation may benefit in analysing SWOT factors of ESCOs that could be potentially used to prioritise the development of ESCO markets and energy efficiency programs in Indonesia.

Chapter 3: Literature Review

3.1. Purpose of Literature Review

The purpose of the literature review is to provide an overview of the current status of ESCOs in developed and developing countries. This overview includes analysing the types of projects, regulatory factors, market drivers, financing availability, and barriers faced. After the SWOT factors are identified, they can be synthesized and included in the methodology and processed in the Analytic Hierarchy Process (AHP) methods.

3.2. What is an ESCO

The concept of Energy Service Companies (ESCOs) was founded in the early 1980s in North America. It resulted from the impact of the energy crisis due to the oil price shock in the early 1970s (Okay and Akman 2010). ESCO implementation started at the beginning of the 1980s and most of the ESCO activity occurred in many countries at the end of the 1980s and early 1990s (Vine 2005). Okay and Akman (2010) stated that "Energy Service Companies (ESCOs), as private-sector instruments, guarantee and deliver energy improvements (saving, efficiency, conservation) to their clients". An ESCO provides various services to customers. They include supply of energy and management, financing, consultancy and technical engineering assistance (e.g. audits), provision of equipment, installation, and operation and maintenance including upgrade, and monitoring, measurement, and verification for energy savings (Morgado 2014), (Bobbino, Galván, and González-Eguino 2013). ESCOs are typically implemented with energy efficiency project design and development, delivering/energy savings guarantee and ensuring cost-effective and optimum performance (Morgado 2014),

(Murakoshi and Nakagami 2009), (Bertoldi, Rezessy, and Vine 2006), (Okay and Akman 2010).

An ESCO scheme has also been used for providing energy services from renewable energy in many countries, e.g. Fiji (Urmee, Harries, and Schlapfer 2009), Kiribati (Dornan 2011), Sri Lanka (Lipp 2001), China and India (Liming 2009). Although an ESCO can implement in both energy efficiency and renewable energy areas, however, this project focused on ESCOs that implement energy efficiency in non-renewable areas.

3.3. The ESCO Model

The ESCO model is classified mainly based on their type of financing or business. The most commonly used business models under ESCOs are "guaranteed savings" and "shared savings" (Bertoldi, Rezessy, and Vine 2006), (Okay and Akman 2010). Other models include an outsourced energy management which is quite popularly used in in the European Union ESCOs (World Bank 2016) and a leasing model (Morgado 2014). A majority of the ESCO commonly use the Energy Performance Contracting (EPC) model to share their profit and risk. Energy Performance Contracting (EPC) is a contractual agreement between the client and the ESCO, concerning the share in energy savings and its inherent risk based on the energy efficiency project measurement (European Commission 2016).

In the "guaranteed savings" model, the ESCO ensures energy performance and energy savings from the project but is not responsible for arranging the financing (Morgado 2014). Hence, the customers are financed directly by the

banks or financial institutions as shown in figure 4. The ESCO will be paid by the customer from the energy savings and performance as stated in the contract.

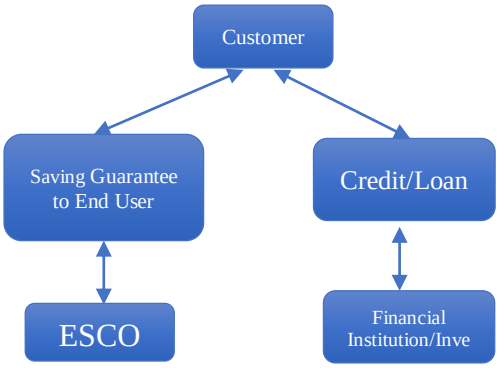


Figure 4. The Financing Mechanism in the Guaranteed Savings Model

Source: adapted from "Advantages and disadvantages of the two dominant world ESCO models; shared savings and guaranteed savings" (Dreessen 2003)

In the "shared savings" model, the ESCO is responsible for taking responsibility for both the energy performance and the credit risk. The ESCO repays the loan and undertakes the credit risk; while the client does not take the financial risk (Morgado 2014), (European Commission 2016). This model is shown in figure 5.

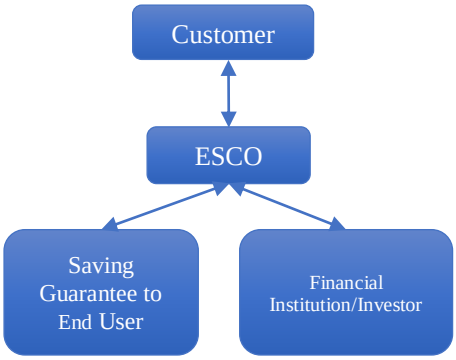


Figure 5. The Financing Mechanism in the Shared Savings Model

Source: adapted from "Advantages and disadvantages of the two dominant world ESCO models; shared savings and guaranteed savings" (Dreessen 2003)

In this model, the ESCOs conduct the project development, financing, and implementation, while the payment for the projects depends on the share of the

savings agreed between the ESCOs and clients. The financial institution provides loans to the ESCOs, which ESCOs invest in energy savings programme and repay the loans from the shared savings. In countries which are developing ESCO markets (e.g. China, Thailand), the ‘‘shared savings’’ model is more suitable since it does not require clients to assume the investment–repayment risk (Okay and Akman 2010).

The leasing and outsourcing model involves customers borrowing the equipment and receiving service for their energy efficiency project. In some cases, the leasing and outsourcing energy management can be more attractive (mostly in industrial equipment) since the payment for leased projects are sometimes lower than the loan repayment for the project (European Commission 2016).

3.4. The ESCO Financing Mechanism

According to Morgado (2014), there are three financing mechanisms for ESCOs. Firstly, the client pays for the services or the equipment based on how much energy savings are achieved. Secondly, financial institutions provide the loan for the customer and/or ESCO. This condition allows a financial institution to act as a third party who provides credit or funds to an ESCO or the customers. Thirdly, ESCOs invest in the equipment, and they use the equipment to provide service and financing to the customers. This mechanism allows ESCOs to guarantee energy reduction and receive an operational cost and the majority of shared savings to recover the capital investment for their equipment.

Once the contract between the ESCO and the client expires, the energy cost reduces gradually, and the client gets the benefit from the energy and cost reduction as shown in figure 6.

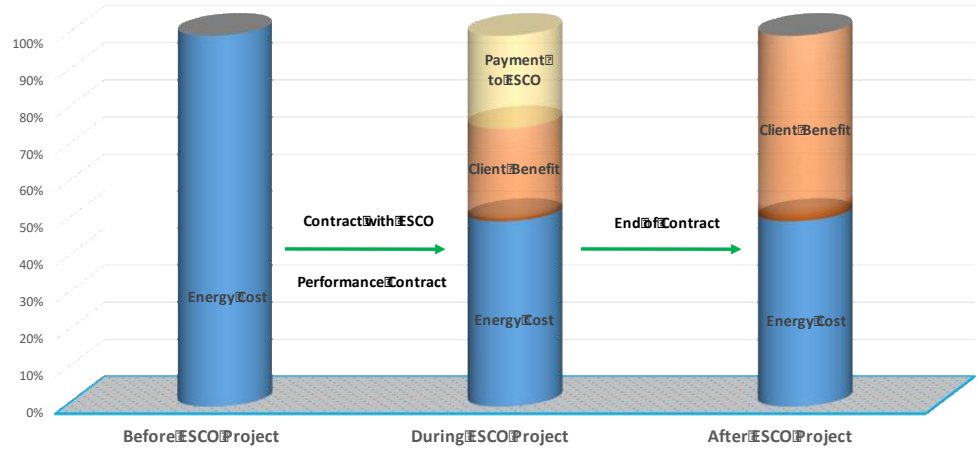


Figure 6. ESCO Project Process for Financing
Source: adapted from Promoting Korean ESCO Business (Lee et al. 2003)

3.5. Examples of ESCOs in Some Countries of the World

The traditional ESCO is a part of an energy service business which implements engineering designs, installs energy efficient equipment and finances these projects as shown in figure 7 (Morgado 2014).

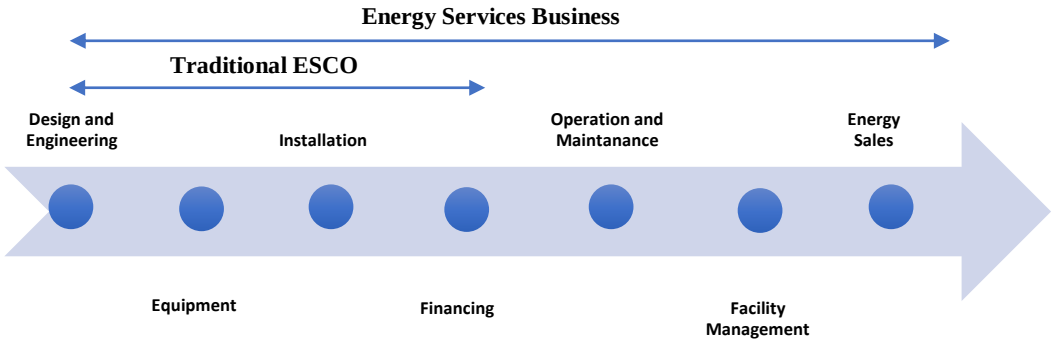


Figure 7. Implementation Plan and Process of an ESCO
Source: adapted from "Energy Service Company and Financing" (Morgado 2014)

According to Murakoshi and Nakagami (2009), most countries in the world apply traditional ESCO concepts similar to those used in the USA. However, according to Hansen (2003), every country has its own culture and uniqueness; so

no single ESCO model can be implemented effectively around the world. Hansen (2011) also stated that knowledge of the local situation and culture is essential for developing ESCOs in both developing and developed countries. Although the concept of an ESCO is similar around the world, the best implementation of an ESCO would differ between countries.

ESCOs traditionally implement the following four strategies: (1) Select funding resources and financial institutions, (2) Involve stakeholders or associations, (3) prepare regulations including standards and reporting, and (4) set targets and conduct the EE business based on the contract.

In Japan, the ESCO model is primarily based on the shared savings contracts (90%). There is a long payback period for many ESCO projects, and these include large-scale ESCOs and customers (Murakoshi and Nakagami 2009). Japan is encouraging and strengthening standards and regulations for developing ESCOs. In the past, they focussed on private sector facilities particularly private industries as the main market drivers. They have now commenced introducing the ESCO concepts in public sector industries/facilities. In terms of financing, Japan provides incentives such as subsidies. Although Japan has an excellent record in implementing funding mechanism for large companies, it has a lacked attractive financing incentives for small and medium enterprises (Murakoshi and Nakagami 2009).

According to Vine (2005), Australia has implemented an Energy Performance Contracting (EPC) scheme and several ESCO regulations. These include creating accreditation of ESCOs, developing standard contracts, development of Energy Performance Contract facilitators, creating a regulatory program for guaranteed savings loan, multiyear budget, and commercial leasing.

The market drivers for these ESCOs come from industry, commercial and municipal organisations. ESCO associations have been formed to promote ESCO projects. However, there was a time delay in the implementation of these projects due to the negotiation of contracts.

ESCO markets in Belgium are mainly based on the public ESCO called Fedesco. There are around 10-15 ESCO firms that focus on public sector buildings and private industry facilities. The Belgian ESCO market is mainly driven by the efforts of the public ESCOs that act as market facilitators. The key barrier of this system is a lack of policy support with a considerable lack of legislative focus on the ESCO market (World Bank 2016).

In Austria, there are currently around 50 ESCOs promoting EE. The types of ESCO projects are space heating, air conditioning, control and automation and lighting. Most of these ESCOs follow the "shared savings" model. As a survey conducted by the European Union in 2013 (World Bank 2016) mentioned that high transaction costs, small project sizes, perceived risks and lack of best practice examples were the common barriers for developing ESCOs.

Germany is considered as a world leader regarding the number of stakeholders in ESCOs and the maturity of the industry (Marino, Bertoldi, and Rezessy 2010). Around 550 companies so far are involved with ESCOs. The market volume for EE services in Germany in 2012 was estimated at €3.5-5.0 billion/a (Seefeldt et al. 2013). Approximately 80-85% of all German ESCO projects are in the form of energy supply contracts, while 8-10% of the market is covered by the EPC scheme (Bertoldi et al. 2014). Numerous associations are also available to support ESCOs. National and European legislation are considered as

key movers of the ESCO market in Germany (MPW Institute LLC 2013), (Bertoldi et al. 2014).

The ESCO market in the UK is amongst the most mature with a relatively long history of providing energy services (Marino, Bertoldi, and Rezessy 2010). About 30-50 ESCO companies are working in the UK market. The majority of the UK ESCOs are responsible for financing, installing, operating and maintaining PV systems rather than providing just EE. Specific regulations on ESCOs and EPC do not exist in the UK, and the business model is constantly changing. The types of ESCO projects available are in the industrial sector, public buildings, hospitals, schools, offices, social housing supply side and networks (district heating), Heating Ventilation and Air Conditioning (HVAC), control technologies, lighting and public lighting.

Overall, in the European system, ESCOs have been implemented under the EPC scheme and mostly in the "shared savings" model. Liberalisation of the electricity market and climate change campaigns (Kyoto Protocol, CDM, Joint Implementation) are the main drivers for the development of ESCO markets in Europe (Bertoldi, Rezessy, and Vine 2006). The implementation of ESCOs in Europe, according to Bertoldi, Rezessy, and Vine (2006) is through several processes and implementations. These include involving Third Party Financing (TPF), starting ESCOs in public and building sectors, creating pilot projects for ESCOs, standard ESCO contracts for industries and finally building and creating online EU databases.

Table 1 summarises the profile of ESCO implementation of several developed countries in the world.

Table 1. The Implementation of ESCOs in Some Countries

Country	Implementation					Source/ remarks
	Types of Project	Regulatory Factors	Market Factors & Association	Financing	Barriers	
Japan	- The long payback period for many ESCO projects - Large-scale ESCOs and other customers	- Strengthening standards and regulations - implemented in public facilities	- Private sector facilities (industrial sector) (Murakoshi and Nakagami 2009) - Japanese Association of ESCOs (JAESCO)	- Shared Savings contracts (90%) - Incentives (e.g. subsidies) - Excellent financing mechanism for large-scale customers	- Financing in small and medium scale is not quite attractive	- (Murakoshi and Nakagami 2009)
Australia	- EPC	- Government involved in accrediting ESCO - Development of EPC facilitators - Regulations for guaranteed savings loans, multiyear budgets, and commercial leasing - Standard contracts and ESCO guidance documents	- Industry, commercial, and municipal, - Australasian Energy Performance Contracting Association Limited (AEPCA) / Energy Efficiency Council	- Multiyear budget (5 years) - Treasury funds for repaying the guaranteed savings loans - Establishing commercial leasing arrangement	- The time delay in project implementation due to negotiations of contracts	- (Vine 2005)
Belgium	- Public ESCO, Fedesco. - Public sector buildings and private industry facilities project. - Main targets include healthcare facilities, educational and office buildings	- Establishment and funding of public ESCO - Information campaigns, - The obligation of recruiting energy managers and mobility officers	- 4 public ESCOs and 10-15 private firms (6 large, 5-7 SMEs) - Public ESCOs that act as market facilitators. - Slow growth - BELESCO: The Belgian Association of ESCOs and energy service providers and AGORIA Green Building platform	- Public energy service contracts - Third Party Financing (TPF) - EPC and Smart EPC (Energy, Maintenance, Comfort and Building Value Performance Contract) -	- Lack of policy support (legislative focus on the ESCO market). -	- (Bertoldi et al. 2014), (World Bank 2016)

Country	Implementation					Source/ remarks
	Types of Project	**Regulatory Factors**	**Market Factors & Association**	**Financing**	**Barriers**	
Austria	- Space heating, AC, control and automation, lighting. - Public sector buildings	- Certification and accreditation scheme - Standards and ecolabels - Mandatory energy consultation - Standardization contracts	- Small Medium Enterprises - 'Dachverband Energiecontracting Austria' (Professional Association for Energy Contracting)	- EPC - shared savings model - Commercial banks are ready to engage in ESCO financing	- High transaction costs, small project sizes, perceived risks and lack of best practice examples	- (Bertoldi et al. 2014), (World Bank 2016)
Germany	- All energy efficiency sectors	- National and European legislation (key movers) - The European directives	- Numerous associations. - Around 550 companies so far involved with ESCOs - EPC market - increasing energy prices	- 80-85% Energy Supply Contracting (ESC), 8-10% EPC. - Mainly shared savings model)	- The regulatory framework (the Renewable Energy Act disadvantage of EPC in ownership operation)	- (Marino, Bertoldi, and Rezessy 2010), (Seefeldt et al. 2013), ; (MPW Institute LLC 2013); (Bertoldi et al. 2014);
UK	- The industrial sector, public buildings, hospitals, schools, offices, social housing - supply side and networks (district heating), HVAC, control technologies, lighting, and public lighting	- Climate and energy conservation policy. - financial incentives	- Various trade associations - cost and environmental motivations	- The Green Investment Ban - EPC (both shared savings and guaranteed savings)	- High transaction cost because of large contract variation and the lack of standardisation	- (Marino, Bertoldi, and Rezessy 2010);(Bertoldi et al. 2014)

3.6. Overview of ESCOs in Developing Countries

In developing countries, issues surrounding the funding of ESCOs and EE projects are still dominant. Therefore, developing countries are working together with international organisations and ESCO associations to create funding mechanisms for promoting the ESCO business model to financial institutions. Incentives and financing mechanisms such as creating low-interest rates, loan guarantees, and revolving funds are being developed to promote the ESCO business (Murakoshi and Nakagami 2009), (Center for Clean Air Policy 2012). ESCOs in developing countries will not be implemented in all sectors but will be developed using pilot projects in specific areas such as public facilities and street lighting. This section will highlight and provide an overview of the implementation of ESCOs in developing countries such as South Korea, China, Thailand, the Philippines, some African Countries (Egypt, Kenya, South Africa) and Brazil.

South Korea has been quite successful in implementing ESCOs by adopting multiyear procurement strategies and removing institutional barriers (Murakoshi and Nakagami 2009). South Korea has implemented long-term and low-interest tax credits for ESCO projects (Lee et al. 2003). The procurement system (institutional barriers), financing barriers and low priority for EE programs in South Korea were some of the barriers encountered (Lee et al. 2003). Lee et al. (2003) reported that other challenges for ESCOs in South Korea were creating a continuous demand for ESCOs, providing capacity building and improving private financing and guaranteed savings contracts. They conducted a pilot project for ESCOs in the public sector by promoting street lighting efficiency. This served as the first target for the ESCO business promotion in South Korea (Lee et al. 2003).

The market driver for the South Korean ESCO is the high cost of energy. This means that increasing energy prices will create a demand for EE and ESCO projects.

In China, the implementation of ESCO associations and loan guarantee mechanisms is essential for creating ESCO markets (Murakoshi and Nakagami 2009). The increased potential for lowering industry and commercial emissions is the main market driver for ESCOs in China. The implementation of ESCO commenced with a pilot project to introduce the ESCO scheme. Shared savings contracts are mostly used in the China ESCO market. Some obstacles encountered during ESCO implementation in China include financial barriers (lack of credit mechanism), institutional barriers (administration and high transaction cost) and technology barriers (lack of standardised procedures) (Da-li 2009).

Thailand has been successful in implementing ESCOs despite the lack of specific associations. The success is attributed to attractive financial incentives. The market drivers in Thailand originate from small and medium enterprises, industrial sectors, and building/commercial sectors (Center for Clean Air Policy 2012). Project financing is one of the barriers in implementing ESCO projects. Thailand has an Energy Conservation Promotion Fund (ENCON funds) which provides the incentives such as capital and technical assistance, low-interest credits and revolving funds mechanism to create the EE market (Murakoshi and Nakagami 2009). Another incentive is provided by ESCO Funds which disperse capital and technical support EE, ESCO projects, and also retrofit projects for buildings (Center for Clean Air Policy 2012). The ENCON Fund is procured from the initial capital outlay from oil and fossil fuel funds.

ESCOs in India were started by conducting small ESCO projects for municipal retrofit lighting, improving the EE of hotels and managing industrial operations (Murakoshi and Nakagami 2009). The lack of skill development, lack of public awareness, financing and ESCO policy regulations were the common ESCO barriers in India (Murakoshi and Nakagami 2009).

In the Philippines, the effective implementation of ESCOs was in the area of a street lighting retrofitting project. The pilot project was supported by the Development Bank of the Philippines to service a benchmark of the industry (Vine 2005). The lack of business concepts for ESCOs is still the biggest problem faced in the Philippines.

In Africa (Egypt, Kenya, and South Africa), conducting cooperation with international institutions for creating funding possibilities, increasing public awareness, and creating ESCO Associations are some strategies adopted for promoting ESCOs in these countries (Vine 2005).

In Brazil, the development of ESCO associations and cooperation with the Canadian Government has enhanced the ESCO development there. Brazil also has an active ESCO Association which is growing and has the potential to be larger (Ellis 2009). Brazil's national electricity conservation program (PROCEL) provides funds or co-funds ESCOs and EE projects for research and development, education, standards and labels and pilot projects (Taylor et al. 2008). The government has also provided loan guarantee funds for EE projects. Despite these programs and various financing schemes, EE marketing is still a major problem in Brazil.

A summary of ESCO implementation in developing countries is shown in Table 2.

Table 2. The Implementation of ESCOs in Developing Countries

Country	Implementation					Source/ remarks
	Types of Project	Regulatory Factors	Market Factors & Association	Financing	Barriers	
Korea	- Street Lighting, industry	- Street lighting as a pilot project - Multiyear procurement	- High energy prices - Korean Association of ESCOs (KAESCO)	- Creating tax credits for ESCO projects, long-term and low-interest loans/credits	- Institutional barrier for procurement (unavailability of multiyear contracts) - Low priority for energy efficiency programs	- (Vine 2005), (Lee et al. 2003)
China	- EPC (mostly shared savings) - Short payback period (less than 2 years) - Greenlight, heating networks, boiler retrofit projects, central air conditioning, integrated - Building and industrial sectors	- Founding Energy Conservation Information and Dissemination Centre (NECIDC) - Creating ESCO Associations and ESCO partial loan guarantee - The revision of Energy Conservation Law	- Projects for reducing emission. - China Energy Conservation Service Industry Association (EMCA)	- Shared savings, guaranteed savings, and outsourcing management contracts. - Loan guarantee system	- financial - institutional - technology	- (Murakoshi and Nakagami 2009),(Da-li 2009)
Thailand	- EPC (Shared and Guaranteed Savings) - Industrial, commercial	- providing incentives for ESCOs - conducting a pilot project for 4 industrial facilities	- Electricity Generating Authority of Thailand (EGAT) involved in promoting ESCOs	- EPC (Shared and Guaranteed Savings) - Creating Energy Conservation Promotion Funds (ENCOND Funds) - Providing the revolving fund mechanism with low-interest rate (less than 4%)	- Project financing	- (Murakoshi and Nakagami 2009), (Center for Clean Air Policy 2012)

Country	Implementation					Source/ remarks
	Types of Project	Regulatory Factors	Market Factors & Association	Financing	Barriers	
India	- EPC	- Small ESCO project for municipal retrofit lighting, - Improve EE. - Involving international organisations - ESCO promotion	- The B\building and industry sector - The Federation of Indian Chamber of Commerce and Industry (FICCI) - the Indian Council for Promotion of EE Business (ICPEEB)	- Decentralized investment of ESCO - Low-interest financing	- Public awareness, and policy	- (Murakoshi and Nakagami 2009)
The Philippines	- EPC	- Develop a model ESCO contract	- Lighting (street lighting)	- Development Bank of Philippines	- Lack of ESCO business concept	- (Murakoshi and Nakagami 2009)
Africa (Egypt, Kenya, South Africa	- EPC	- In Egypt, providing training for energy audit, EE technologies, and ESCO project evaluation and financing - In Kenya, conducting a survey banks and hiring energy consultants to explore the establishment of ESCO in the country. -	- Egypt: Cooperation with the US Agency for International Development (USAID) - Egyptian Energy Service Business Association. - Kenya: creating the Kenyan Association of Manufacturers Industrial EE Project - In South Africa, creating an association for ESCOs (the South Africa Association of ESCOs (SAAEs), and the Black Energy Service Companies Association)	- Cooperation with an international organisation to get a funding	- Funding - Public awareness	- (Vine 2005)
Brazil	- EPC	- Establishing National Electricity Conservation Program (PROCEL) to fund EE projects - Collaboration with the Canadian government	- Developing ESCO Association in 2009 (Brazilian Association of ESCOs (ABESCO)	- Loan guarantee fund. - Creating funding and cooperation with PROCEL	- EE marketing	- (Vine 2005)

3.7. Conclusions Drawn from ESCOs in Developing and Developed Countries

The following conclusions can be drawn from the implementation of ESCOs in developed and developing countries:

A. Policies and Implementation

The policies for implementing ESCOs varied in different countries and depended on factors such as culture, the acceptance of EE and the level of EE development. Although the same ESCO policy could be implemented in several countries, the results and outcomes would be different. The policy implementation of ESCOs requires adjustment of market participation for the development of ESCOs. The lessons learned from the policy implementation in developed and developing countries are that:

1. Almost all countries which implement ESCOs commonly use the shared savings model.
2. Creating a market driver and identifying a market for ESCOs is essential for implementing the appropriate ESCO policy. Not all developed countries have large ESCO markets such as Japan, Germany, and the UK. Developed countries such as Austria have an efficient market policy for small and medium enterprises.
3. It is essential to improve an institutional weakness by providing an appropriate institutional organisation. Creating an ESCO Association is one such example. The ESCO association contributes towards promoting the development of ESCOs. For instance, Japan created the Japanese Association of Energy Service Companies (JAESCO) in 1999 with a few members initially, and in 2003 the number of members had increased to

110 (Murakoshi and Nakagami 2003). ESCO associations can provide dissemination information to companies and assist them in understanding the role of ESCOs in the functioning of their companies. ESCO associations can also provide suggestions and inputs for a government for setting up ESCO policies in the country.

4. It is essential to create a pilot project in a public-sector facility or a government building for promoting the first stage of an ESCO project. This has been shown to work in Austria, Belgium, Japan, China, the Philippines, and South Korea. The implementation of an ESCO pilot project in one or more government buildings could trigger an increasing market structure for ESCO including ESCO expertise and capital investment, especially in the private sector. The pilot project can demonstrate the implementation of ESCOs in introducing energy efficient technologies and the concept of EPC.
5. Enhancing standards and regulations, improving EPC and accreditation of ESCOs are important and these regulatory programs are especially strong in developed countries (Japan, Australia). The accreditation of ESCOs is necessary for their reliable services in EE projects. A standard contract also minimises uncertainty and problems in distinguishing energy performance contracts in each sector (industrial, commercial or public sector).

B. Financial

Finance and funding are the important issues in almost all sectors of ESCO projects.

1. In developed countries, most companies are familiar with the implementation of ESCOs and EE. Therefore, funding is not a crucial issue since EE can be run from business to business. However, in some developed countries such as Japan, sometimes there is a lack of government support for small and medium manufacturers (Murakoshi and Nakagami 2009).
2. Providing funding resources is essential. The main policy for developing a source of financing is by involving third-party financing (TPF), private banks, lending and financial institutions and donor agencies such as the European Bank, the World Bank, the Asian Development Bank (ADB) and the Global Environment Facility (GEF) to support ESCO projects. In developing countries, funding is hard to obtain from a local bank due to a lack of information and understanding about energy performance contracting. Therefore, the involvement of an international organisation is necessary to provide the finance to promote ESCOs. In developed countries, which are already familiar with EPC, the governments still encourage strengthening TPF and the involvement of local banks, and financial institutions in the ESCO markets.
3. It is essential to improve the financial mechanism especially in the area of ESCO procurement for EE. For example, in Australia and South Korea, the governments issued regulations for allowing multiyear procurement and contract mechanisms for ESCO projects.
4. Loan Guarantee policy also can be a solution in the financing mechanism in both developed and developing countries. This would ensure the

security of financial institutions that finance the project by minimising the credit risks (Australia and China).

5. Providing incentives for a financial institution is important. The incentives can be offered depending on the market situation. For example, in South Korea, the incentives are given through tax credit mechanism for ESCO projects, long-term and low-interest rate credits. In Thailand, the incentives are provided by a revolving fund mechanism with a low-interest rate (less than 4%).

3.8. ESCO Barriers in Promoting Energy Efficiency

The challenges for promoting energy efficiency in both developed and developing countries are multi-fold. These barriers stretch across issues concerning institutional and legal frameworks, financial and economic incentives, information, knowledge, technology and infrastructure:

i. Institutional Barriers

- The legal and regulatory framework in energy performance contracting (Germany, Belgium).
- In developing countries, few financial institutions have experience in ESCO business (Africa, India).
- Lack of government support for EPC and which have an impact on banks, while private investors are reluctant to participate (India, Africa).
- Some countries do not allow multiyear contracts (South Korea and developing countries).
- High transaction cost due to large variation in contracts and lack of standardisation (developed countries).
- Limited institutional capacity (both in public and private).

ii. Financial Barriers

- The financing problem for obtaining funds and getting credit is the biggest obstacle in developing ESCOs. To solve this problem, it needs cooperation across sectors and institutions such as government, financial institution, banks, and ESCO associations.
- Lack of financial incentives
- Risk of investment. As the energy efficiency measures energy savings as a commodity (non-assets based), there are many types of EPC that should be adjusted to the various project types to reduce the risk of investment. In almost all countries, several projects require high-cost investments.
- Unfavourable market structures.

iii. Knowledge and Information Barriers

- A lack of awareness about the operation of ESCOs (Africa, China, India, South Korea).
- A low priority for energy efficiency programs (Africa, China, India, South Korea).
- A lack of information, education and training.

iv. Technology and Infrastructure Barriers

- A lack of energy efficiency technologies.
- A lack of infrastructure.

3.9. Energy Efficiency Policy and ESCO Implementation in Indonesia

3.9.1. Energy Efficiency Policy

As a developing country, Indonesia is a big country with a large population of 256 million people and a growth rate of 1.2% in 2015 (Central Bureau

Statistics of Indonesia 2016). In 2015, Indonesia recorded a Gross Domestic Product (GDP) of 4.8% accounting for $861.9 billion. It was ranked as the 16th largest GDP in the world (World Bank 2015).

Indonesia's energy consumption increases by 7% per year. The Ministry of Energy and Mineral Resources (2016a) reported that the total energy consumption in Indonesia was 731 million Barrel Oil Equivalent (BOE) or 2.86 BOE per-capita in 2015. Indonesia's energy consumption is still heavily dominated by fossil fuels such as oil, gas, and coal, accounting for 95% of the total fuel consumption. The electrification ratio in Indonesia is 88%, and renewable energy is seen only as an alternative, contributing towards only 4.5 % of the total power consumption.

However, there is a huge potential for savings of around 10-30% energy in both the commercial building and the industrial sectors in Indonesia (Ministry of Energy and Mineral Resources 2016b). In the National Energy Policy year 2014 (Government Regulation No.79), the government has set a target for energy elasticity to be less than 1 by 2025 and reducing the energy intensity by 1% per year. The implementation of energy efficiency measures in Indonesia is not only aimed at securing and strengthening the domestic energy supply but also to achieve the target of national greenhouse gas emission reduction simultaneously. Regarding emission reduction, Indonesia has committed to reduce greenhouse emission by 29% from the Business as a Usual scenario by their own means efforts in 2030 and the emission reduction is expected to increase to 41% with International support (Government of Indonesia 2016).

Law no. 30/2007 on Energy and Government Regulation no. 70/2009 on Energy Conservation has mandated that energy conservation be the

responsibility of the government, local governments, business sectors and the general society. The government (central and local government), the private/business sectors and the people community play an important role in carrying out energy conservation in Indonesia. The regulation also mandates large energy users that consume energy as much as 6,000 Tonne Oil Equivalent (TOE) or more, are obliged to implement energy management, develop standards and labelling for energy efficient technology.

Regarding the ESCO regulation, the government has issued a Ministerial Regulation no. 14 in 2016 outlining the provision of energy conservation supporting services business (ESCO included). In this regulation, the ESCOs require a Letter of Acceptance from the government to run their businesses. ESCOs can also collaborate with financial institutions to arrange the finance.

The complete historical policy and regulation for energy efficiency and energy conservation in Indonesia from 1982 until ESCO regulation was issued in 2016 is shown in Figure 8 below.

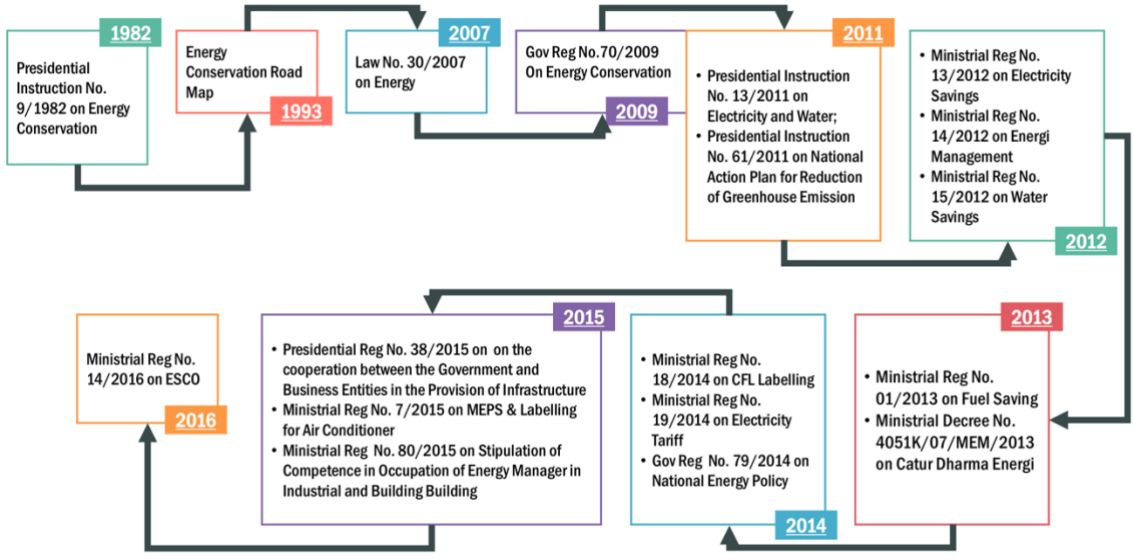


Figure 8. Historical of Energy Efficiency Regulation
Source: Regulasi Usaha Jasa Konservasi Energi (ESCO) Sektor Publik Sebagai Langkah Percepatan Implementasi Efisiensi Energi (Ministry of Energy and Mineral Resources 2017)

3.9.2. Energy Efficiency Potential Investment

According to the Ministry of Energy and Mineral Resources (2017), research by ReEx Capital Study, Asian Development Bank (ADB) and ASEAN Energy Outlook, have shown the potential investment on energy efficiency in Indonesia. This is outlined in table 3:

Table 3. The Research for Investment on Energy Efficiency Investment

Estimated EE Investment in Indonesia	Sources
USD 1.4 – 9.7 billion	ReEx Capital Study 2010
USD 3-4 billion	ADB Study 2010
USD 6.02 billion	ASEAN Energy Outlook 2011 and Nexant calculation

Source: regulasi Usaha Jasa Konservasi Energi (ESCO) Sektor Publik Sebagai Langkah Percepatan Implementasi Efisiensi Energi (Ministry of Energy and Mineral Resources 2017)

According to the research results, it can be concluded that Indonesia has a big opportunity for investing in energy efficiency investment including the ESCO scheme. The nominal range USD 3-9 billion as shown in the table 3 is a big investment as it similar amounts to the investment sizes of ESCOs established in developed countries such as China, United States, Germany, and France (Table 4):

Table 4. The ESCO estimation for Investment in Developed Countries

Country	Estimated ESCO Industry Size ($ million)	Source
China	$4,000-$7,000	Cahill and Bertoldi (2013)
United States	~ $5,300	Stuart et al. (2013)
Germany	~$3,900-$5,200	Cahill and Bertoldi (2013)
France	~$4,000 - $5,000	Marino et al. (2010)
United Kingdom	~$320	Cahill and Bertoldi (2013)
Italy	~$600	Cahill and Bertoldi (2013)
Spain	$390-$500	Cahill and Bertoldi (2013)
Switzerland	~$170-$300	Marino et al. (2010)
Denmark	$180-$190	Cahill and Bertoldi (2013)
Japan	~$374	Murakoshi (2013)
Romania	~$50	Marino et al. (2010)

Source: Current Size and Remaining Market Potential of the U.S. Energy Service Company Industry (Stuart et al. 2013)

3.9.3. ESCO Implementation and Stakeholders

The implementation of ESCO projects can be run in the public and private sectors. The ministry regulations have introduced and regulated the specific implementation of ESCOs such as ESCO business model (guaranteed/shared savings model), ESCO registration, Energy Performance Contract (specifically in Indonesia known as Energy Saving Performance Contract (ESPC)), the priority for ESCO registration reporting, penalty and ESCO ranking based on the ability and capital investment.

There are several institutions and stakeholders that are involved in developing ESCOs and energy efficiency financing in Indonesia. These include domestic banks, project developers/ESCO companies, building owners and associations, government (Ministry of Energy and Mineral Resources, Ministry of

Finance), banking regulator (OJK), energy efficiency association and donors (international organisations).

3.10. SWOT of ESCO

The strengths, weaknesses, opportunities, threats (SWOT) of ESCO implementation in Indonesia can be drawn from the literature analysis of ESCO implementation in the world as discussed earlier. Tables 5 and 6 provide a summary of SWOT factors for the Indonesian situation:

A. Regulatory aspects

Table 5. SWOT ESCO Based on Regulatory Aspects

Strengths		Weaknesses		Opportunities		Threats	
S1	National Energy Policy and the Energy Efficiency Regulation (Ministry of Energy and Mineral Resources 2017)	**W1**	Lack of ESCO standardisation and accreditation (Vine 2005),(Murakoshi and Nakagami 2009)	**O1**	Training and dissemination information of the ESCO program to the stakeholders (Da-li 2009), (World Bank 2016)	**T1**	Low energy price and subsidies (Lee et al. 2003),(Marino, Bertoldi, and Rezessy 2010)
S2	Potential for energy efficiency savings (Ministry of Energy and Mineral Resources 2017)	**W2**	Limited institutional capacity (both public and private) (Bertoldi et al. 2014)	**O2**	Enhancing the ESCO association to assist the government in policy development, information dissemination, and creating an ESCO market (Vine 2005)	**T2**	Unclear incentives and government policies (Murakoshi and Nakagami 2009)
S3	Institutional framework support from the Ministry of Energy and Mineral Resources (MEMR), the Ministry of Finance (MoF), and the Financial Services Authority (OJK) (Ministry of Energy and Mineral Resources 2017), (Vine 2005)	**W3**	Lack of government support through policies, regulations and incentives (Center for Clean Air Policy 2012)	**O3**	Implementing an ESCO pilot project (Murakoshi and Nakagami 2009)	**T3**	Lack of energy efficiency technology and infrastructure available for the ESCO project (Vine 2005), (Da-li 2009)
		W4	Lack of understanding of the Energy Performance Contracting (EPC) process (Vine 2005)	**O4**	Multiyear procurement option for the ESCO project (Lee et al. 2003)	**T4**	Financing institutions are not familiar with how ESCOs operate and therefore are reluctant to allocate loans. (Murakoshi and Nakagami 2009)

B. Financial and Awareness Aspects

Table 6. SWOT of ESCO Based on Financial and Awareness Aspects

Strengths		Weaknesses		Opportunities		Threats	
S1	Regulation on energy efficiency program development (Ministry of Energy and Mineral Resources 2017)	**W1**	Lack of financial incentives (Vine 2005)	**O1**	Awareness development of the financial institutions regarding ESCO (Murakoshi and Nakagami 2009)	**T1**	Low energy price and subsidies (Ministry of Energy and Mineral Resources 2017)
S2	Potential to reduce energy consumption to save money (Ministry of Energy and Mineral Resources 2017)	**W2**	Low participation of financial institutions due to the risk of investment recovery. (Murakoshi and Nakagami 2009)	**O2**	Fiscal and policy incentives (low-interest financing) (Murakoshi and Nakagami 2009)	**T2**	Low priority for energy efficiency programs, unclear incentives and government policies (Vine 2005), (Lee et al. 2003)
S3	Financial support from the Ministry of Energy and Mineral Resources (MEMR), the Ministry of Finance (MoF), and the Financial Services Authority (OJK) (Ministry of Energy and Mineral Resources 2017)	**W3**	High-interest rates and low borrowing capacity of project implementers. (Center for Clean Air Policy 2012)	**O3**	Loan guarantee and revolving fund scheme (Da-li 2009), (APEC Energy Working Group 2006)	**T3**	Institutional barriers (i.e. multiyear procurement prohibition) (Lee et al. 2003)
S4	The knowledge of ESCO Models (for example Shared Savings, Guaranteed Savings, and Leasing models/others) (Murakoshi and Nakagami 2009)	**W4**	Unfavourable market structure (Murakoshi and Nakagami 2009)	**O4**	Green financing from international support/funds and multiyear procurement option for ESCO projects (Vine 2005), (World Bank 2016)	**T4**	Lack of trust from financial institutions for ESCO and energy efficiency programs (unpopular ESCO mechanism) (Vine 2005)

3.11. Literature Review Conclusion

Energy Service Companies (ESCO) have been implemented widely in the world in both developed and developing countries. The development of ESCOs is very essential since energy efficiency is necessary for all countries. Potential factors that affect the development of ESCOs are energy prices, subsidies, environmental issues international policies and ESCO markets.

Although the concept and model of ESCOs in the world are quite similar, the implementation of ESCOs in every country varies. Various barriers are encountered during the implementation of ESCOs in different countries. These challenges can be cultural, financial, institutional and policy barriers. By understanding the approach of ESCOs various developed and developing countries lessons can be learned and best practices adopted. Not many developing countries are successful in promoting ESCOs. However, they have an opportunity to learn about policy implementation of ESCOs from developed countries to promote ESCOs even though these policies may not suit the culture of that country.

There is potential for developing ESCOs in developing countries as economies are growing especially in industry. The implementation of an ESCO can be started in the public sector, and public facilities as this would also promote the ESCO concept in these countries. Policy regulation and financial incentives can improve the development of ESCO in developing countries. For example, in China, there is significant potential for energy efficiency (EE) programs for ESCO as China is the second largest energy consumer in the world and also a major emissions polluter (Da-li 2009). A suitable bidding mechanism, loan guarantee and other

regulations and financial incentives could be actualised to improve the ESCO development.

The implementation of financing mechanism ESCO for public and private involvement in industrial and building sectors will have more favourable market potential in developing countries such as Indonesia due to their huge prospect and potential energy saving. The support and expertise of international agencies and developed countries are required to develop ESCO projects in developing countries. Okay and Akman (2010) stated that the amount of money a country could spend on ESCO projects is dependent upon the wealth (innovation level) of that country (ADB 2012). Developed countries could support ESCO programs in developing countries through their innovation and aid in the form of financing would be immensely beneficial.

From the above discussion in Chapter 3 and after analysing the barriers and challenges from the developed and developing countries, the strengths, weaknesses, opportunities, and threats (SWOT) in Indonesia are identified. The SWOT factors then are used in the survey and questionnaire for determining the priority factor using SWOT AHP analysis that will be further explained in Chapter 4. The priority factors then are used to analyse the strategy to develop markets for ESCO in Indonesia.

Chapter 4: Survey Results and Analysis

4.1. Survey Participation and Stakeholders' Experience regarding ESCOs in Indonesia

The research questionnaire was sent to 90 people, who were representatives of the stakeholder population for ESCOs in Indonesia. Stakeholders were divided into three groups: the government, ESCO companies/association and experts, and financial institutions as mentioned in Chapter 2. Out of this group of 90, 44 people responded to the survey. This accounted for a response rate of 48.8 %. Out of the 44 respondents, 15 people (34%) were from the government, 15 (34%) from ESCO companies/association and experts and the remaining 14 (32%) were from banks/financial institutions in Indonesia (Figure 9). The detailed breakdown of the institution is shown in Appendix B.

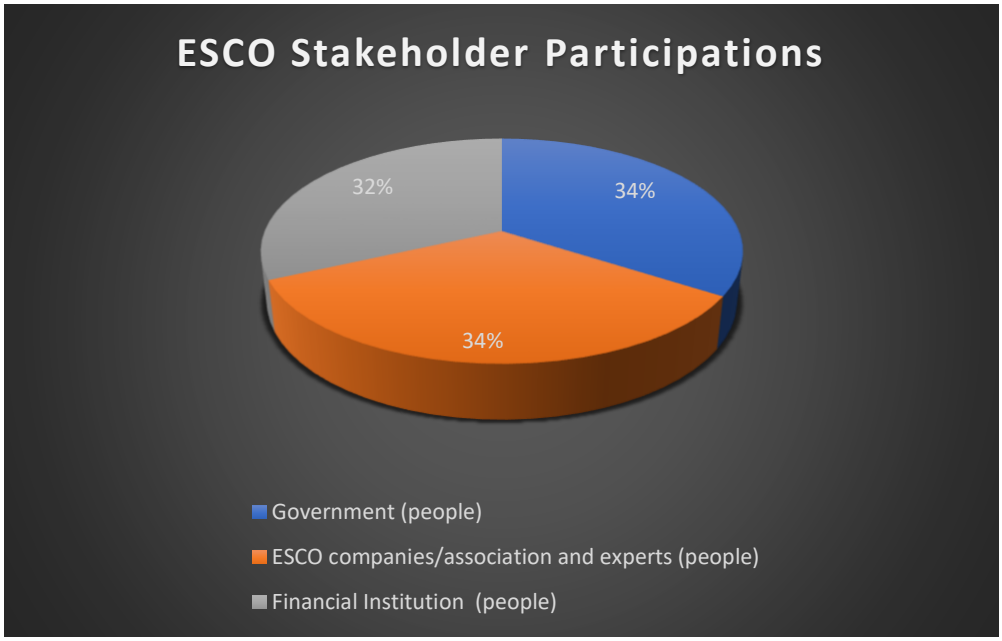


Figure 9. ESCO stakeholder Participation in the Survey

The participants were asked about their length of experience in working with the ESCO concept. The survey results showed that about 34% of the respondents had less than two years of experience while 36% of the participants had

2-5 years' experience (Figure 10). Only 14% and 16% of the participants had 5-10 years and more than ten years' respectively.

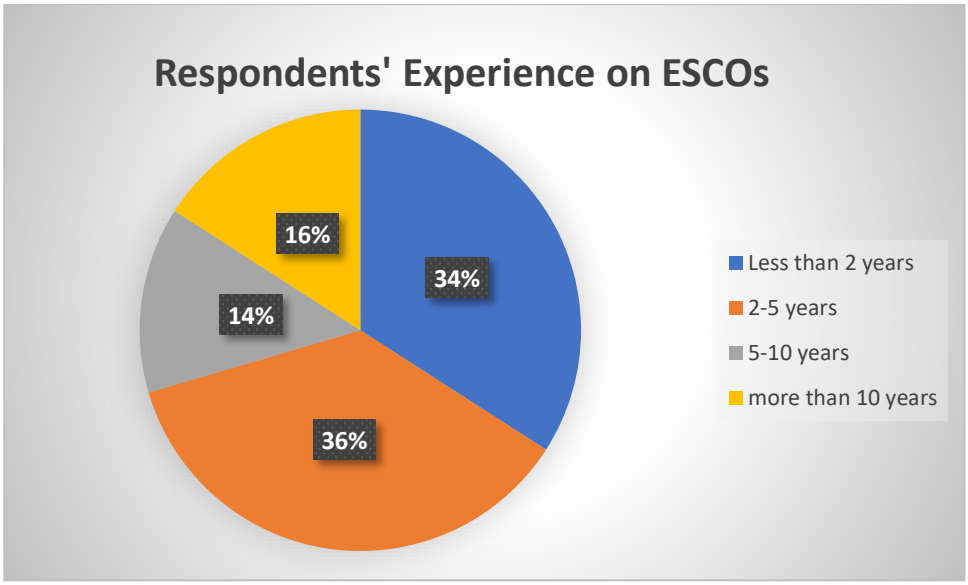


Figure 10. Participants' Experience with the ESCO concept.

The survey results indicated that the ESCO concept is a relatively new scheme that was introduced in Indonesia. The regulation for ESCOs was only launched in 2016 through the Ministerial Regulation no 14/2016. The regulation is aimed at providing energy efficiency programs through the establishment of energy services companies (ESCOs). Thus, the process of understanding and implementing ESCOs in Indonesia is still in its early stages.

4.2. Stakeholders' Perception and knowledge of Central Information on ESCOs

The key to a successful implementation of ESCOs in Indonesia is the availability of knowledge in this area. To disseminate information regarding ESCOs in Indonesia, the set-up of a central information and repository system is essential. There is also a need for an ESCO campaign which would assist all stakeholders involved. As previously discussed in the literature review, the success of the ESCO

programs in the European countries, for example, was attributed to the strength of the various information dissemination programs.

In this survey, participants were asked about the central information and repository system for ESCOs in Indonesia and their perception of this system. Most participants (48%) mentioned that there was no central information repository in Indonesia. However, 32% of the participants felt that there was a central information repository available, but they were not aware of any details regarding the same. Most of the participants who say yes (32%), also agreed that the Ministry of Energy and Mineral Resources was currently perceived as the central information for ESCO activities in Indonesia. Around six people (13%) were unsure about the existence of this system, whilst, there were 3 participants (7%) who did not address/answer the question correctly (Figure 11 and Table 7). Based on these findings, it can be concluded that more than 60% of the participants did not know or were not sure about the existence of a central information repository for ESCOs in Indonesia.

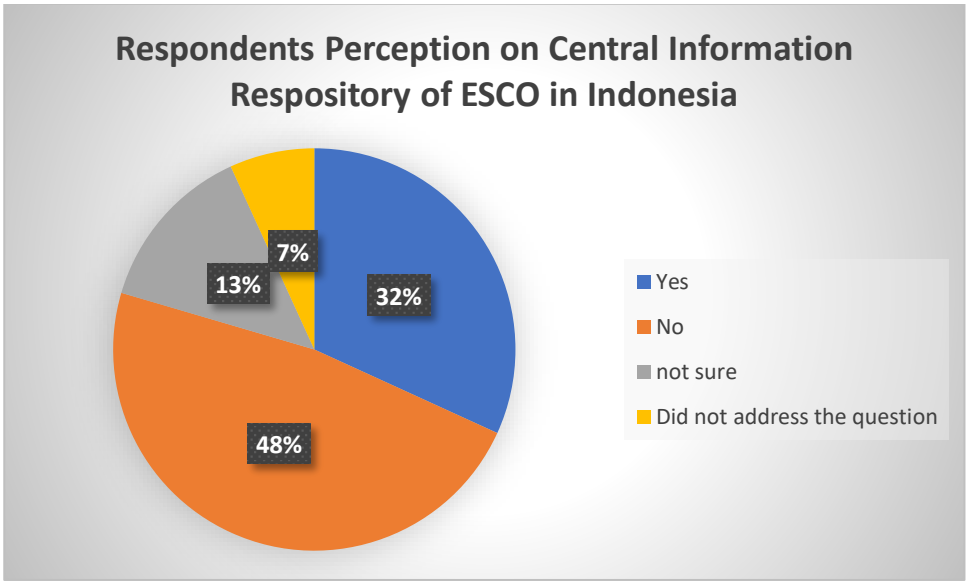


Figure 11. Perception on the availability of the Central Information Repository of ESCOs in Indonesia

Table 7 shows the breakdown of the results for this question from the different groups of stakeholders. Approximately 53% (8 people) of the government participants believed that the access information on ESCOs was already made available in Indonesia. However, their perception compared to that of the ESCO companies/associations/experts and financial institutions were very different. A vast majority of participants in the latter two groups (60% or 9 people, and 43% or 6 people respectively) were of the opinion that currently there was no information available about ESCOs in Indonesia. The detail figures/pie chart result of each group stakeholder is shown in Appendix B.

Table 7. Stakeholder Perception on the ESCO Central Information Repository

Stakeholder Answer	Government	ESCO companies/ Association/ Experts	Financial Institutions	Total
Yes	8	2	4	14
No	6	9	6	21
not sure	1	2	3	6
Question not addressed	0	2	1	3

According to the above analysis, it can be concluded that the dissemination of ESCO information between the government and the ESCO stakeholders need to be improved so that the stakeholders form the same perception of the central information on ESCOs as the government officials. The discrepancy in perception between the government and the ESCO stakeholders would lead to difficulties in creating markets for ESCOs in Indonesia as the various participants in this program were unclear about information and knowledge about ESCOs.

4.3. Stakeholder Perception on SWOT Factors for Developing ESCO Markets

There are a number of the SWOT factors that have been analysed in this section. The summary of the SWOT factors and the detailed sources were obtained from the analysis of the literature review in Chapter 3. After getting the value of the SWOT factors from the stakeholders' survey, the data were analysed using the SWOT-AHP method and MCDM techniques.

Tables 8 and 9 show the SWOT priority score for the regulatory aspects of the development of ESCOs in Indonesia. In the calculations for all pairwise comparison matrices, the consistency ratio (CR) was less than 0.1. This indicates that the data in this survey were all consistent (Saaty 2008). In Tables 8 and 9, three stakeholder groups including the government, ESCO companies/association/experts, and financial institutions (banks) had given their opinion regarding the SWOT factors. The SWOT factors for each SWOT category were equal, accounting for 0.250. The opinion/perspective from all the stakeholders was quantified as having an equal weight in each stakeholder factor priority. The level of weight factors obtained from the participants' survey was averaged to produce the stakeholder factor priority in each group and also to calculate the local priority. The detail pairwise comparison calculation for getting the *Stakeholder Factor Priority* is shown in Appendix C.

The global priority is the value of the level of stakeholder perspective which is obtained by multiplying the local priority with the SWOT scaling factors. If the value of the global priority is high, then this factor is to be prioritised for the development of ESCO markets in Indonesia.

4.3.1. Stakeholders' Perception on the Regulatory Aspects of ESCO

Table 8. The Regulatory Aspects of SWOT-AHP Result for ESCOs in Indonesia

SWOT Category	Scaling Factor	Stakeholder Factor Priority			Local Priority	Global Priority
		Government	ESCO companies/ association/ experts	Financial Institutions		
Strengths	0.250					
S1		**0.346**	**0.360**	0.308	**0.338**	**0.084**
S2		0.308	0.320	**0.346**	0.325	0.081
S3		**0.346**	0.320	**0.346**	0.337	0.084
Weaknesses	0.250					
W1		0.233	0.231	0.226	0.230	0.057
W2		**0.267**	**0.269**	0.226	0.254	0.063
W3		**0.267**	0.231	0.258	0.252	0.063
W4		0.233	**0.269**	**0.290**	**0.264**	**0.066**
Opportunities	0.250					
O1		**0.250**	**0.259**	0.242	**0.251**	**0.063**
O2		**0.250**	0.222	**0.273**	0.248	0.062
O3		**0.250**	**0.259**	0.242	**0.251**	**0.063**
O4		**0.250**	**0.259**	0.242	**0.251**	**0.063**
Threats	0.250					
T1		0.200	0.250	0.235	0.228	0.057
T2		0.267	0.250	0.235	0.251	0.063
T3		0.233	0.208	**0.265**	0.235	0.059
T4		**0.300**	**0.292**	**0.265**	**0.285**	**0.071**

According to the survey results, each stakeholder has a different level of perception regarding the SWOT factors on the regulatory aspects of ESCOs (Table 8). The numbers in bold indicate the highest priority or the most critical factor. For example, the average government participants selected S1, *National Energy Policy and the Energy Efficiency Regulation* and S3, *Institutional framework support*, as the most crucial factors in the Strengths category for ESCO development in Indonesia (0.346). The ESCO companies also selected S1 as the most important factor, but their

stakeholder factor priority was higher (0.360) compared to the government participants (0.346). However, the financial institutions had a different opinion and selected S2, *the potential of reducing energy consumption to save money* and S3 as the most essential factors (0.343).

By analysing the *stakeholder factor priority*, and focussing on each the highest number, the decision makers could find the best approach for developing ESCOs in Indonesia. For instance, the financial institutions would prefer that the government (policy makers) put more effort into promoting the implementation of ESCOs. This would involve the government campaigning about the strengths of ESCOs in reducing energy consumption and saving money rather than discussing ESCO regulations and policy implementation. Therefore, it is essential to consider each stakeholder factor priority category before presenting the policy to the ESCO stakeholders.

While calculating the global priority on the regulatory aspects (Table 8), it was noticed that there were several critical factors for each SWOT category. For example, S1 (*National Energy Policy and the Energy Efficiency Regulation)*, was the most important factor in the strengths category (0.084), while W4 (*Lack of understanding of the Energy Performance Contracting (EPC) process*) is the most significant factor in weakness category (0.066). In the opportunities category, O1 (*Training and dissemination*), O3 (*Implementing ESCO pilot project*) and O4 (*Multiyear procurement option*) had the same weight (0.064). Therefore, the three factors (O1, O3 and O4) were considered as essential factors. In the threats category, T4 (*Not understanding the ESCO scheme for a financial institution that leads to difficulty in getting loan and funding*) had the highest value (0.071). Figure 12 shows a clear relationship between the overall/global priority and the local priority on Regulatory

Aspects on SWOT factors for the development of ESCOs in Indonesia. This figure indicates the factors that are the most or least important in each ESCO SWOT category that should be prioritised by the government.

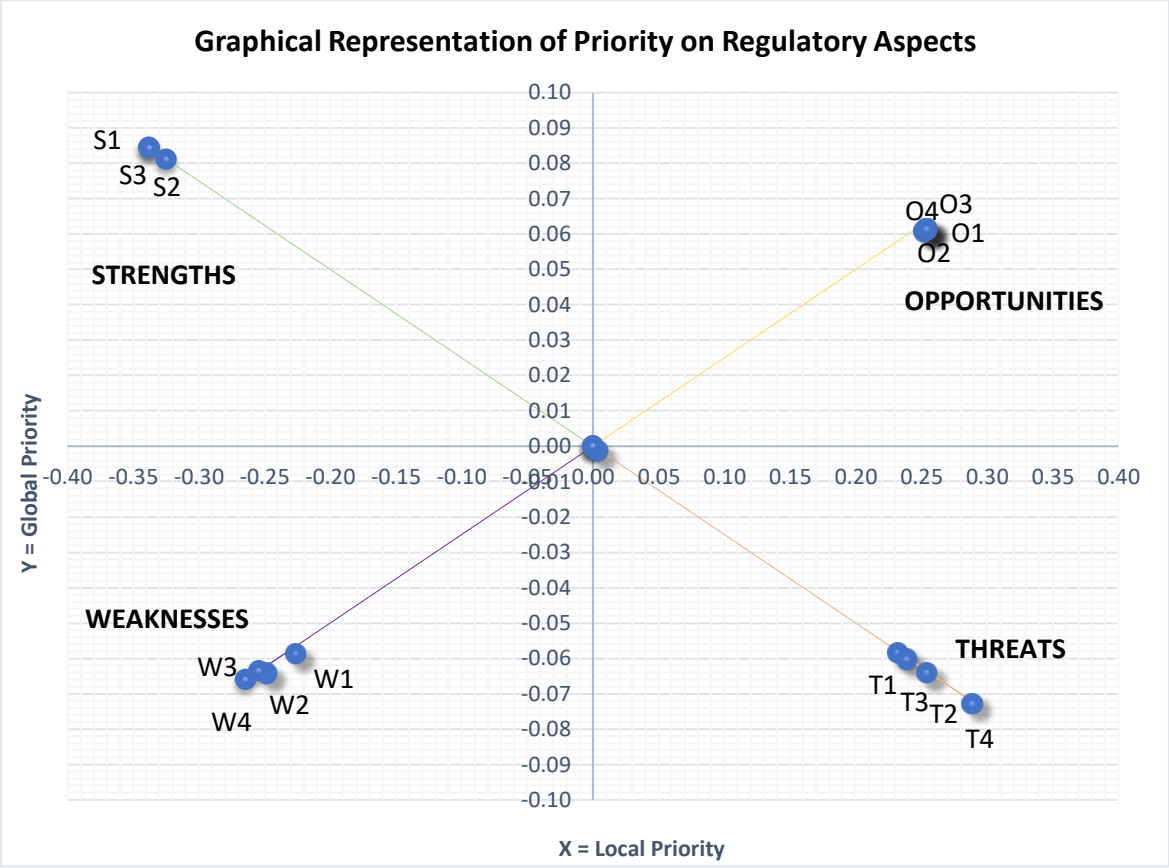


Figure 12. Graphical Representation of the Overall Priority on Regulatory Aspects

4.3.2. Stakeholder Perception on Financial and Awareness Aspects on ESCO

Table 9. Financial and Awareness Aspects of SWOT-AHP Result Survey for ESCO

SWOT Category	Scaling Factor	Stakeholder Factor Priority			Local Priority	Global Priority
		Government	ESCO companies/ association/ experts	Financial Institutions		
Strengths	0.250					
S1		**0.250**	**0.286**	0.242	**0.259**	**0.065**
S2		**0.250**	0.250	0.242	0.247	0.062
S3		**0.250**	0.250	**0.273**	0.258	0.064
S4		**0.250**	0.214	0.242	0.236	0.059
Weaknesses	0.250					
W1		**0.250**	0.233	0.226	0.236	0.059
W2		**0.250**	**0.267**	**0.258**	**0.258**	**0.065**
W3		**0.250**	**0.267**	**0.258**	**0.258**	**0.065**
W4		**0.250**	0.233	**0.258**	0.247	0.062
Opportunities	0.250					
O1		**0.250**	0.241	0.242	0.245	0.061
O2		**0.250**	**0.276**	0.242	**0.256**	**0.064**
O3		**0.250**	0.241	**0.273**	0.255	0.064
O4		**0.250**	0.241	0.242	0.245	0.061
Threats	0.250					
T1		0.207	**0.267**	**0.250**	0.241	0.060
T2		0.241	0.233	**0.250**	0.242	0.060
T3		0.276	0.233	**0.250**	0.253	0.063
T4		**0.276**	**0.267**	**0.250**	**0.264**	**0.066**

Using the same analysis technique as the regulatory aspects, Table 9 shows the results for the financial and awareness aspects. In the strengths category, S1 (*Regulation on Energy Efficiency Program Development*) was selected as the primary strength in the level of global priority (0.065), while W2 (*the low participation of financial institutions due to risk of investment recovery)*, and W3, (*high-interest rates and low borrowing capacity of project implementers)* were

considered as the most important factors in the weakness category (0.065). O2 (*fiscal and policy incentives/low-interest financing*) (0.064) and T4 (*lack of trust from a financial institution to the ESCO and EE financing due to unpopular ESCO mechanism*) (0.066) were the two most important factors in the opportunities and threats Categories respectively. According to the stakeholder perceptions, these significant factors contribute towards enhancing or delaying the deployment of ESCOs in Indonesia. Figure 13 shows the overall/global priority and the local priority on the Financial and Awareness Aspects on the development of ESCOs in Indonesia.

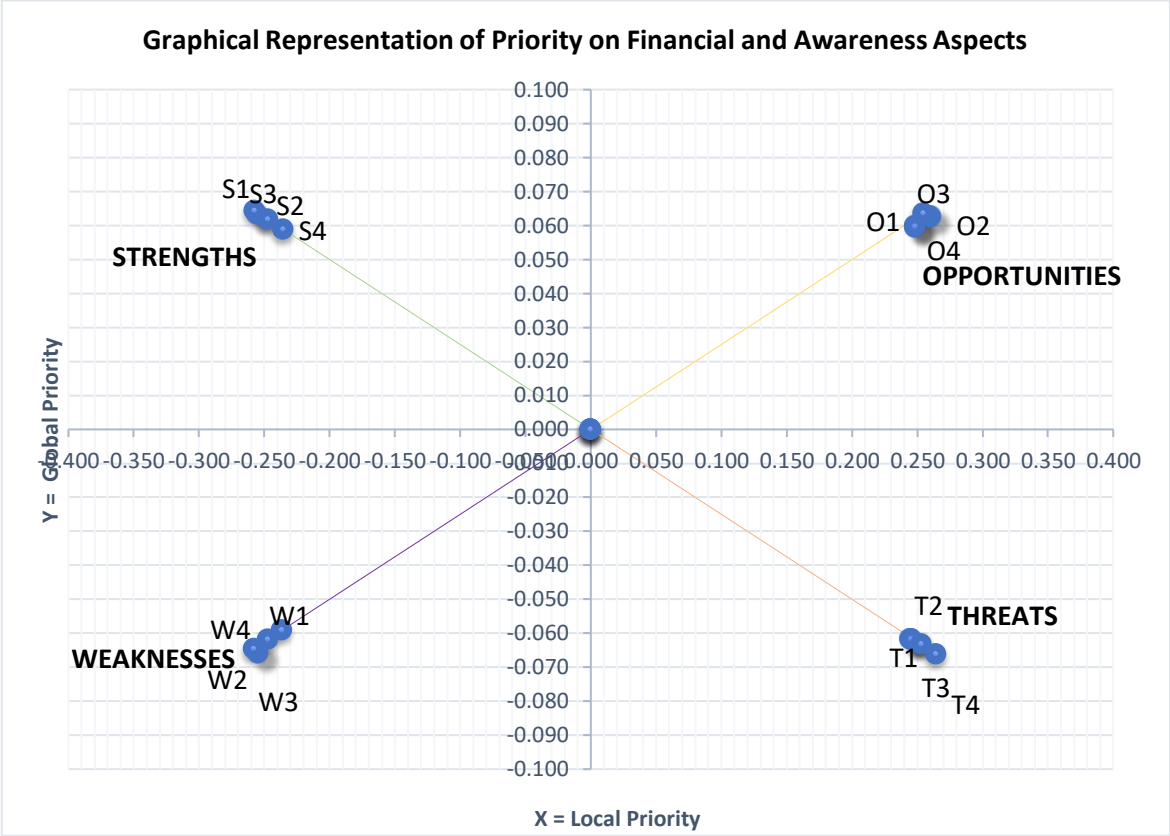


Figure 13. Graphical Representation of Overall Priority on Financial & Awareness Aspects

4.3.3 Regulatory Aspects SWOT-AHP Discussion and Analysis

In this section, the regulatory aspects SWOT-AHP results from the survey of the ESCO stakeholders will be discussed.

A. Strengths of Regulatory Aspects

Possible policies and regulations can support the development of ESCOs. According to Vine (2005), many developing countries have no energy efficiency regulations and demand-side management policies. Some countries have no standards or energy codes or a requirement for an energy audit. However, in Indonesia, the regulation is perceived as a strength factor that can support ESCOs and energy efficiency programs based on the stakeholders' perception.

Table 10. The Regulatory Aspects of SWOT-AHP Result (Local and Global Priority)

SWOT Category	Issue	Ranking	Local Priority	Global Priority
Strengths				
S1	National Energy Policy and the Energy Efficiency Regulation (Ministry of Energy and Mineral Resources 2017)	**[1]**	**0.338**	**0.084**
S2	Potential for energy efficiency savings (Ministry of Energy and Mineral Resources 2017)	[3]	0.325	0.081
S3	Institutional framework support from the Ministry of Energy and Mineral Resources (MEMR), the Ministry of Finance (MoF), and the Financial Services Authority (OJK) (Ministry of Energy and Mineral Resources 2017), (Vine 2005)	[2]	0.337	0.084
Weaknesses				
W1	Lack of ESCO standardisation and accreditation (Vine 2005),(Murakoshi and Nakagami 2009)	[4]	0.230	0.057
W2	Limited institutional capacity (both public and private) (Bertoldi et al. 2014)	[2]	0.254	0.063
W3	Lack of government support through policies, regulations and incentives (Center for Clean Air Policy 2012)	[3]	0.252	0.063
W4	Lack of understanding of the Energy Performance Contracting (EPC) process (Murakoshi and Nakagami 2009) (Vine 2005)	**[1]**	**0.264**	**0.066**

Opportunities				
O1	Training and information dissemination of the ESCO program to the stakeholders (Da-li 2009), (World Bank 2016)	**[1]**	**0.251**	**0.063**
O2	Enhancing the ESCO association to assist the government in policy development, information dissemination and creating an ESCO market (Vine 2005)	[2]	0.248	0.062
O3	Implementing an ESCO pilot project (Murakoshi and Nakagami 2009)	**[1]**	**0.251**	**0.063**
O4	Multiyear procurement option for the ESCO project (Lee et al. 2003)	**[1]**	**0.251**	**0.063**
Threats				
T1	Low energy price and subsidies (Lee et al. 2003),(Marino, Bertoldi, and Rezessy 2010)	[4]	0.228	0.057
T2	Unclear incentives and government policies (Murakoshi and Nakagami 2009)	[2]	0.251	0.063
T3	Lack of energy efficiency technology and infrastructure available for the ESCO project (Vine 2005), (Da-li 2009)	[3]	0.235	0.059
T4	Financing institutions are not familiar with how ESCOs operate and therefore are reluctant to allocate loans. (Murakoshi and Nakagami 2009)	**[1]**	**0.285**	**0.071**

Based on the analysis of data (Table 10), in the strengths category of the survey, *the National Energy Policy and Energy Efficiency Regulation* was the most influential factor (0.084). The National Energy Policy was issued by the Government Regulation No. 79 in 2014. This regulation stated that Indonesia had to reduce the intensity of energy by 1% per year and achieve an elasticity of energy of less than 1. The energy efficiency regulation for ESCOs has been controlled by the Government Regulation No. 70 since 2009 and also by the Ministerial Regulation No 14 since 2016. Although the regulation on ESCOs is quite new, it is supported by policies that promote energy efficiency programs and ESCO schemes.

The other strength factor, which had a high global priority (0.084) was *Institutional Support from the Related Agencies and Bodies* (Table 10). The Institutional framework for ESCOs within the MEMR, MoF, and OJK has to be developed for the successful implementation of ESCOs. All regulations should also be implemented and enforced consistently throughout Indonesia including at municipal and regency levels. This is crucial because limited enforcement of government policies would fail energy efficiency projects. According to Taylor (2009), in some developing countries, there is no institutional framework for ESCOs. With no institutional framework, the government will have difficulties in classifying the ESCO as a business, and this will create a significant legal barrier for the start-up of the ESCO.

The SWOT factor, S2 *(The potential energy efficiency savings in Indonesia*) had a significant global priority of 0.081 which indicates that it is possible to achieve a 10-30% saving/reduction in energy use in Indonesia. The potential for energy saving could be an attractive factor for private companies or ESCO companies to incorporate and practice this scheme.

B. Weaknesses of Regulatory Aspects

According to the survey, amongst the weaknesses of the regulatory aspects, W4 *(The lack of understanding of the EPC process)* with a global priority factor of 0.066 was a significant barrier for the development of ESCOs (Table 10). Many ESCO stakeholders did not understand energy efficiency financing and technical concepts of ESCOs. Additionally, the small margin of profitability in EPC also makes it difficult to finance an ESCO scheme. Vine (2005) reported that the lack of understanding of EPC is due to the lack of information, awareness and knowledge

and also the lack of expertise in EPC. The level of technical and financial awareness among the stakeholders regarding ESCOs would significantly improve if there were expertise in the area of EPC. Hence, knowledge and information about the ESCO concept and its financing model are essential in understanding the EPC concept.

The SWOT factor, W3 (*the lack of policy support through regulation and incentives)* is another factor that should be addressed as it received a global priority factor of 0.063 (Table 10). Although Indonesia has a national energy policy framework and government and ministerial regulations, the implementation of the policy and incentives to create ESCOs market are not optimal. Currently, there are no fiscal incentives, e.g. low-interest rate financing available for energy efficiency projects that could support energy efficiency in Indonesia. According to the Center for Clean Air Policy (2012), in Thailand, ESCO/developers were historically not interested in borrowing funds because of high-interest rates. However, through its regulation and incentives scheme, the government of Thailand, set a policy to provide low-interest rate loans to developers of energy efficiency projects using the Energy Efficiency Revolving Fund scheme. The Thailand government created an Energy Conservation Promotion Fund (ENCON Fund) to finance energy efficiency projects such as ESCOs.

Weakness 2 (W2)-*The lack of institutional capacity both in public and private sectors*, had a global priority factor of 0.063 (Table 10). The lack of institutional capacity would make it difficult for stakeholders to accept the creation and development of ESCO markets. The lack of institutional capacity would also reduce the acceleration of building energy efficiency projects in Indonesia.

The final weakness factor, W1 is the *lack of standardisation and accreditation* with a global priority factor of 0.057 (Table 10). Ellis (2009) stated that

accreditation and standardisation would make contract negotiations less challenging. Vine (2005) also reported that accreditation was essential in ensuring that ESCOs provided reliable services. Government-owned ESCO agencies could deliver the accreditation, or it could be done through an independent institution. The ESCO association could also be involved in improving the quality of the accreditation system. It is also essential to develop a standard document contract before setting up ESCO markets. This standard document contract would help both end users (clients) and financial institutions in understanding the procurement process of an ESCO. However, as different ESCO projects have different characteristics of implementation and financing, it would be a challenge to create one standard document contract that could then be used across all ESCOs (Vine 2005). For example, the standard project document contract for the general public would be different from a standard document contract for the private sector.

C. Opportunities of Regulatory Aspects

The survey of the stakeholders' perception on the opportunities of regulatory aspects indicated that O3, *the implementation of a pilot project of ESCO* (0.063) was one of the essential factors and carried the same weight with other opportunities factors such as O1, *the dissemination of information and training* (0.063) and O4, *allowing multiyear procurement contract* (0.063) (Table 10).

The pilot project of ESCO (0.063) is important because it demonstrates the benefit of an ESCO and energy efficiency project financing. Through a pilot project, the client company and the financial institution can understand and trust the EE business as a significant opportunity. According to the Ministry of Energy and Mineral Resources (2017), there are some energy efficiency projects which could

potentially be converted into pilot projects for energy efficiency financing and ESCOs (Table 11). The projects span across the private sector and public sector, e.g. street lighting retrofit projects. Some projects are also supported by various donors and institutions. Murakoshi and Nakagami (2009) reported that many developing countries such as India, China, Thailand and Malaysia had implemented pilot projects for ESCOs which have been undertaken and supported by international funding bodies and local government funds such as USAID, GEF, World Bank, and ENCON Funds.

Table 11. Energy Efficiency Projects in Indonesia

No	Project EE	Year	Investments	Energy Savings	Notes
1	Pilot for ISO 50001 Energy Management System	2015-2017	Rp. 10.3 Billion	1409,5 GWh	UNIDO
2	Street Lighting Project under ADB Grant	2016	Rp. 2.4 Billion	73,6 MWh	ADB
3	Project EE Building	2015-2016	Rp. 30.1 Billion		Private
4	Project JCM (Building & Industry)	2015-2016	Rp.1,377.6 Billion		Private/JCM
5	Street Lighting Project (local Government)	2015-2017	Rp. 21.5 Billion		Public/Government
6	Street Lighting Project (Central Government)	2015-2016	Rp. 117.6 Billion		Government
7	EE in industrial and building commercial				Government

Source: Regulasi Usaha Jasa Konservasi Energi (ESCO) Sektor Publik Sebagai Langkah Percepatan Implementasi Efisiensi Energi (Ministry of Energy and Mineral Resources 2017)

The SWOT opportunities factor (O1), *Information dissemination and training* with a global priority of 0.063 (Table 10), is also considered essential for the stakeholders. In small-scale projects, sometimes the energy efficiency/ESCO projects are not very popular due to their high transaction cost. This is because the ESCO mechanism often requires a transfer of knowledge and ways of identifying the

potential saving (energy audit need) before implementing the ESCO scheme (Murakoshi and Nakagami 2009). By conducting information dissemination and training (both knowledge and technical), the awareness and understanding of the ESCO concept amongst the stakeholders can be increased. Information dissemination can also be used to attract financial institutions to join the ESCO business opportunities and in turn, create ESCO markets. This can be undertaken in multiple ways such as conducting energy efficiency campaigns and seminars, engaging in capacity building, creating internet-based information, conducting Focus Group Discussion (FGD) and creating a central information repository on ESCOs in Indonesia.

O4, *the multiyear procurement contract* (0.063) should also be considered to increase the development of ESCOs in Indonesia. The multiyear procurement contract can eliminate the institutional barrier that usually occurs in the procurement process. In South Korea, the institutional barriers were eliminated by adopting a multiyear procurement process. This benefitted energy efficiency projects since some projects need more than one year to make a profit and obtain a reasonable payback period (Lee et al. 2003).

The last opportunity factor, O2 is *enhancing the ESCO association* (0.062) (Table 10). In Indonesia, there are several associations for energy efficiency such as APKENINDO (Energy Conservation Support Services Association), HAKE (Energy Efficiency Expert Association), Industrial and Building Associations such as Green Building Council Indonesia (GBCI). However, these associations do not have a central cooperation with the different ESCO projects. As a result, ESCO projects get fragmented support from this stakeholder, i.e. ESCO association. Therefore, there is a need for an ESCO company to focus on the enhancement of the current ESCO

association in Indonesia. Vine (2005) reported that creating an ESCO association would increase the market structure. This would make it easy to create and disseminate information and knowledge to the ESCO stakeholders. Membership of the ESCO association would also significantly increase with the new ESCO association.

D. Threats of Regulatory Aspects

There are several threats for the regulatory aspects in the development of ESCOs in Indonesia. *The difficulty to get funding (loan) from financial institutions due to unfamiliarity with the ESCO concepts* (0.071) is the most prominent threat based on the stakeholder perception (Table 10). The difficulty in accessing financing is the main threat in the traditional financing concept. Financial institutions prefer to use a collateral mechanism before allocating a loan. Most ESCO projects are non-asset based, and therefore the above system cannot be used. The banks/financial institutions are not familiar with the energy savings concept and prefer positive cash flow rather than negative cash flow due to the savings involved (Ellis 2009). Furthermore, the financial institutions are not familiar with the operation of ESCOs and how profits can be shared (Murakoshi and Nakagami 2009).

Unclear government policies and incentives or T2 (0.063) is also a SWOT factor of concern (Table 10). There is a ministry regulation that regulates various incentives and disincentives. However, the ESCO incentives and disincentives have not been the implemented yet by the Government. As a result, ESCOs are unable to consider and calculate profits prior to starting an energy efficiency project.

The lack of energy efficiency technology and infrastructure (0.059) to implement an ESCO is also another threat (Table 10). In the case of energy efficiency

projects, some of the large ESCO projects require advanced technology. The lack of advanced technology in Indonesia is due to the high cost of importing the technology and the import taxes on this technology (Vine 2005). The concern around the reliability and safety of the technology also hinders the introduction of the new technology. The professional skills required to adapt to the new technology is also essential. According to Da-li (2009), in the Chinese industry, people were willing to use energy efficiency technologies but their motivation to adopt the technology dropped due to the lack of infrastructure, skills and technical competence. *Low energy price and subsidy* (0.057) is also a critical threat for ESCOs (Table 10). This is because a low energy price will lead to an extended payback period for ESCOs and hinder the attractiveness of the energy efficiency project in general (Bertoldi et al. 2014). In Indonesia, the low energy price is still an issue, especially in the residential sector. In recent years the fossil fuel subsidy has been reduced in Indonesia. However, low energy prices in some sectors such as the electricity sector, is still an issue of concern.

4.3.4. Financial and Awareness Aspects: SWOT-AHP Discussion and Analysis

In this section, the financial and awareness SWOT-AHP results from the survey of the ESCO stakeholders will be discussed.

A. Strengths of the Financial and Awareness Aspects

Based on the stakeholders' perception, the most important factors in the strengths category of the financial and awareness aspects of ESCOs are S1, *the power of energy efficiency programs and regulations in Indonesia* (0.065) and S3, *financial support from the institutions such as the Ministry of Energy, the Ministry of Finance and the Financial Service Authority* (0.064) (Table 12).

Table 12. Financial and Awareness Aspects of SWOT-AHP Result Survey (Local and Global Priority)

SWOT Category	Issue	Ranking	Local Priority	Global Priority
Strengths				
S1	Regulation on energy efficiency program development (Ministry of Energy and Mineral Resources 2017)	**[1]**	**0.259**	**0.065**
S2	Potential to reduce energy consumption to save money (Ministry of Energy and Mineral Resources 2017)	[3]	0.247	0.062
S3	Financial support from the Ministry of Energy and Mineral Resources (MEMR), the Ministry of Finance (MoF), and the Financial Services Authority (OJK) (Ministry of Energy and Mineral Resources 2017)	[2]	0.258	0.064
S4	The knowledge of ESCO Models (for example Shared Savings, Guarantee Savings, and Leasing models/others) (Murakoshi and Nakagami 2009)	[4]	0.236	0.059
Weaknesses				
W1	Lack of financial incentives (Vine 2005)	[3]	0.236	0.059
W2	Low participation of financial institutions due to the risk of investment recovery. (Murakoshi and Nakagami 2009)	**[1]**	**0.258**	**0.065**
W3	High-interest rates and low borrowing capacity of project implementers. (Center for Clean Air Policy 2012)	**[1]**	**0.258**	**0.065**
W4	Unfavourable market structure (Murakoshi and Nakagami 2009)	[2]	0.247	0.062
Opportunities				
O1	Awareness development of the financial institutions regarding ESCOs (Murakoshi and Nakagami 2009)	[3]	0.245	0.061
O2	Fiscal and policy incentives (low-interest financing) (Murakoshi and Nakagami 2009)	**[1]**	**0.256**	**0.064**
O3	Loan guarantee and revolving fund scheme (Da-li 2009) , (APEC Energy Working Group 2006).	[2]	0.255	0.064

O4	Green financing from international support/funds and multiyear procurement option for ESCO projects (Vine 2005) , (World Bank 2016)	[3]	0.245	0.061
Threats				
T1	Low energy price and subsidies (Ministry of Energy and Mineral Resources 2017)	[4]	0.241	0.060
T2	Low priority for energy efficiency programs, unclear incentives and government policies (Vine 2005), (Lee et al. 2003)	[3]	0.242	0.060
T3	Institutional barriers (i.e. multiyear procurement prohibition) (Lee et al. 2003)	[2]	0.253	0.063
T4	Lack of trust from financial institutions for ESCO and energy efficiency programs (unpopular ESCO mechanism) (Vine 2005)	**[1]**	**0.264**	**0.066**

Many programs and regulations have been issued by the Indonesian government to deal with the awareness and financing aspects of the ESCO implementation. According to the Ministry of Energy and Mineral Resources (2017), the government has issued a Presidential Regulation Number 38/2015 which regulates the cooperation between the business entity and the government in the provision of infrastructure. This can include energy infrastructure for promoting energy efficiency. The policy has also been included in a technical guideline for the public sector/government and private entities in the central and local regions in Indonesia. This policy also encompasses the regulation that organises the procurement of goods and services in Indonesia. Regulations such as this strengthen the development of ESCOs in public and private sectors, e.g. ESCO involvement in public sectors such as energy efficiency projects (retrofitting), the street lighting and government buildings/office's efficiency.

S3, *financial support through the regulations created by government institutions such as the Ministry of Energy and Mineral Resources, Ministry of Finance and the Financial Service Authority* had a global priority factor of 0.064 (Table 12). All these institutions should cooperate to support energy efficiency financing schemes and regulations. Financial support for energy efficiency programs is a new concept in Indonesia and best practice for applying it needs to be found.

S2, which is *the potential energy saving in Indonesia resulting in potentially saving money* had a global priority factor of 0.062 (Table 12). According to the Ministry of Energy and Mineral Resources (2017), the Investment Grade Audit (IGA) project conducted in 2014 identified 10 companies in the industrial and commercial building sectors for potential energy savings. The audit estimated potential energy efficiency savings of 159 billion, 49 billion and 34.5 billion rupiahs respectively in the textile, iron and steel and chemical industrial sub-sectors. In 2016, the potential energy saving from the IGA in the commercial buildings sector was estimated at 16 billion rupiahs.

Another vital strength factor is S4, *the stakeholders' knowledge of the ESCO models*, (0.059) (Table 12). The level of understanding the ESCO models and ESCO schemes will be a strength for a stakeholder in each country. This knowledge could then be used to spread the information regarding ESCOs, and the stakeholders could handle the financing issues with the financial institutions (Murakoshi and Nakagami 2009). The various ESCO models and schemes should be understood by the clients and the financial institutions, for the development of ESCO markets in Indonesia.

B. Weaknesses of Financial and Awareness Aspects

W2, *the low participation of financial institutions due to financing risk recovery* (0.065) and W3, *high-interest rate and low borrowing capacity of project implementers* (0.065) are the most crucial factors for SWOT weakness factors (Table 12).

Most financial institutions prefer to lend a working capital with asset-based financing. However, energy efficiency projects do not use the traditional or conventional concepts and are therefore considered by the financial institutions as a financing risk. Financial institutions still perceive that projects that provide savings are not categorised as a project that can produce a profit (Taylor et al. 2008). The traditional banking scheme is still based on the use of collateral, borrowers' credit history and liquid assets. Furthermore, banks or financial institutions prefer to take a commercial risk rather than the kind of technical risks that are often encountered in ESCO projects. Thus, schemes such as loan guarantees are needed to overcome this issue.

High-interest rates deter ESCOs from getting involved with companies. In Thailand, the government addressed this issue by offering low interest rates to the banking institutions which automatically increased the profitability of the ESCO projects (Center for Clean Air Policy 2012).

W4, *the unfavourable market structure* (0.062) for ESCOs in Indonesia was also a weakness factor in the SWOT study (Table 12). The ESCO market in Indonesia is still small with small and medium companies unfamiliar with the different schemes offered by ESCOs. However, based on survey perception, if large companies are having a capital and do not have an issue with finance, the ESCO business could run without requiring government incentives. They have a good

awareness that energy efficiency will increase their profits. However, ESCO markets have not been formed in small and medium companies. This is where government intervention and policies are required to improve the ESCO market. It is good to understand the strategies used by other countries and lessons they learned to improve the ESCO market in Indonesia. Some countries such as Thailand, Japan and China have successfully implemented a market structure for ESCOs, while other countries have had difficulty implementing the market structure (Murakoshi and Nakagami 2009).

Another important weakness is the *lack of financial incentives* (0.059) (Table 12). The lack of incentives in Indonesia for ESCO projects has discouraged many private companies from adopting and applying for energy efficiency and ESCO projects. The incentives that were given by the government for energy efficiency projects were limited to schemes such as conducting a free energy audit. Other incentives such as fiscal incentives or tax incentives for the energy efficiency equipment were not included. According to Vine (2005), the incentives could be given to the financial institutions as "first movers" or "good citizens" in this sector. An example would be creating a website dedicated to the financial institution which supported ESCOs. This strategy will push the aims and achievements of energy efficiency and recognise that energy efficiency programs are more valuable.

C. Opportunities of Financial and Awareness Aspects

There are some opportunities for ESCO development that can be implemented in Indonesia. The most important opportunity, O2, is the *fiscal and policy incentives that can support the enhancement of ESCO markets* (0.064) (Table 12). A good investment environment for an ESCO could be created by providing

low-interest rate loans and favourable tax treatment for small and medium enterprises (Murakoshi and Nakagami 2009).

O3, t*he loan guarantee and revolving fund scheme,* (0.064) is also an essential criteria in the opportunity category (Table 12). The loan guarantee can help banks minimise their credit risk as the government will guarantee the loan. At the same time, this scheme can help the ESCO in accessing funding as the banks will be more flexible in financing the ESCO project due to increased trust in the project. A revolving fund scheme can be the best program to increase the low-interest policy since it will create an understanding and awareness of ESCO for domestic banks conducting a commercial lending to finance energy efficiency projects (APEC Energy Working Group 2006).

Another opportunity in the SWOT study that was important was O1, *increase in awareness of the financial institutions about the possibility of ESCO projects making profits* (0.061) (Table 12). Several capacity building sessions have been conducted for the banks and financial institutions by the government to explain the viability of energy financing in Indonesia. This important strategy should continue to run as it increases the awareness for ESCOs in the banking sector. In Japan, Thailand, and China, the governments along with ESCO companies have taken the lead in conducting seminars, exhibitions and conferences to disseminate information and increase the awareness and motivation of the ESCO stakeholders and financial institutions (Murakoshi and Nakagami 2009).

O4, *Green financing/international support and multiyear procurement* (0.061) (Table 12) is an opportunity that has the potential to be implemented in Indonesia. There are opportunities for getting support from international organisations such as the World Bank, the Asian Development Bank and Global

Environment Facilities (GEF). These international organisations provide the technical assistance and capacity building support programs to develop ESCO markets in developing countries such as Indonesia. In China, the support from the World Bank/GEF (Global Environment Facility) in 1998 helped promote market-oriented EPC and develop the ESCO mechanism as a pilot project (Da-li 2009), (World Bank 2016). Countries such as India and Brazil also have support from the World Bank to develop financial mechanisms for funding projects (Vine 2005). Taylor et al. (2008) stated that the goal of the green fund is to reduce the risk related to the starting up of the project and includes conducting capacity building programs and undertaking energy audits.

The multiyear procurement could also be considered as an option in the financing system as sometimes it is difficult to allow for multiyear budgeting. The lesson learned from South Korea can be an example for the Indonesian government on how to eliminate the institutional barriers for procurement (Lee et al. 2003).

D. Threats of Financial and Awareness Aspects

According to the stakeholders, the major threat for the financial aspects and awareness was T4, *the unpopular ESCO mechanism which led to a lack of trust from a financial institution for giving a loan and supporting the energy efficiency program* (0.066) (Table 12). Even in developed countries such as Australia, Italy, Sweden, and Switzerland this factor was considered as an essential barriers (Vine 2005).

Another important threat factor, is T3, *the institutional barriers such as multiyear procurement prohibition* (0.063) (Table 12). The institutional barrier for the development of ESCOs is the high administrative and transaction costs for

implementing ESCOs. The transaction costs include the processes from the transfer of knowledge until the ESCO is well-established. The entire process involves conducting capacity building, knowledge transfer (technical and process), convincing the financial institutions and understanding the ESCO concept.

T1, *Low energy price and low subsidies for energy efficiency projects* (0.060) is another threat factor (Table 12). Low energy price influences the payback period from the ESCO project, while low subsidies for energy efficiency projects will not increase the attractiveness of ESCO projects. Subsidies in Indonesia are still offered to fossil fuels rather than to energy efficiency projects. Eliminating the domestic price of fossil fuel subsidies would be a crucial step for enhancing the ESCO business. The subsidies could then be reallocated to energy efficiency projects such as subsidies for an energy audit. However, some people argue that subsidies for energy efficiency projects would be counter-productive and could inhibit the sustainable commercial growth of the ESCO market (Taylor et al. 2008).

T2, *the low priority for energy efficiency programs and unclear incentives and disincentives imposed by government* (0.060) is also a threat factor for developing ESCOs (Table 12). The priority for energy efficiency needs to be enhanced by making it an important policy in the government's programs. Currently, disincentives for inefficient energy producers are not consistently applied, and the law needs to be enforced on these producers.

4.4. Stakeholders' View on How to Solve the ESCO Barriers

In the survey, the participants were asked about their opinion regarding the solutions to overcome the various ESCO barriers. The stakeholders' answers are

shown in Table 13. There are several essential opinions from the stakeholders for eliminating the barriers for the development of ESCOs in Indonesia. These are divided into three categories based on the type of solution:

1. Information and Awareness Solution

   Strategy:

   - Conducting a pilot project (demonstration project) mainly for financial institutions to demonstrate the benefits of ESCOs.
   - Training, increasing awareness and capacity (knowledge) and technical capabilities of ESCOs.
   - A collaboration project between universities, industry and the government.

2. Regulatory Solution

   - Prioritising energy efficiency as a national priority program.
   - Integrating the various institutions (MEMR, BKF, and OJK) to regulate the EE financing mechanism.
   - Consistency in the government regulation and support while creating ESCO markets.
   - Law enforcement model (incentive and disincentive) and mandatory regulation for EE in the building and industrial sector.
   - Implementing Minimum Energy Performance Standard (MEPS), building codes and creating a benchmark.

3. Financial Solution

   - Financial incentives and schemes such as low-interest rates, tax policy, grants, subsidies, soft loan, loan guarantee and revolving funds.

- Tax incentives and rebates.
- Financing access for the multiyear service contract and formulating a procurement standard (EPC) for ESCOs.

The first strategy of conducting a pilot project is very essential. Most survey participants mentioned the importance of conducting a pilot project. A demonstration project is essential to show the benefits obtained from the implementation of an ESCO. Some projects such as Investment Grade Audit (IGA), which have already been conducted in a particular building could become an example of an ESCO pilot project in Indonesia. However, many demonstration projects with various types of energy efficiency programs are required to highlight that ESCOs could be implemented in wide variety of projects (public, building, and industry).

Increasing the awareness, and knowledge among the stakeholders about the technical capabilities of ESCOs is essential for them to better understand the ESCO mechanism. Banks and financial institutions have to be informed that there is a significant opportunity for the ESCO business in Indonesia. To help with dissemination of information, various Universities need also to be involved. Collaborations between universities, industry and the particular government projects of ESCO would help improve the current status of ESCOs in Indonesia.

The second strategy is to formulate government regulations which support the development of ESCOs in Indonesia. The regulation on energy efficiency should be made a priority in the national program on energy. This condition would make it easy for the government to make law enforcement and mandatory regulations for energy efficiency in the building, industrial and public sectors. There is also a need for the Ministry of Energy and Mineral Resources, the Ministry of Finance and the Financial Service Authority (OJK) to integrate and to create an EE financing

mechanism. The implementation of MEPS and building codes will encourage companies and ESCOs to adopt efficient appliances and standards. All set regulations should then be enforced with consistency in all sectors. This strategy would lead to creating ESCO markets in Indonesia.

The third strategy is to create a financial solution to overcome the funding problem in the implementation of ESCO. Financial incentives could be given to ESCOs and the financial institutions could help create an ESCO market. There are many types of schemes such as low-interest rate loans, tax policies, grants, subsidies, soft loan, loan guarantee and revolving funds that could be adopted to help with funding. In Indonesia, the low-interest rate loans, for example, could be combined with the revolving fund's system as this scheme was quite successful in Thailand. Finally, as the energy efficiency project could take several years before the benefits can be seen, a multiyear procurement system could be offered to the ESCOs. The standards document for ESCOs also needs to be developed to create a standard for various types of projects. Table 13 shows the stakeholder perception of the how barriers for ESCOs in Indonesia could be eliminated.

Table 13. Stakeholder Perception Survey on how to Solve the ESCO Barriers

Government	ESCO companies/Association/Experts	Financial Institutions
- Promoting ESCOs as a means of making significant energy cost savings - Training and increasing awareness and knowledge of the benefits of ESCO (increasing capacity) - Creating an ESCO market - Improving regulations - Incentives and soft loans - Pilot projects (demonstration projects) - Funding improvement - Integration amongst institutions (MEMR, BKF, and OJK) to regulate the EE financing mechanism - Prioritising EE as a national priority program	- Pilot Projects (demonstration projects) - Low-interest rates for green financing projects (ESCO projects) - Incentives (grants/subsidies/soft loans) for ESCO projects - Incentives for EE equipment (EE technology) - Tax incentives for EE stakeholders and rebates for EE consumers - Appoint a state-owned company to conduct the ESCO business and together work with the state-owned electricity company (PLN) - Consistent and comprehensive support from the government (regulations/incentives) to create an ESCO market - Law enforcement regulation for new building standards (control new building permits) - Introduce disincentives for inefficient building/industry by implementing progressive tariffs - Financing access for multiyear service contracts and regulation for ESCO projects - Mandatory government regulation for EE in the building and industrial sectors - Developing a procurement standard for ESCO - Implementing MEPS and building codes and creating an industrial energy benchmark - Training and increasing knowledge especially for financial institutions - ESCO collaboration between universities, industry and the government - Encouraging the banking institutions to have a thorough understanding of the ESCO mechanism by creating their own ESCO companies - Integrating all ESCO stakeholders and multi-sectors - Developing financing schemes (loan guarantees, tax policies, low-interest rate loans, revolving funds other incentives) - Formulating the EPC - Information Dissemination - Subsidies for conducting Long Term Agreement (LTA) for EE investments between the government and a specific sector such as building and commercial	- Training, information dissemination and capacity building for the promotion of ESCO - Pilot projects support from government such as credit program schemes - Penalties and disincentives for inefficient building/industry/company

Chapter 5: Conclusion and Recommendation

The purpose of this final chapter is to review the research question and summarise the lessons learned. Based on the results of this research, recommendations are presented that may be considered to enhance the development of ESCOs in Indonesia.

5.1. Answering the Research Question

The first research question that was asked in this research was, *"What are the strengths, weaknesses, opportunities and threats (SWOT) in implementing an ESCO?*

The strengths, weaknesses, opportunities and threats (SWOT) for ESCO implementation in Indonesia have been identified and presented in Chapter 3-Section 3.10 (Tables 5 and 6). These SWOT factors for the Indonesian context were obtained from the literature review. The SWOT factors for ESCO were categorised into two aspects: (1). The SWOT factors for regulatory aspects and (2) the SWOT factors for financial aspects.

The second research question that was, *"What are the barriers in implementing energy efficiency ESCO in developing countries such as Indonesia and how to overcome these barriers?*

To answer this question, a survey was conducted with the ESCO stakeholders.

Based on the analysis of the survey and literature review, the barriers are summarised below. These barriers are categorised into four categories: (i) institutional (ii) financial and economic (iii) knowledge and information (iv) technology and infrastructure.

Institutional Barriers

- Lack of policies, legal and regulatory frameworks and enforcement.
- Lack of government support.
- Limited institutional capacity (both in the public and private sectors).
- Breakup of energy consumption among a diverse range of end-users and business models.
- Lack of standardisation.

Financial and Economic Barriers

- Low Energy prices
- Unfavourable market structures.
- Lack of financial incentives.

Knowledge and Information Barriers

- Lack of awareness about the ESCO operation.
- Low priority for energy efficiency programmes.
- Lack of information, education and training.

Technology and Infrastructure Barriers

- Lack of energy efficiency technologies.
- Lack of infrastructure.

The SWOT-AHP analysis identified the significant SWOT factors that should be taken into account by the government/decision makers. Based on the global priority analysis, the most importance SWOT factors that should be prioritised are presented in Tables 14 and 15:

Regulatory Aspects:

Table 14. The Most Importance SWOT factors on the Global Priority Regulatory Aspects

Strengths	**Opportunities**
- Optimising the National Energy Policy and the Energy Efficiency Regulation	- Training and information dissemination of the ESCO program to the stakeholders - Implementing an ESCO pilot project - Multiyear procurement option for the ESCO project
Weaknesses	**Threats**
- Lack of understanding of the Energy Performance Contracting (EPC) process	- Financing institutions are not familiar with how ESCOs operate and therefore are reluctant to allocate loans

Financial and Awareness Aspects:

Table 15. The Most Important SWOT factors on the Global Priority Financial and Awareness Aspects

Strengths	**Opportunities**
- Optimising regulation of the energy efficiency program development	- Implementing fiscal and policy incentives (low-interest financing)
Weaknesses	**Threats**
- Low participation of financial institutions due to the risk of investment recovery. - High-interest rates and low borrowing capacity of project implementers	- Lack of trust from financial institutions for ESCO and energy efficiency programs (unpopular ESCO mechanism)

5.2. Recommendations

The response from different stakeholders suggests several solutions to overcome the barriers mentioned above, which can be proposed to the Government as recommendations.

1. Strengthening the central information to be the source of the ESCO information and create ESCO markets. This can also be supported by the ESCO and EE associations.
2. Conducting one or more pilots project is essential. The demonstration project is important to show the benefits obtained from the implementation of ESCOs.
3. Increasing awareness, training capacity (knowledge) and technical capabilities of ESCOs to help understand the ESCO mechanism (EPC).
4. Improving regulation to support the ESCO development. Energy efficiency should be made a national priority.
5. Creating financial solutions such as low-interest rate loans, tax policies, grants, subsidies, soft loans, loan guarantees, and revolving funds to overcome the funding problem in the implementation of ESCOs.

5.3. Significance and Limitations of the Results

Several outcomes and the significance of the result for this research are:

- The research was successful in in identifying the priority factors in each SWOT category for ESCO development in Indonesia.
- The research was also able to map the various barriers in developing ESCOs in Indonesia and has proposed solutions to overcome these issues.

Limitations of the Results

- Due to the lack of time, it was not possible to access stakeholders from around the country. Only a few selected stakeholders were targeted for this survey. In future, a more extensive and detailed survey involving more people with various type of ESCO stakeholder backgrounds are required to collect comprehensive data.
- To get a clear picture for future research, face to face interviews and focus group discussions with the stakeholders need to be conducted. Due to time constraints and lack of resources, this research was not able to apply these techniques.

5.4. Concluding remarks

Energy Service Companies (ESCO) have been implemented widely around the world in both developed and developing countries. The development of ESCOs is in great demand as countries strive to achieve energy efficiency. There are potential factors that affect the development of ESCOs such as energy price, subsidies, environmental issues, international policies and markets for ESCO. Although the ESCO concept and model around the world is quite similar, the actual implementation of an ESCO in every country varies. This results in various barriers encountered during the development and implementation of ESCOs. The barriers can be institutional, financial and lack of knowledge and information. The lessons learned from the implementation of ESCOs in developed and developing countries would help the promotion of ESCOs in Indonesia.

The policy implementation of ESCOs in Indonesia depends on many factors such as culture, the acceptance of energy efficiency and the level of energy

efficiency development. Policies used for ESCO implementation in other countries may not be suitable to adopt and implement in Indonesia as the results and impacts of these policies would vary significantly. Therefore, the analysis of SWOT factors for the ESCO need to be discussed and reviewed to obtain the best strategy for running the ESCO policy and projects in Indonesia. The survey involving the ESCO stakeholder groups including the government, ESCO companies/association/expertise and financial institutions were conducted to collect information and feedback. The regulatory aspects, financing/funding and awareness aspects were the two important aspects of all ESCO projects.

According to the survey, the ESCO mechanism is a relatively new concept. Around 70% of the total participants were new to the ESCO mechanism (less than 5 years). More than 60% of the participants did not know or were not sure about the existence of a central information and repository for ESCOs in Indonesia. There were differences in perception between the government and other ESCO stakeholders on the central information and repository on ESCOs.

Finally, strong policy regulation and financial incentives can improve the development of ESCOs in Indonesia. The potential for developing ESCOs is big as there are enormous investment opportunities for energy efficiency projects in Indonesia. All the opportunities and strategies can be implemented to overcome the barriers for ESCOs in Indonesia.

5.5. Future Research Recommendations

Based on the findings of this research, the following recommendation may be useful for future research:

- Conducting an in-depth research through an interview and Focus Group Discussion (FGD) that will give provide more accurate and reliable information to identify the challenges and opportunities.
- It is also an opportunity to define and analyse the best financing model options that could be suitable for developing ESCOs in Indonesia.
- There is a need to collect more information from all stakeholders. E.g., business, suppliers, another value chain.

References

ADB. 2012. *ASEAN 2030:Toward a Borderless Economic Community*, *Chapter 2: Aspirations for a "RICH" ASEAN*: Asian Development Bank.

APEC Energy Working Group. 2006. APEC Energy Efficiency and Renewable Energy Financing Task Force Progress Report. In *EWG32.* Yuzhno-Sakhalinsk, Russian Federation: APEC.

Bertoldi, Paolo, Benigna Boza-Kiss, Strahil Panev, and Nicola Labanca. 2014. ESCO Market Report 2013. Luxembourg: European Commission.

Bertoldi, Paolo, Silvia Rezessy, and Edward Vine. 2006. "Energy service companies in European countries: Current status and a strategy to foster their development." *Energy Policy* 34 (2006):1818–1832. doi: 10.1016/j.enpol.2005.01.010.

Bobbino, Samuel, Héctor Galván, and Mikel González-Eguino. 2013. Budget-Neutral Financing to Unlock Energy Savings Potential: An Analysis of the ESCO Model in Barcelona. edited by BC3 Working Paper Series: Basque Centre for Climate Change.

Center for Clean Air Policy. 2012. "Revolving and Esco Funds for Renewable Energy and Energy Efficiency Finance: Thailand." In *Funding the Future: The growing might of financing boosts renewable energy and energy efficiency*. Washington, DC 20002: Center for Clean Air Policy (CCAP). http://ccap.org/assets/CCAP-Booklet_Thailand.pdf (accessed 9 October 2016).

Central Bureau Statistics of Indonesia. 2016. "Berita Resmi Statistik Indonesia." 2016, accessed 4 May 2017. https://www.bps.go.id/index.php.

Chanthawong, Anuman, and Shobhakar Dhakal. 2016. "Stakeholders' perceptions on challenges and opportunities for biodiesel and bioethanol policy development in Thailand." *Energy Policy* 91 (2016):189-206. doi: 10.1016/j.enpol.2016.01.008.

Da-li, Gan. 2009. "Energy service companies to improve energy efficiency in China: barriers and removal measures." *Procedia Earth and Planetary Science* (2009):1695–1704. doi: 10.1016/j.proeps.2009.09.260.

Dornan, M. 2011. "Solar-based rural electrification policy design: The Renewable Energy Service Company (RESCO) model in Fiji." *Renewable Energy* 36 (2010):797-803.

Dreessen, Thomas. 2003. "Advantages and disadvantages of the two dominant world ESCO models; shared savings and guaranteed savings. ." Proceedings First Pan-European Conference on Energy Service Companies.

Ellis, Jennifer. 2009. *Energy service companies in developing countries: Potential and practice*, *August 2009*: International Institute for Sustainable Development (IISD).

Eslamipoor, Reza, and Abbas Sepehriar. 2014. "Firm relocation as a potential solution for environment improvement using a SWOT-AHP hybrid method." *Process Safety and Environmental Protection* 92 (2014):269-276. doi: 10.1016/j.psep.2013.02.003.

European Commission. 2016. "Energy Performance Contracting." Joint Research Centre European Commission, accessed 3 Oktober 2016. http://iet.jrc.ec.europa.eu/energyefficiency/european-energy-service-companies/energy-performance-contracting.

Fang, Wen Shwo, Stephen M. Miller, and Chih-Chuan Yeh. 2012. "The effect of ESCOs on energy use." *Energy Policy* 51 (2012):558-568. doi: 10.1016/j.enpol.2012.08.068.
Government of Indonesia. 2016. FIRST NATIONALLY DETERMINED CONTRIBUTION REPUBLIC OF INDONESIA. Government of Indonesia.
Hansen, Shirley J. 2011. "ESCOs around the world." *Strategic Planning for Energy and the Environment* 30 (3):9-15.
Hansen, Shirley J. 2003. "Lesson Learned Around the World." First European Conference on Energy Service Companies (ESCOs): "Creating the Market for the ESCOs Industry in Europe.
Helms, Marilyn M, and Judy Nixon. 2010. "Exploring SWOT analysis–where are we now? A review of academic research from the last decade." *Journal of strategy and management* 3 (3):215-251.
IEA. 2015. World Energy Outlook 2015. 75739 Paris Cedex 15, France: International Energy Agency.
International Energy Agency. 2010. Energy Poverty: How to make energy acess universal? Special early excerpt of the World Energy Outlook (WEO) 2010 for the UN General Assembly on the Millennium Development Goals. Paris: United Nations.
Kenny, Charles. 2016. "Goal 1—End Poverty in All its Forms Everywhere." United Nations, accessed 17 January 2017. https://unchronicle.un.org/article/goal-1-end-poverty-all-its-forms-everywhere.
Kurttila, Mikko, Mauno Pesonen, Jyrki Kangas, and Miika Kajanus. 2000. "Utilizing the analytic hierarchy process (AHP) in SWOT analysis—a hybrid method and its application to a forest-certification case." *Forest policy and economics* 1 (1):41-52.
Lee, Myung-Kyoon, Hyuna Park, Jongwhan Noh, and J.P. Painuly. 2003. "Promoting energy efficiency financing and ESCOs in developing countries: experiences from Korean ESCO business." *Journal of Cleaner Production* 11 (2003):651–657. doi: 10.1016/S0959-6526(02)00110-5.
Liming, Huang. 2009. "Financing rural renewable energy: A comparison between China and India." *Renewable and Sustainable Energy Reviews* 13 (2008). doi: 10.1016/j.rser.2008.03.002.
Lipp, Judith. 2001. "Micro-financing Solar Power The Sri Lankan SEEDS Model." *Refocus* 2 (8):18-21. doi: 10.1016/S1471-0846(01)80100-1.
Marino, Angelica, Paolo Bertoldi, and Silvia Rezessy. 2010. Energy Service Companies Market in Europe Luxembourg: European Commission.
Mehmood, Fahad, Mohammad Hassannezhad, and Tahir Abbas. 2014. "Analytical investigation of mobile NFC adaption with SWOT-AHP approach: A case of Italian Telecom." The 7th International Conference Interdisciplinarity in Engineering (INTER-ENG 2013).
Ministry of Energy and Mineral Resources. 2016a. Handbook of Energy and Economic Statistic 2016. edited by Ministry of Energy and Mineral Resources. Jakarta.
Ministry of Energy and Mineral Resources. 2016b. "Penerapan Model Bisnis Energy Saving Performance Contract (ESPC) oleh Energy Services Company (ESCO) untuk Mendukung Implementasi Efisiensi Energi di Sektor Publik." Directorate General New and Renewable Energy and Energy Conservation, accessed 26 August 2017. http://lintas.ebtke.esdm.go.id/konservasi-energi/id/swasta/view/1/23-penerapan-model-bisnis-energy-saving-performance-

contract-espc-oleh-energy-services-company-esco-untuk-mendukung-implementasi-efisiensi-energi-di-sektor-publik.
Ministry of Energy and Mineral Resources. 2017. REGULASI USAHA JASA KONSERVASI ENERGI (ESCO) SEKTOR PUBLIK SEBAGAI LANGKAH PERCEPATAN IMPLEMENTASI EFISIENSI ENERGI. Accessed 16 September 2016.
Morgado, David. 2014. "Energy Service Companies and Financing." IEA, accessed October 4. https://www.iea.org/media/training/presentations/latinamerica2014/8A_Energy_Service_Companies_and_Financing.pdf.
MPW Institute LLC. 2013. The Energy Service Market 2020.
Murakoshi, Chiharu, and Hidetoshi Nakagami. 2003. "Present condition of ESCO business for carrying out climate change countermeasures in Japan." Proceedings of the 2003 ECEEE Summer Study, Paris, France.
Murakoshi, Chiharu, and Hidetoshi Nakagami. 2009. *Current state of ESCO activities in Asia: ESCO industry development programs and future tasks in Asian countries*.
Okay, Nesrin, and Ugur Akman. 2010. "Analysis of ESCO activities using country indicators." *Renewable and Sustainable Energy Reviews* 14 (2010):2760–2771. doi: 10.1016/j.rser.2010.07.013.
Raosoft. 2004. "Sample Size Calculator." Raosoft Inc, accessed 2 September 2017. http://www.raosoft.com/samplesize.html.
Saaty, Thomas L. 1990. "How to make a decision: The Analytic Hierarchy Process." *European Journal of Operational Research* 48 (1990):9-26.
Saaty, Thomas L. 2008. "Decision making with the analytic hierarchy process." *International. J. Services Sciences* 1 (2008):83-98.
Seefeldt, Friedrich, Ruth Offermann, Markus Duscha, Lars-Arvid Brischke, Corinna Schmitt, Wolfgang Irrek, Esmail Ansari, and Christian Meye. 2013. Marktanalyse Und Marktbewertung Sowie Erstellung Eines Konzeptes Zur Marktbeobachtung Für Ausgewählte Dienstleistungen Im Bereich Energieeffizienz. Berlin: Prognos.
Stuart, Elizabeth, Peter H Larsen, Charles A Goldman, and Donald Gilligan. 2013. Current size and remaining market potential of the US energy service company Industry. Ernest Orlando Lawrence Berkeley National Laboratory (LBNL), Berkeley, CA (United States).
Taylor, Robert P. 2009. Personal communication with Robert Taylor. Lead Energy Specialist, East Asia Transport and Energy Sector Unit: World Bank.
Taylor, Robert P., Chandrasekar Govindarajalu, Jeremy Levin, Anke S. Meyer, and William A. Ward. 2008. *FInancing Energy Efficiency: Lessons from Brazil, China, India, and Beyond*: The International Bank for Reconstruction and Development, The World Bank.
Urmee, Tania, David Harries, and August Schlapfer. 2009. "Issues related to rural electrification using renewable energy in developing countries of Asia and Pacific." *Renewable Energy* 34 (2009):354–357. doi: 10.1016/j.renene.2008.05.004.
Vine, Edward. 2005. "An international survey of the energy service company (ESCO) industry." *Energy Policy* 33 (2005):691–704. doi: 10.1016/j.enpol.2003.09.014.
World Bank. 2015. "Gross Domestic Product 2015." accessed 11 May 2017. http://databank.worldbank.org/data/download/GDP.pdf.

World Bank. 2016. "Fostering the Development of ESCO markets for energy efficiency." World Bank Group, accessed 1 October 2016. http://documents.worldbank.org/curated/en/709221467753465653/pdf/103932-BRI-LW54-OKR-PUBLIC.pdf.

Wu, Jianguo. 2015. "Goal 7—Ensure Access to Affordable, Reliable, Sustainable and Modern Energy for All." United Nations, accessed 13 January 2017. https://unchronicle.un.org/article/goal-7-ensure-access-affordable-reliable-sustainable-and-modern-energy-all.

Bibliography

Bertoldi, P. and B. Boza-Kiss (2017). "Analysis of barriers and drivers for the development of the ESCO markets in Europe." Energy Policy 107: 345-355.

K. Lo, "A critical review of China's rapidly developing renewable energy and energy efficiency policies," *Renewable and Sustainable Energy Reviews*, vol. 29, pp. 508-516, 2014.

Trick, Michael A. 1996. "Analytic Hierarchy Process." accessed 17 March 2017. http://mat.gsia.cmu.edu/classes/mstc/multiple/node4.html.

Appendices

Appendix A. Questionnaire/Survey
Analysing Strengths, Weaknesses, Opportunities and Threats (SWOT) - Analytic Hierarchy Process (AHP) of ESCO in Indonesia

A. Details of Participants

Name of Participant :
Email Address :
Phone Number (optional) :
Name of Institution/Company :

Please choose the sector you belong to:
a. Government
b. ESCO Association/Expertise
c. ESCO Companies
d. Industrial/Building Association
e. Banking regulators
f. Banks/Financial Institutions
g. Others

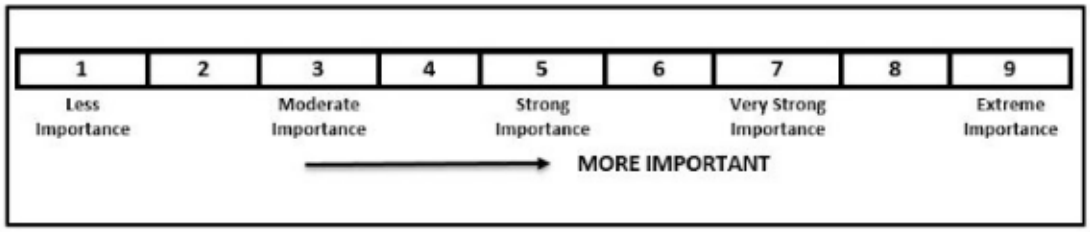
H**ow long have you or your institution been working on the ESCO mechanism?**
a. Less than 2 years
b. 2-5 years
c. 5-10 years
d. More than 10 years

B. Question – Regulatory Aspects

Please rate the importance of each factor in terms of the **regulatory aspect** that may influence the development of ESCO in Indonesia.
The conditions of the criteria are divided into four groups: Strengths, Weaknesses, Opportunities and Threats.

For your convenience, the rating scale is provided below:
Please rate 1-9 based on the intensity of importance

Intensity of Importance Numeric Scale and Definition



Regulatory Aspects

Strengths (Please rate from 1-9 based on the intensity of importance)

1. National Energy Policy and the Energy Efficiency Regulation
   Answer:
   1 2 3 4 5 6 7 8 9

2. Potential for energy efficiency savings
   Answer:
   1 2 3 4 5 6 7 8 9

3. Existing institutional framework support from the Ministry of Energy and Mineral Resources (MEMR), the Ministry of Finance (MoF), and the Financial Services Authority (OJK)
   Answer:
   1 2 3 4 5 6 7 8 9

Weaknesses (Please rate from 1-9 based on the intensity of importance)

1. Lack of ESCO standardisation and accreditation
   Answer:
   1 2 3 4 5 6 7 8 9

2. Limited institutional capacity (both public and private)
   Answer:
   1 2 3 4 5 6 7 8 9

3. Lack of government support through policies, regulations and incentives
   Answer:
   1 2 3 4 5 6 7 8 9

4. Lack of understanding of the Energy Performance Contracting (EPC) process
   Answer:
   1 2 3 4 5 6 7 8 9

Opportunities (Please rate from 1-9 based on the intensity of importance)

1. Training and dissemination information of the ESCO program to the stakeholders
   Answer:
   1 2 3 4 5 6 7 8 9

2. Enhancing the ESCO association to assist the government in policy development, information dissemination, and creating an ESCO market
   Answer:
   1 2 3 4 5 6 7 8 9

3. Implementing an ESCO pilot project
   Answer:
   1 2 3 4 5 6 7 8 9

4. Multiyear procurement option for the ESCO project
   Answer:
   1 2 3 4 5 6 7 8 9

Threats (Please rate from 1-9 based on the intensity of importance)

1. Low energy price and subsidies
   Answer:
   1 2 3 4 5 6 7 8 9

2. Unclear incentives and government policies
   Answer:
   1 2 3 4 5 6 7 8 9

3. Lack of energy efficiency technology and infrastructure available for the ESCO project
   Answer:
   1 2 3 4 5 6 7 8 9

4. Financing institutions are not familiar with how ESCO operate and therefore are reluctant to allocate loans.
   Answer:
   1 2 3 4 5 6 7 8 9

C. Financial and Awareness Aspects

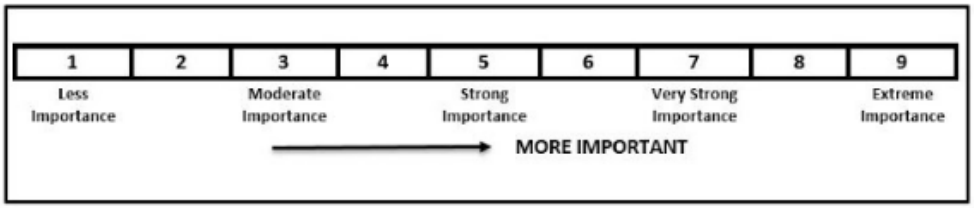
Please rate the importance of each factor in terms of the **financial and awareness aspect** that will influence the development of ESCO in Indonesia.

The criteria are divided into four groups: Strengths, Weaknesses, Opportunities and Threats.

For your convenience, the rating scale is provided below:

Please rate from 1-9 based on the intensity of importance.

Intensity of Importance Numeric Scale and Definition



Financial and Awareness Aspects

Strengths (Please rate from 1-9 based on the intensity of importance):

1. Regulation on energy efficiency program development
   Answer:
   1 2 3 4 5 6 7 8 9

2. Potential to reduce energy consumption to save money
   Answer:
   1 2 3 4 5 6 7 8 9

3. Financial support from the Ministry of Energy and Mineral Resources (MEMR), the Ministry of Finance (MoF), and the Financial Services Authority (OJK)
   Answer:
   1 2 3 4 5 6 7 8 9

4. The knowledge of ESCO Models (for example Shared Savings, Guarantee Savings, and Leasing models/others)
   Answer:
   1 2 3 4 5 6 7 8 9

Weaknesses (Please rate from 1-9 based on the intensity of importance)**:**

1. Lack of financial incentives
   Answer:
   1 2 3 4 5 6 7 8 9

2. Low participation of financial institutions due to risk of investment recovery.
   Answer:
   1 2 3 4 5 6 7 8 9

3. High-interest rates and low borrowing capacity of project implementers.
   Answer:
   1 2 3 4 5 6 7 8 9

4. Unfavourable market structure
   Answer:
   1 2 3 4 5 6 7 8 9

Opportunities (Please rate from 1-9 based on the intensity of importance):

1. Awareness development of the financial institutions regarding ESCO
   Answer:
   1 2 3 4 5 6 7 8 9

2. Fiscal and policy incentives (low-interest financing)
   Answer:
   1 2 3 4 5 6 7 8 9

3. Loan guarantee and revolving fund scheme
   Answer:
   1 2 3 4 5 6 7 8 9

4. Green financing from international support/funds and multiyear procurement option for ESCO projects
   Answer:
   1 2 3 4 5 6 7 8 9

Threats (Please rate from 1-9 based on the intensity of importance)**:**

1. Low energy price and subsidies
   Answer:
   1 2 3 4 5 6 7 8 9

2. Low priority for energy efficiency programs, unclear incentives and government policies
   Answer:
   1 2 3 4 5 6 7 8 9

3. Institutional barriers (i.e. multiyear procurement prohibition)
   Answer:
   1 2 3 4 5 6 7 8 9

4. Lack of trust from financial institutions for ESCO and energy efficiency programs (unpopular ESCO mechanism)
   Answer:
   1 2 3 4 5 6 7 8 9

D. Additional Questions

- To the best of your knowledge, is there a central information repository on ESCOs and their benefits in Indonesia?

- How do you think the barriers for promoting ESCO in Indonesia could be eliminated?

Appendix B. Detail Survey Results

1. Respondent Distribution Survey

Table. Respondent Distribution in Survey

Category Respondent	Government (people)		ESCO companies/association and experts (people)		Financial Institution (people)	
Institutions	Ministry of Energy	9	ESCO & private company/association	7	Banks Category - BUKU1	2
	Ministry of Finance	3	Industrial/Building Company and Association	3	Banks Category - BUKU2	3
	OJK	3	Energy Efficiency Expertise	4	Banks Category - BUKU3	1
			University	1	Banks Category - BUKU4	2
					Credit Association	1
					unknown category	5
Subtotal		**15**		**15**		**14**
Total		**44**				

2. Government Perception on Central Information Repository

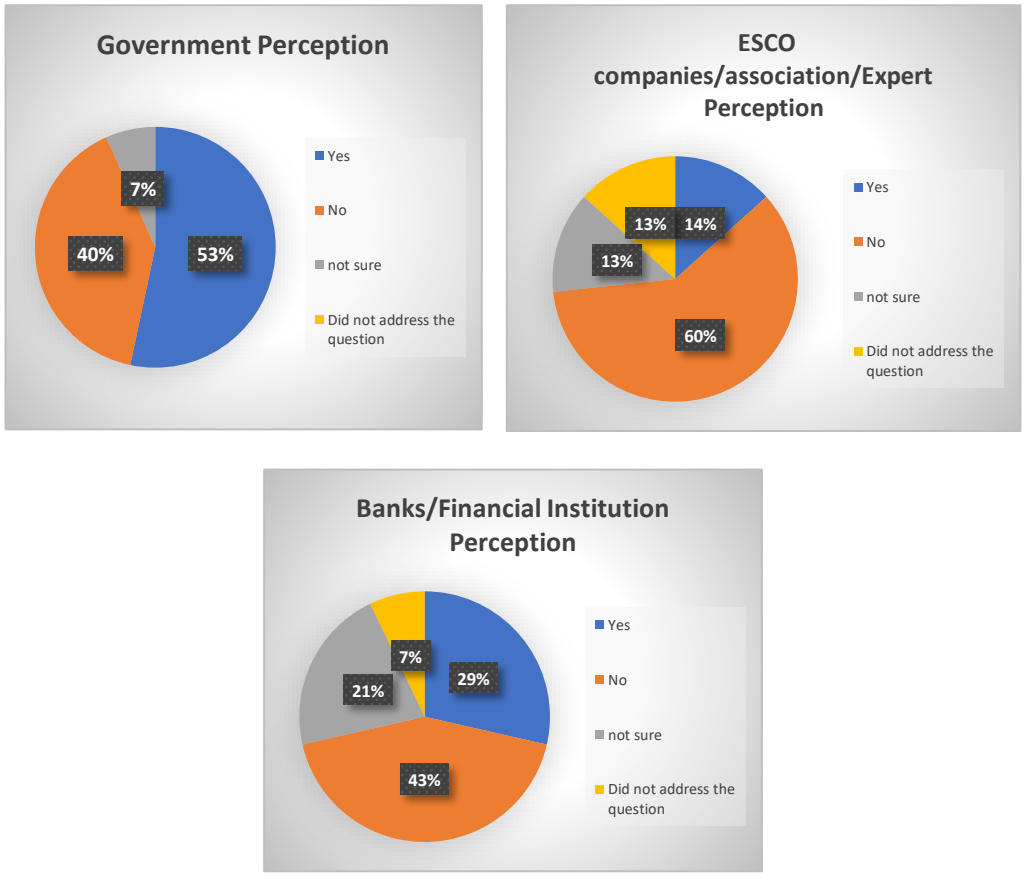


Figure. Stakeholder Perception on Central Information Repository

Appendix C. Pairwise Comparison Calculation

(i) Regulatory Aspects

1. Regulatory Strengths

Government

	S1	S2	S3	multiplying	3th root product	Factor Priority
S1	1.00	1.13	1.00	1.13	1.04	0.346
S2	0.89	1.00	0.89	0.79	0.92	0.308
S3	1.00	1.13	1.00	1.13	1.04	0.346

Lambda Max =3, CI =0, RI (n=3) = 0.58 (Wharton), CR=0

ESCO Association/Expertise/ Private Sector

	S1	S2	S3	multiplying	3rd root product	Factor Priority
S1	1.00	1.13	1.13	1.27	1.08	0.360
S2	0.89	1.00	1.00	0.89	0.96	0.320
S3	0.89	1.00	1.00	0.89	0.96	0.320

Lambda Max=3, CI =0, RI (n=3)= 0.58 (Wharton), CR=0

Financial Institution

	S1	S2	S3	multiplying	3th root product	Factor Priority
S1	1.00	0.89	0.89	0.79	0.92	0.308
S2	1.13	1.00	1.00	1.13	1.04	0.346
S3	1.13	1.00	1.00	1.13	1.04	0.346

Lambda Max=3, CI =0, RI (n=3)= 0.58 (Wharton), CR=0

2. **Regulatory - Weaknesses**

Government							
	W1	**W2**	**W3**	**W4**	**multiplying**	**4th root product**	**Factor Priority**
W1	1.00	0.88	0.88	1.00	0.77	0.94	0.233
W2	1.14	1.00	1.00	1.14	1.31	1.07	0.267
W3	1.14	1.00	1.00	1.14	1.31	1.07	0.267
W4	1.00	0.88	0.88	1.00	0.77	0.94	0.233

Lambda Max =4, CI =0, RI (n=4) = 0.9 (Wharton), CR=0

ESCO Association/Expertise/ Private Sector							
	W1	**W2**	**W3**	**W4**	**multiplying**	**4th root product**	**Factor Priority**
W1	1.00	0.86	1.00	0.86	0.73	0.93	0.231
W2	1.17	1.00	1.17	1.00	1.36	1.08	0.269
W3	1.00	0.86	1.00	0.86	0.73	0.93	0.231
W4	1.17	1.00	1.17	1.00	1.36	1.08	0.269

Lambda Max =4, CI =0, RI (n=4) = 0.9 (Wharton), CR=0

Financial Institution							
	W1	**W2**	**W3**	**W4**	**multiplying**	**4th root product**	**Factor Priority**
W1	1.00	1.00	0.88	0.78	0.68	0.91	0.226
W2	1.00	1.00	0.88	0.78	0.68	0.91	0.226
W3	1.14	1.14	1.00	0.89	1.16	1.04	0.258
W4	1.29	1.29	1.13	1.00	1.86	1.17	0.290

Lambda Max =4, CI =0, RI (n=4) = 0.9 (Wharton), CR=0

3. Regulatory-Opportunities

Government							
	O1	**O2**	**O3**	**O4**	**multiplying**	**4th root product**	**Local Priority**
O1	1.00	1.00	1.00	1.00	1.00	1.00	0.250
O2	1.00	1.00	1.00	1.00	1.00	1.00	0.250
O3	1.00	1.00	1.00	1.00	1.00	1.00	0.250
O4	1.00	1.00	1.00	1.00	1.00	1.00	0.250

Lambda Max =4, CI =0, RI (n=4) = 0.9 (Wharton), CR=0

ESCO Association/Expertise/ Private Sector							
	O1	**O2**	**O3**	**O4**	**multiplying**	**4th root product**	**Local Priority**
O1	1.00	1.17	1.00	1.00	1.17	1.04	0.259
O2	0.86	1.00	0.86	0.86	0.63	0.89	0.222
O3	1.00	1.17	1.00	1.00	1.17	1.04	0.259
O4	1.00	1.17	1.00	1.00	1.17	1.04	0.259

Lambda Max =4, CI =0, RI (n=4) = 0.9 (Wharton), CR=0

Financial Institution							
	O1	**O2**	**O3**	**O4**	**multiplying**	**4th root product**	**Local Priority**
O1	1.00	0.89	1.00	1.00	0.89	0.97	0.242
O2	1.13	1.00	1.13	1.13	1.42	1.09	0.273
O3	1.00	0.89	1.00	1.00	0.89	0.97	0.242
O4	1.00	0.89	1.00	1.00	0.89	0.97	0.242

Lambda Max =4, CI =0, RI (n=4) = 0.9 (Wharton), CR= 0

4. **Regulatory-Threats**

Government							
	T1	**T2**	**T3**	**T4**	**multiplying**	**4th root product**	**Factor Priority**
T1	1.00	0.75	0.86	0.67	0.43	0.81	0.200
T2	1.33	1.00	1.14	0.89	1.35	1.08	0.267
T3	1.17	0.88	1.00	0.78	0.79	0.94	0.233
T4	1.50	1.13	1.29	1.00	2.17	1.21	0.300

Lambda Max =4, CI =0, RI (n=4) = 0.9 (Wharton), CR=0

ESCO Association/Expertise/ Private Sector							
	T1	**T2**	**T3**	**T4**	**multiplying**	**4th root product**	**Factor Priority**
T1	1.00	1.00	1.20	0.86	1.03	1.01	0.250
T2	1.00	1.00	1.20	0.86	1.03	1.01	0.250
T3	0.83	0.83	1.00	0.71	0.50	0.84	0.208
T4	1.17	1.17	1.40	1.00	1.91	1.17	0.292

Lambda Max =4, CI =0, RI (n=4) = 0.9 (Wharton), CR=0

Financial Institution							
	T1	**T2**	**T3**	**T4**	**multiplying**	**4th root product**	**Factor Priority**
T1	1.00	1.00	0.89	0.89	0.79	0.94	0.235
T2	1.00	1.00	0.89	0.89	0.79	0.94	0.235
T3	1.13	1.13	1.00	1.00	1.27	1.06	0.265
T4	1.13	1.13	1.00	1.00	1.27	1.06	0.265

Lambda Max =4, CI =0, RI (n=4) = 0.9 (Wharton), CR= 0

(ii) Financial and Awareness Aspects

1. Financial and Awareness - Strengths

Government

	S1	S2	S2	S4	multiplying	4th root product	Factor Priority
S1	1.00	1.00	1.00	1.00	1.00	1.00	0.250
S2	1.00	1.00	1.00	1.00	1.00	1.00	0.250
S3	1.00	1.00	1.00	1.00	1.00	1.00	0.250
S4	1.00	1.00	1.00	1.00	1.00	1.00	0.250

Lambda Max =4, CI =0, RI (n=4) = 0.9 (Wharton), CR=0

ESCO Association/Expertise/ Private Sector

	S1	S2	S2	S4	multiplying	4th root product	Factor Priority
S1	1.00	1.14	1.14	1.33	1.74	1.15	0.286
S2	0.88	1.00	1.00	1.17	1.02	1.01	0.250
S3	0.88	1.00	1.00	1.17	1.02	1.01	0.250
S4	0.75	0.86	0.86	1.00	0.55	0.86	0.214

Lambda Max =4, CI =0, RI (n=4) = 0.9 (Wharton), CR=0

Financial Institution

	S1	S2	S2	S4	multiplying	4th root product	Factor Priority
S1	1.00	1.00	0.89	1.00	0.89	0.97	0.242
S2	1.00	1.00	0.89	1.00	0.89	0.97	0.242
S3	1.13	1.13	1.00	1.13	1.42	1.09	0.273
S4	1.00	1.00	0.89	1.00	0.89	0.97	0.242

Lambda Max =4, CI =0, RI (n=4) = 0.9 (Wharton), CR=0

2. **Financial and Awareness - Weaknesses**

Government							
	W1	**W2**	**W3**	**W4**	**multiplying**	**4th root product**	**Factor Priority**
W1	1.00	1.00	1.00	1.00	1.00	1.00	0.250
W2	1.00	1.00	1.00	1.00	1.00	1.00	0.250
W3	1.00	1.00	1.00	1.00	1.00	1.00	0.250
W4	1.00	1.00	1.00	1.00	1.00	1.00	0.250

Lambda Max =4, CI =0, RI (n=4) = 0.9 (Wharton), CR=0

ESCO Association/Expertise/ Private Sector							
	W1	**W2**	**W3**	**W4**	**multiplying**	**4th root product**	**Factor Priority**
W1	1.00	0.88	0.88	1.00	0.77	0.94	0.233
W2	1.14	1.00	1.00	1.14	1.31	1.07	0.267
W3	1.14	1.00	1.00	1.14	1.31	1.07	0.267
W4	1.00	0.88	0.88	1.00	0.77	0.94	0.233

Lambda Max =4, CI =0, RI (n=4) = 0.9 (Wharton), CR=0

Financial Institution							
	W1	**W2**	**W3**	**W4**	**multiplying**	**4th root product**	**Factor Priority**
W1	1.00	0.88	0.88	0.88	0.67	0.90	0.226
W2	1.14	1.00	1.00	1.00	1.14	1.03	0.258
W3	1.14	1.00	1.00	1.00	1.14	1.03	0.258
W4	1.14	1.00	1.00	1.00	1.14	1.03	0.258

Lambda Max =4, CI =0, RI (n=4) = 0.9 (Wharton), CR=0

3. Financial and Awareness - Opportunities

Government							
	O1	**O2**	**O3**	**O4**	**multiplying**	**4th root product**	**Factor Priority**
O1	1.00	1.00	1.00	1.00	1.00	1.00	0.250
O2	1.00	1.00	1.00	1.00	1.00	1.00	0.250
O3	1.00	1.00	1.00	1.00	1.00	1.00	0.250
O4	1.00	1.00	1.00	1.00	1.00	1.00	0.250

Lambda Max =4, CI =0, RI (n=4) = 0.9 (Wharton), CR=0

ESCO Association/Expertise/ Private Sector							
	O1	**O2**	**O3**	**O4**	**multiplying**	**4th root product**	**Factor Priority**
O1	1.00	0.88	1.00	1.00	0.88	0.97	0.241
O2	1.14	1.00	1.14	1.14	1.49	1.11	0.276
O3	1.00	0.88	1.00	1.00	0.88	0.97	0.241
O4	1.00	0.88	1.00	1.00	0.88	0.97	0.241

Lambda Max =4, CI =0, RI (n=4) = 0.9 (Wharton), CR=0

Financial Institution							
	O1	**O2**	**O3**	**O4**	**multiplying**	**4th root product**	**Factor Priority**
O1	1.00	1.00	0.89	1.00	0.89	0.97	0.242
O2	1.00	1.00	0.89	1.00	0.89	0.97	0.242
O3	1.13	1.13	1.00	1.13	1.42	1.09	0.273
O4	1.00	1.00	0.89	1.00	0.89	0.97	0.242

Lambda Max =4, CI =0, RI (n=4) = 0.9 (Wharton), CR=0

4. Financial and Awareness - Threats

Government							
	T1	**T2**	**T3**	**T4**	**multiplying**	**4th root product**	**Factor Priority**
T1	1.00	0.86	0.75	0.75	0.48	0.83	0.207
T2	1.17	1.00	0.88	0.88	0.89	0.97	0.241
T3	1.33	1.14	1.00	1.00	1.52	1.11	0.276
T4	1.33	1.14	1.00	1.00	1.52	1.11	0.276

Lambda Max =4, CI =0, RI (n=4) = 0.9 (Wharton), CR=0

ESCO Association/Expertise/ Private Sector							
	T1	**T2**	**T3**	**T4**	**multiplying**	**4th root product**	**Factor Priority**
T1	1.00	1.14	1.14	1.00	1.31	1.07	0.267
T2	0.88	1.00	1.00	0.88	0.77	0.94	0.233
T3	0.88	1.00	1.00	0.88	0.77	0.94	0.233
T4	1.00	1.14	1.14	1.00	1.31	1.07	0.267

Lambda Max =4, CI =0, RI (n=4) = 0.9 (Wharton), CR=0

Financial Institution							
	T1	**T2**	**T3**	**T4**	**multiplying**	**4th root product**	**Factor Priority**
T1	1.00	1.00	1.00	1.00	1.00	1.00	0.250
T2	1.00	1.00	1.00	1.00	1.00	1.00	0.250
T3	1.00	1.00	1.00	1.00	1.00	1.00	0.250
T4	1.00	1.00	1.00	1.00	1.00	1.00	0.250

Lambda Max =4, CI =0, RI (n=4) = 0.9 (Wharton), CR=0