# The Determinants of Demand Intention for Energy Management Services

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***Abstract*--Enhance the efficiency of energy usage and lower energy costs have gained attention in the recent years. Prior research has neglected the transaction structure of energy management service. This study investigated the *ex ante* and *ex post* transaction costs with respect the contracting between Energy Service Company (ESCOs) and energy demanders. Combined with the internal control mechanisms and the external environments of ESCOs, this study conducted a large-scale survey of 835 energy demanders and a focus group as well. Four key determinants of energy management services were identified including asset specificity, task complexity, market competitiveness and institutional supports. These results showed that asset propriety and task complexity significantly increase the transaction costs and reduce the demand intention for energy management services. However, market competitiveness and institutional supports are negatively related to the transaction costs and increase demand intention for energy management services. This study further verified the importance of formal control mechanisms, which are not only strengthen the industrial development, but also increase the demand intention of energy management services.**

## I. INTRODUCTION

Due to global warming and underdeveloped sources of replacement energy such as solar, wind, marine, plant, atomic, and deep geothermal, the costs of energy usage are continually rising [17]. Along with the shortage of energy supply, many countries have attempted to lower energy costs by applying business principles to energy management services. Specifically, energy service companies (abbreviated as ESCOs) have arisen out of this context that strives to link energy suppliers and energy demanders. This emerging industry is expected not only to increase the return on investment of industrial participants, but also enhance the efficiency of environmental protection.

To enhance the development of energy management services, many countries have also begun to explore corresponding issues such as national policies and business models. Prior studies described ESCOs as a forward-looking industry in terms of industrial development and economic contribution [11,13]. The development of the ESCO industry is still in the initial stages, however, this industry is facing numerous existing and latent problems that hinder the growth. Specifically, even though the number of ESCOs in Taiwan has increased to 130 in 2010, the potential and scale of the energy services market have not been fully exploited. The institutional context of energy management services is still vulnerable and hinders the industry's development [24, 27]. Moreover, government agencies are suggested to play the critical role of stimulating the business model of ESCOs [20].

Prior studies mostly focused on the *supply* side of energy management services [28]. The empirical studies exploring the *demand* of energy management service are comparatively rare [8, 23]. The sharing of value creations between both supply and demand sides has increasingly been emphasized [19]. However, the energy services provided by an ESCO are highly involved and complex, thus the value is difficult to measure. Asymmetric information between energy demanders and ESCOs can easily lead to difficulties in terms of measuring the delivery of services. Given this situation, the costs of searching, negotiating, and supervising energy management services have increased, so the supply and the demand side are prone to speculative behavior. Based on transaction cost theory, this study examined the demands of the energy management service by linking the supply and demand sides through effective governance mechanisms.

## II. THEORETICAL BACKGROUND

### *A. The Origin and Development of ESCOs*

ESCOs engage in the integration of energy-saving facilities, technologies and services to reduce energy costs. The energy management service not only improves environmental quality but also establishes an energy-saving 'green' image for an energy demander. Moreover, demanders of energy management services anticipate rapidly balancing their investment in the purchase of energy-saving facilities, technologies, and services with energy consumption.

Globally, the first ESCO was established in Sweden in 1978, and major development of ESCOs began around the late 1980s. The ESCO industry was most active in Germany, where as many as 500-1000 ESCOs were established from 1990 to 1995. Furthe, ESCOs in Germany have output values of over $150 million while the output value of each Canadian ESCO averages approximately $10-20 million. In Asia, Japan started the first ESCO in 1997, and 158 ESCOs have been established in Korea since 1992. In China where the energy management industry developed much later, there are currently about 23 ESCOs.

The first ESCO in Taiwan was founded in 1998. The number of ESCOs has substantially increased from 20 in 2005 to 130 in 2010. The output value of Taiwan's ESCOs showed annual growth of up to 60% from 2005 to 2008. Due to the global financial crisis in 2009, the total value of energy conservation improvement projects, energy-saving equipment and technology sales were declined by 9%. Nevertheless, growth of overall ESCO output value was found to be as high as 32.5% in 2010 and 42.2% in 2011 [2].

*B. Transaction Costs of Energy Management Services*

*1) Generation of transaction costs*

The fundamental concept of transaction cost theory was proposed by Coase [4], who argued the market functional system is incomplete, and must rely on effective distribution and integration of resources. Williamson [29, 30] incorporated organization theory, strategy theory and contractual behavior theories to expand the framework. Transaction dimensions are environmental factors affecting one another in complicated relationships, resulting in increased transaction costs and market failure where resource efficiency is not optimally distributed. Specifically, transaction cost is mutually formed by transaction attributes and behavioral assumptions.

Conceptually, transaction attributes include uncertainty, asset specificity and transaction frequency. Uncertainty refers to the cost derived from asymmetric information between buyers and sellers in a transaction. Asset specificity refers to the specific uses of commodity/services in a transaction, and generates differentiated value when the commodity/service is transferred to another transaction. That is, the value of invested commodities or services will decline, generating potential costs upon different usage purposes. Transaction frequency, which is tied to risks, refers to the frequency of transactions between the buyer and seller. Generally, the less frequent the transactions, the smaller the relevant risks are, resulting in increased transaction costs. On the other hand, behavioral assumptions mainly refer to limited rationality and opportunism. The former indicates both parties to a transaction can only handle uncertainty with their limited capacity, thus making the completion of transactions difficult and raising the relevant cost. The latter refers to behavioral factors involved in the strategies adopted by buyer and seller according to their interests.

Furthermore, based on transaction attributes and behavioral assumptions, Sorrell [23] incorporated the dimension of institutional context. This study argues transaction costs in energy management services are derived from asset specificity, task complexity, competitiveness, and institutional context. Asset specificity indicates the obstacles faced by energy demanders in the investment in entity assets, equipment, human resources or other aspects. Task complexity highlights the problem that most financial organizations take conservative attitudes towards emerging industries because they lack relevant assessment mechanisms for ESCOs and are unwilling to provide financing. Competitiveness represents the shortage of integrated talent as the number of ESCOs grows. Finally, the institutional context highlights energy policies and programs regulated by the government.

*2) Types of transaction costs*

The premise of transaction cost theory is company behaviors are related to the lowest costs in executing a transaction. Williamson [29] argued transaction costs could be sourced from *ex ante* and *ex post* perspectives. Dahlman [5] explored the pre- and post-costs of a transaction. Pre-transaction costs refer to search and information costs and bargaining and decision-making costs. Search and information costs are paid in search for trading partners, which is affected by the sufficiency of market information and transaction frequency. Bargaining and decision-making costs refer to negotiation processes involved in completing a transaction [14]. Post-transaction costs can be divided into monitoring costs and enforcement costs. The former indicates the costs an energy service demander has to monitor as to whether the ESCO fulfills obligations according to the contract. The latter refers to the speculative behavior in executing a contract when one party violates the agreement against the other party [5]. Similarly, in terms of transaction location, Furubotn and Richter [9] divided transaction costs into market (i.e. external) and organizational (i.e. internal) costs. Specifically, market costs include search and information costs, bargaining and decision-making costs, and monitoring costs as well as enforcement costs. Organizational costs include the costs of founding, maintaining, changing and operating an organization (see Table 1).

TABLE 1 TYPES OF TRANSACTION COSTS

| Location / Time | Market | Organization |
|---|---|---|
| Ex ante | 1.Search and information cost (i.e. in search for appropriate trading partners)<br>2.Bargaining and decision-making cost (i.e. bargaining, negotiation and decision-making) | 1.Organizational establishment (i.e. founding, maintenance, design and change) |
| Ex post | 1.Monitoring costs (i.e. monitoring if seller fulfills relevant obligations according to the contract)<br>2.Enforcement costs (i.e. prevent from violating the agreement and result in cost to the other party) | 1.Organizational operation (i.e. decision-making and enforcement monitoring) |

This study explores the *ex ante* and *ex post* transaction costs between energy demanders and ESCOs. In ex ante costs, search and information costs refer to the costs paid by energy demanders in searching for an appropriate ESCO. Bargaining and decision-making costs represent costs incurred in the contract negotiation between ESCO and energy demander. In ex post costs, monitoring costs are incurred when energy demanders monitor whether an ESCO fulfills relevant obligations. Enforcement costs are incurred due to an ESCO's breach of the agreement. Specifically, transaction costs will directly affect the behaviors of an energy service demander. If the service costs paid to ESCOs are less than that of the usual energy expenditure, the demanders prefer to adopt the strategic behavior of outsourcing [1].

*C. Control Mechanisms of Energy Management Services*

To reduce transaction costs, trading parties must design various control mechanisms to reduce the harm caused by opportunism, uncertainty, and moral hazard. A well-designed control mechanism can enhance efficiency and reduce the costs generated by transactions [30]. Coase [4] classified governance mechanism into two types: market governance and hierarchy governance. For an enterprise, market governance should be adopted if the relevant costs derived from market trading are less than those of self-production. The perspective of hybrid governance was proposed by Williamson [31], which suggests transactions can be reached in the balanced form of market governance and hierarchy governance.

Moreover, Vine et al. [28] subdivided governance mechanisms into third-party enforcing agreements and self-enforcing agreements in accordance with partnership type. Third-party enforcing agreements indicate partners require formal governance mechanisms, such as legal contracts, to maintain and complete transactions, while self-enforcing agreements indicate partners carry out transaction behaviors through informal governance mechanisms under the condition of mutual trust and social linkages.

Given this fact, control mechanisms can be classified into formal governance and informal governance. A formal governance mechanism reflects the formulation of legal contracts that specify origin, negotiation, monitoring, adaptation, and termination [18, 31]. While the informal governance mechanism is relationship-orientated; transactions are completed through the regulation of trust and commitment [6]. Regardless of the various types, the control mechanism is primarily a tool to establish and structure transaction relationships, and demonstrate the multi-facetted phenomena of origin, maintenance and termination of relationships [14].

Prior studies argue formal control mechanisms should be adopted first and informal governance mechanisms should be adopted later only if mutual cooperation and relationships have become more stable [7,12]. Since energy management services are still in their infancy, control mechanisms for the provision of energy-saving technologies and services have not yet been fully identified. Under this unfamiliar environment, this study argues energy-trading partners have more willingness to regulate rights and obligations through formal contracts. The formal control mechanism is suggested to provide definite regulations for both parties, and increase the completion and thoroughness of transactions [31].

## III. RESEARCH METHOD

*A. Research Hypotheses*

*1) Impacts of asset specificity on transaction cost*

Prior studies suggest a greater asset specificity of investment increases transaction costs and risks [21, 30]. Given the fact trading parties may invest in relevant resources for energy management services, such as labor, time and materials spent on data collection. And given such investment may generate sunk costs if the other party behaves opportunistically, this study proposes the higher asset specificity of ESCOs will increase costs in terms of *ex ante* and *ex post* transaction costs. Therefore, this study proposes:

***H1: The more asset specificity of energy management service, the greater the transaction costs are likely to be.***

*2) Impact of task complexity on transaction cost*

Williamson [29] suggested higher task complexity lead to trading parties being more prone to opportunism. Task complexity is due to behavioral uncertainty or environmental uncertainty [23]. For trading partners engaged in energy management services, in particular, energy-saving projects are considered highly complex [27]. This study argues the higher task complexity of energy management service will increase the relevant transaction costs. Thus:

***H2: The more task complexity of energy management service, the greater the transaction costs are likely to be.***

*3) Impact of market competitiveness on transaction cost*

In a competitive market environment, trading parties are suggested as being more likely to act opportunistically [10]. As the number of competitors increases, product/service providers are expected to introduce low-cost, low-price and rapidly improved products or technologies to gain higher market share [22]. On the contrary, a seller may easily establish prices that exceed the marginal costs in a monopoly/oligopoly market. This study argues the competiveness of energy management services is negatively related to the transaction costs. Thus:

***H3: The more market competiveness of energy management service, the less the transaction costs are likely to be.***

*4) Impact of institutional support on transaction cost*

In an institutional context, standard operations and functional certificates can lower the risks of opportunism by

the trading parties, thereby decreasing the investment costs and boosting confidence [16]. The establishment, maintenance, and protection of a legal system, as well as standard enforcement, can feasibly lead the trading parties to fulfill their cooperation obligations. In addition, prior research argues for stronger support from the institutional context of ESCOs will decrease the anticipated relevant transaction costs [23]. Therefore, the hypotheses are developed as follows:

***H4: The more institutional support of energy management service, the less the transaction costs are likely to be.***

*5) Impact of transaction cost on demand intention*

Increased transaction costs will impede the trading parties' willingness to cooperate, and reduce customers' willingness to purchase [29]. Thompson and Yuany [26] applied this concept to the relationship between transaction costs and demand willingness among online customers. The results verified transaction costs negatively affect customers' demand willingness. This study argues transaction costs directly affect the transaction behaviors between ESCOs and energy demanders, and the demand intention for energy management services. Thus:

***H5: The more transaction costs of energy management service, the less the demand intentions are likely to be.***

*6) Moderating role of control mechanisms*

Organizations may regulate the incurred transaction costs through formal governance mechanisms [31]. Stump and Heide [25] suggested a formal mechanism such as formal contracts would make the business process more transparent, effectively clarifing the interactions between the trading parties. Furthermore, formal governance contracts and formal process control can effectively regulate the costs incurred from the interactions between ESCO and demanders [23]. Due to the attributes of emerging industry, this study argues the formal control mechanism would be more effective for energy management services. Thus:

***H6: Control mechanisms positively moderate the influence of transaction costs on demand intentions for energy management services.***

*B. Research Framework*

This study focused on the transaction costs between ESCOs and demanders. Since the transaction costs generated in the delivery of energy management service are complex, the determinants of transaction costs suggested by Sorrell [23] are taken in this study. In line with the viewpoints of transaction cost theory, this study developed several hypotheses as to the possible relationships between attributes of the transaction and environment and transaction costs. Moreover, the role of control mechanisms as moderating variables was investigated (see Figure 1).

*C. Operational Definition of Research Variables and Questionnaire Development*

Based on the research framework and theoretical foundation, this study explored the investigated variables of antecedents and the consequence of the transaction, formal control mechanism, and demand intention. The operational definition of the investigating variables was summarized in Table 2. This study controlled two variables, including asset scale and industry type. Prior study indicated enterprises with larger asset scales typically have larger procurement volumes and operating scales [15]. In addition, energy demanders of various industries may have different levels of intention for energy management services.

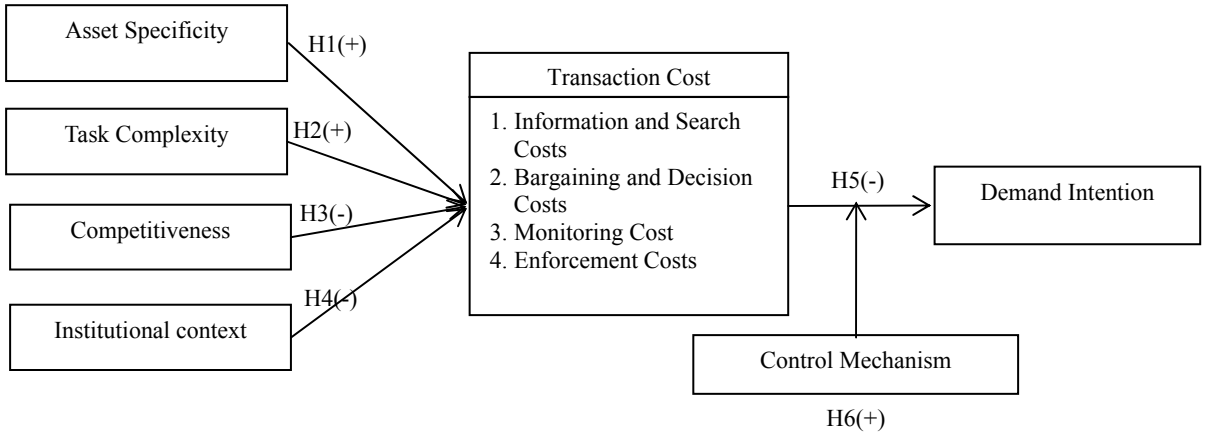


Figure 1 Research Framework of Demand Intention and Transaction Costs

TABLE 2 OPERATIONAL DEFINITIONS OF THE INVESTIGATING VARIABLES

| Variable | Operational definition | Source |
|---|---|---|
| Asset specificity | The specificity of the invested facility, equipment and manpower | Heide, 1994; Sorrell, 2007 |
| Task complexity | The perceived level of complexity for the energy project | Campbell, 1988; Selnes and Sallis, 2003 |
| Market competiveness | The level of rare, valuable, inimitable, insubstitutable of ESCOs in the market | Barney, 1991; Shy and Stenbacka, 2005 |
| Institutional support | The appropriateness and legitimacy of institutional regulation and requirement for energy management services | Hinings and Greenwood, 1988; Scott and Meyer, 1983 |
| Information & search cost | The costs of searching for feasible information and ESCO | Rindfleisch and Heide, 1997; Sorrell, 2007 |
| Bargaining & decision-making cost | The costs of human, transportation, and time endeavors in negotiating with ESCO | Heide, 1994; Sorrell, 2007 |
| Monitoring cost | The costs of monitoring ESCO whether fulfill relevant obligations according to the contract | Rindfleisch and Heide, 1997; Sorrell, 2007 |
| Enforcement cost | The costs of preventing ESCO from violating the agreement | Rindfleisch and Heide, 1997; Sorrell, 2007 |
| Formal control mechanism | The governance of the rights and obligations for energy management service through a formal contract | Lusch and Brown, 1996 Stump and Heide, 1996 |
| Demand intention | The possibility to adopt energy management service from a ESCO | Dodds et al., 1991; Schiffman and Kanuk, 2000 |

In designing the questionnaire, this study used scale scores and set counter questions to avoid nonsampling errors. Since this study collected results using the same questionnaire, the questionnaire stressed respondents should answer the questions with overall, not individual, concepts to avoid common source bias. Since, the concepts of the investigating variables are difficult to quantify, the study adopted Likert's seven-point scale for measurement.

Manufacturing sectors have been verified as the largest carbon dioxide emitters among all the industries [3]. Manufacturing sectors can be divided into the cement industry, food industry, plastics industry, electronics industry, automobile industry, rubber industry, steel industry, paper manufacturing industry and chemical industry, resulting in a total of 835 companies. This study selected the public-listed companies as the research targets for two reasons: (1) the companies have a long-operating experience and more resources for energy management services; and (2) the data of financial statements are audited and can be accessed. This study sent the questionnaire to the deputy-general managers or above in the belief a company's energy policies are closely related to their decision-making. In order to having a high resposne reate, an introduction via email, fax, or telephone was used to explain the purpose and importance of the study before the questionnaire distribution.

Finally, the study collected 225 valid questionnaires, for a response rate of 26%. Among the respondents, most were in the electronic industry, with a total of 127 companies (accounting for 56%). Most of the companies have been founded for over 20 years, with a total of 141 companies (accounting for 63%). Classified by asset scale, enterprises with more than NT$500 million in assets made up the highest proportion, with a total of 194 companies (accounting for 84%). There were 85 companies among the enterprises that had adopted energy management services (accounting for 38%). Specifically, the provisions of energy management are mainly conducted by the lighting industry, with a total of 146 projects (accounting for 27%).

## IV. RESULTS AND DISCUSSION

### *A. Factor Analysis and Reliability Test*

This study examined the co-variance between the investigating variables through the Bartlett ball test and the Kaiser-Meyer-Olki (KMO) measure of sampling adequacy. The data indicated the KMO measure was 0.845, and the Bartlett test value was 0, suggesting the data collections were suitable for factor analysis. Furthermore, as the variance inflation factors of the variables ranged between 1.000 and 4.220, the results suggest no significant effects of collinearity. The Cronbach's α values were greater than 0.70, the factor loading magnitude was greater than 0.5 and the cumulative explained variation was above 70%, indicating the questionnaire had good construct validity.

Moreover, this study conducted confirmatory factor analysis to examine the construct of the research framework. The results revealed that the antecedents of transaction cost RMSEA was 0.04, GFI 0.96, AGFI 0.95 and CFI 0.97; task complexity RMSEA was 0.03, GFI 0.95, AGFI 0.94 and CFI 0.96; market competitiveness RMSEA was 0.05, GFI 0.97, AGFI 0.96 and CFI 0.98; and institutional support RMSEA was 0.02, GFI 0.94, AGFI 0.93 and CFI 0.95. The values of these variables were all in compliance with the criteria for the judgment indicators, suggesting that the dimensions were applicable to the analysis of this study.

### *B. Multiple regression analysis and discussion*

This study verified the causal relationships between the various dimensions through multiple regression analysis. According to Models 2, 4, 6 and 8 in Table 3, the asset

specificity variable showed positive and significant influences on search and information cost, bargaining and decision-making costs, as well as monitoring costs and enforcement cost. This implies the higher asset specificity of the energy management service, the *ex ante* and *ex post* transaction costs will be also higher. The findings support Hypothesis 1 and its relevant sub-hypotheses. The task complexity variable showed positive and significant impacts on search and information costs, bargaining and decision-making costs, as well as monitoring cost and enforcement cost. This suggested the higher task complexity of energy management service, the *ex ante* and *ex post* transaction costs will also be higher. This finding supports Hypothesis 2 and its relevant sub-hypotheses.

Additionally, the market competitiveness variable showed negative and significant influences on search and information cost, bargaining and decision-making cost, monitoring cost and as well as enforcement cost. The higher market competitiveness of ESCOs, the *ex ante* and *ex post* transaction costs will be lower. This finding supports Hypothesis 3 and its relevant sub-hypotheses. Finally, the institutional support variable showed negative and significant impacts on search and information costs, bargaining and decision-making costs, as well as monitoring costs and enforcement costs. Thus, if the institutional context is favorable for energy management services, the *ex ante* and *ex post* transaction costs will be lower. This finding supports Hypothesis 4 and its relevant sub-hypotheses.

Hypothesis 5 proposed the higher the *ex ante* and *ex post* transaction costs of energy management services, the lower the demand willingness for transactions. Model 10 in Table 4 showed both *ex ante* and *ex post* transaction costs have a negative and statistical significance with demand intention, supporting Hypothesis 5 and its relevant sub-hypotheses. Moreover, Hypothesis 6 proposed the formal governance mechanisms have positive moderating effects on the relationship between transaction costs and demand willingness. Model 11 in Table 5 showed that formal control mechanisms have positive and statistical significances for the relationship between transaction costs and demand willingness, supporting Hypothesis 6 and its relevant sub-hypotheses.

To ensure the validity of the research findings, a focus group of nine participants was composed of representatives from ESCOs, energy demanders, financial institutions and energy verification institutions. The ESCOs in the fields of construction, lighting, air-conditioning and boiler fields were selected because they were in the majority with well-developed energy management technologies in Taiwan. Open discussions were conducted in the focus group to encourage more insights and not limit participants' answers. Through this process, we are able to compare the practical experiences with the research findings in this study.

TABLE 3 RESULT OF REGRESSION ANALYSIS

| DV / IV | Ex-ante Transaction Cost | | | | Ex-post Transaction Cost | | | |
|---|---|---|---|---|---|---|---|---|
| | Search and Information Cost | | Bargaining and Decision-making Cost | | Monitoring Cost | | Enforcement Cost | |
| | Model1 | Model2 | Model3 | Model 4 | Model5 | Model 6 | Model7 | Model 8 |
| Predictor Variables | | | | | | | | |
| Asset Specificity | | 0.413*** | | 0.336* | | 0.327 * | | 0.297* |
| Task Complexity | | 0.355** | | 0.418** | | 0.392 * | | 0.352* |
| Market Competition | | -0.110$^{+}$ | | -0.194$^{+}$ | | -0.126* | | -0.178$^{+}$ |
| Institutional Support | | -0.192** | | -0.163$^{+}$ | | -0.106* | | -0.119* |
| Control Variables | | | | | | | | |
| Industry Type | 0.082 | 0.015 | 0.119 | 0.047 | 0.099 | | 0.002 | -0.054 |
| Asset Scale | 0.177$^{+}$ | 0.066 | 0.121 | 0.018 | 0.126 | | 0.122 | 0.024 |
| *F Value* | 2.175 | 46.851 *** | 1.588 | 26.733*** | 1.413 | 27.125*** | 0.915 | 21.092*** |
| *Adjusted* $R^2$ | 0.019 | 0.689 | 0.009 | 0.555 | 0.007 | 0.558 | 0.002 | 0.493 |

Note：$^{+}$ $p \leq .10$; * $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$; two-tailed test

TABLE 4 RESULTS FROM TRANSACTION COSTS TO DEMAND INTENTION

| DV / IV | Demand Intention | |
|---|---|---|
| | Model9 | Model10 |
| Predictor Variables: | | |
| Search & Information Costs | | -0.166$^{+}$ |
| Bargaining & Decision-making Costs | | -0.211$^{+}$ |
| Monitoring Cost | | -0.123$^{+}$ |
| Enforcement Costs | | -0.084$^{+}$ |
| Control Variables: | | |
| Industry Type | -0.127 | -0.143 |
| Asset Scale | -0.090 | -0.099 |
| *F Value* | 1.342 | 1.221 |
| *Adjusted* $R^2$ | 0.005 | 0.011 |

Note：$^{+}$ $p \leq .10$; * $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$; two-tailed test

TABLE 5 RESULTS FROM CONTROL MECHANISM TO DEMAND INTENTION

| DV / IV | Demand Intention |
|---|---|
| | Model 11 |
| Predictor Variables: | |
| Search & Information Costs * Control Mechanism | 0.186** |
| Bargaining & Decision Costs * Control Mechanism | 0.163 * |
| Monitoring Cost * Control Mechanism | 0.140 * |
| Enforcement Costs * Control Mechanism | 0.099 * |
| Control Variables: | |
| Industry Type | -0.132 |
| Asset Scale | -0.115 |
| *F Value* | $2.002^{+}$ |
| *Adjusted* $R^2$ | 0.047 |

Note: $^{+}$ $p \leq .10$; * $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$; two-tailed test

Overall, the demanders of energy management service believe they would have to pay additional costs for installation, equipment and personnel. Specifically, energy demanders are cautious if the energy-saving equipment can be used in a specific operational site. They may incur more subsequent expenses (e.g. repair, maintenance, human training) to adopt the equipment with energy-saving features. In addition, since ESCO is an emerging industry, there is limited information to judge a qualified and reputable ESCO. The scope of energy management services may cover air conditioning, lighting, boilers, and steam, so it is difficult to verify energy-saving performance. All of the above practical arguments support the findings of Hypotheses 1 and 2.

Accompanied by intense market competition, it is easy for energy demanders to evaluate the ESCO who meets their expectations. Meanwhile, to obtain market share and profit, ESCOs strive to provide quality energy-saving services and reduce relevant costs. In terms of the institutional context, government agencies in Taiwan have formulated a series of policy reforms for energy management services. For instance, ESCOs are on the list of *Emerging Important Strategic Industries*, so the ESCOs are qualified for the financial and tax incentives for five years. In 2008, the Executive Yuan also implemented an *Economy Boosting Plan* to promote and improve the energy-saving attributes of buildings. Thus, energy demanders in compliance with the official standards and provisions can not only receive the reduced implementing costs, but also develop a positive company image. All of the above practical arguments support the findings of Hypotheses 3 and 4. The finding of the relationship between transaction costs and demand willingness is consistent with Thompson and Yuany [26], who argued the more costs demanders bear in a transaction; the more demand willingness for products/services will drop.

Since most energy demanders do not understand the technical aspects and decision-making process of ESCOs, many inefficient negotiations take place with considerable costs incurred on personnel and transportation. Moreover, there is shortage of standard verification mechanisms for energy demanders to measure the actual energy-saving performance. Given this, to prevent ESCOs from claiming unrealistic outputs, many energy demanders have to supervise and detect whether energy-saving benefits have been enhanced. The increased costs for energy demanders reduce the willingness to adopt energy management services. All of the above practical arguments support the finding of Hypotheses 5.

The ESCO industry is still in the initial development stage, and the relevant regulations and verification mechanisms are incomplete. Energy demanders do not fully understand how to work with ESCOs, such as the payment processes and the priority order of operating sequences. Given this situation, a set of standardized governance mechanisms should be established prior to cooperation. Moreover, trading parties must regulate their transaction process, trading methods and progress through formal contracts to specify clearly their respective rights and obligations. A formal control mechanism provides a legal basis to guarantee the transactions, and make the negotiation and decision-making processes proceed smoothly. In our survey, 167 enterprises (74%) indicated they would accept energy management services within the next 12 months, suggesting the strong demand willingness for energy management services. Establishing formal contracts with a transparent verification process will accelerate energy demanders' decision-making and increase their willingness to accept the services. This offers an explanation as to why hypothesis 6 can be supported.

## V. CONCLUSIONS

This study focuses on the demand intention of energy management services between ESCOs and energy demanders from transaction costs theory. This study provides a clear profile of the relationship between demand intention, control mechanisms, and transaction costs. This study extends the understanding of the stimulants of energy management services from the perspective of transaction cost theory. In addition, by establishing control mechanisms with energy demanders, ESCOs not only can strength their competition abilities and overcome the problems of transaction costs, but also enhance the demand intention of energy demanders for

energy management services.

In this rapidly changing external environment, energy cost is the most fundamental reason for the existence and the development of the ESCO industry. This study suggests the agreement of energy management services to combine with land value tax, housing tax and relevant government policies to maintain overall energy costs. As for the internal environment, since the facilities and equipment provided by ESCOs have asset specificity and complex operation system, and these result in high operation costs for energy management services. This study suggests building a collaborative platform between ESCO and energy demanders to encourage participation in technology skills through knowledge sharing for energy management. This will make it easier for energy demanders to evaluate the costs of in-house R&D and allow comparison with the costs of the available energy-saving projects.

This study reveals energy demanders play the dominant role in the decision-making of energy management services. The results explain why ESCOs should be aware of the importance of customers' needs in the link between energy management agreement and energy demanders. Specifically, control mechanisms are found to stimulate the demand intention of energy demanders for energy management services. This study suggests control mechanisms not only provide more understanding of operation and maintenance in executing energy management, but also reduce information and search costs as well as bargaining and decision costs for energy demanders. ESCOs should further respond to the concerns of energy demanders, and provide suitable suggestions and strategies for energy demanders. Thus, long-term business operations and control mechanisms will generate a win-win situation for energy demanders and ESCOs. In summary, this study suggests the stimulants of energy management services should be focused on: (1) integrating government policies; (2) strengthening their own expertise, knowledge and technology; (3) establishing transparent control mechanisms; and (4) paying attention to the perspectives of energy demanders.

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