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REVENUE MODELS AS DRIVERS FOR IEMS AMONG SMEs IN TAIWAN

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FINANCIAL STRATEGIES AND CAPITAL MARKETS

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Summary

The Industrial Energy Management System (IEMS) is a computer-aided controlling system that aims to minimize energy inefficiencies at an industrial plant. Traditionally, the heavy financial burdens and the complexity in performance measurements greatly limit the willingness to incorporate IEMS especially among small and medium enterprises (SMEs) in Taiwan. The result of quantitative questionnaires and a qualitative in-depth interview on both the demand and supply sides of the IEMS market suggest that the Taiwanese SME market for IEMS is underserved due to information gap and financial constraints despite general interests and positive feedback. The research concludes that the Energy Performance Contract revenue model that addresses the financial limitations and alignment of interests is a great fit to the market needs and is capable of increasing the willingness to adapt the IEMS significantly among the SMEs in Taiwan.

Contents

Figures and Table Directory

List of abbreviations

SME	Small and medium-sized enterprises
IEMS	Industrial energy management system
EMS	Energy management system
HVAC	Heating, Ventilation and Air Conditioning
VFC	Variable Frequency Control
AC	Alternating current
CSR	Corporate social responsibility
LEED	Leadership in Energy and Environmental Design
PPA	Power Purchase Agreement
SEA	South East Asia
GDP	Gross domestic product

ADB	Asia develop bank
EPC	Energy performance contract
ESCO	Energy service company

1. Introduction

1.1. Background of Research

The goal of this research is to provide insights and recommendations for the revenue model that can incentivise the adoption of IEMS for small-and-medium enterprises (SMEs) in the Taiwanese market. The research begins with an introduction of the industrial energy management system (IEMS), continued with a comparison of various revenue models available for the conventionally investment-heavy IEMS industry, followed by an analysis of the Taiwanese IEMS market through market survey and the case study of BenQ, an IEMS provider in Taiwan. The research concludes with thorough discussions of the findings in all previous sections and the recommendations for promoting the adoption of IEMS to both private and public roles.

The consumption of fossil fuel due to rapid industrialization in the past century has led to the acceleration of global warming and the continuous growth of recent extreme weather events[1], as well as millions of air pollution-related premature deaths around the globe[2]. Under this ever-growing threat, the topic of carbon emission (CO_2) reduction has become one of the most discussed issues in both private and public research. The unfortunate event of Fukushima nuclear reactor disaster in 2011 was a brutal awakening to the world that once believed that the nuclear fission energy could be the economic and clean alternative to carbon emitting energy from coal and crude oil.[3] Although renewable energy (including hydroelectricity) already represents 23.7% the electricity source in the world and was the largest segment of net additions to global electricity capacity in 2014, the higher price tag and intermittency of renewable energy made it tough to replace the cheap and reliable CO_2 emitting thermal energy running on fossil fuel.[4,5]

New energy sources from the development of technologies may be the long-term solution to CO_2 emission, yet they are not the only method to reduce the dependence on fossil fuel. In fact, a more efficient energy utilization through careful planning, monitoring, and optimizing energy consumption behavior can make the most timely and economic contribution towards solving these problems in the short run.[6] On the contrary to the common misunderstanding that energy efficiency management comes with a premium price tag, energy efficiency requires the lowest leveled cost (USD 2.4 cents per kWh) of all sources of electricity when taking infrastructure investments into account[7]. There are other important drivers for companies to engage in energy efficiency improvements, including

(1) Risks in energy prices as a result of the fluctuations in global crude oil prices;

(2) Stricter emission regulations regarding carbon footprints and environmental impact;

(3) Consumers' willingness to pay a premium for "green products."

These drivers make it sensible for energy-thirsty companies to strive for a more efficient energy utilization for the long-term financial return, tightening regulations, and positive corporate image.[6]

An energy management system (EMS) is a computer-aided analytical tool that monitors the energy consumption at various facilities and provides analytical data for decision-making or direct operation optimization for minimizing inefficiency in energy utilization. Case studies suggest that on average EMS is capable of reducing electricity consumption from 11.39% to 16.22% across private and public sectors.[8] Companies around the globe have been actively participating in EMS and relating services for decades, whether as an equipment manufacturer, construction contractor or energy management consultant. Some notable firms including Siemens, GE-Alstom Grid, Honeywell, and Schneider Electric, are currently serving residential, commercial, public and industrial facilities around the globe. Among the list of target sectors for EMS, the industrial sector exhibits the greatest saving potential as it is liable for the consumption of 42.5% of the electricity generated globally[9] (see Figure 1). Apart from its significant share in electricity consumption, the industrial sector is also responsible for an additional 21% of the CO_2 emissions throughout the production process[10], making the industrial sector the biggest source of CO_2 emission.

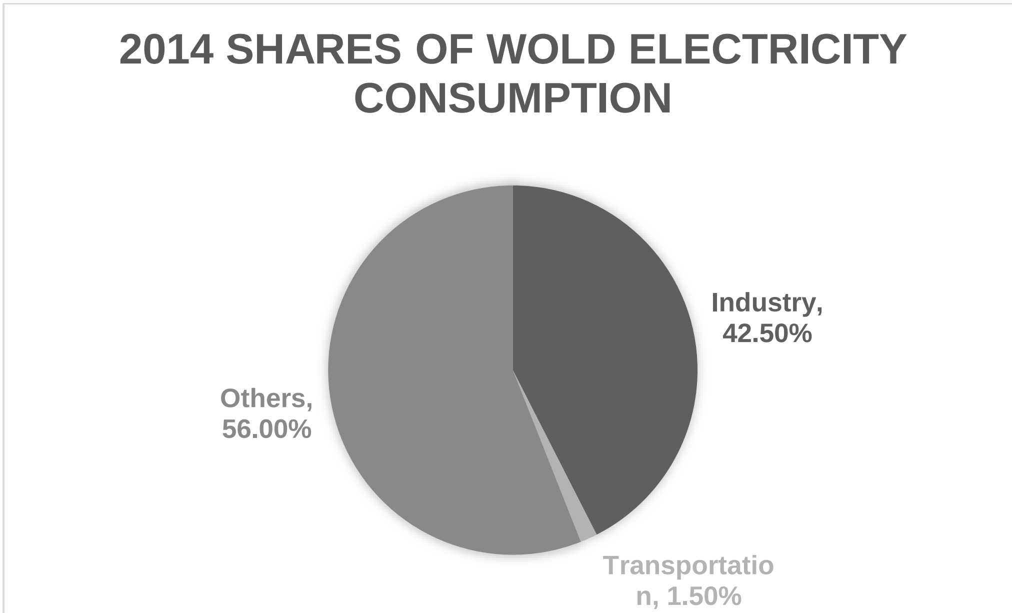

Figure 1: Share of world electricity consumption in 2014 (%). International Energy Agency, *Key World Energy Statistics,* (Rep. International Energy Agency, 2015). Web.

Other sources of energy consumption include agriculture, commercial and public services, residential, and non-specified other. Nevertheless, none of those above is consuming energy at a comparable level to the industrial segment. In addition to the amount of consumption, the research by Molina also found that the industrial sector can save more ($2.6 cents per kWh) from improved energy efficiency as compared to the $2.0 cents per kWh for general households[7]. With the vast room for improvement and rewarding financial return, the market for IEMS is expected to grow at a compound annual growth rate of 21% and reach $5.5 billion by 2020 in the United States[11].

There are many conducts to reduce energy consumption at industrial locations, starting as effortless as turning off unused production equipment and ceiling lights when one leaves his or her shift. However, to increase energy efficiency at a significant level without jeopardizing productivity and more importantly, risking production quality requires much more delicate knowledge of manufacturing process and energy utilization. In Lee's research, he categorized the IEMS can reduce energy consumption through the following five general methods:

(1) **Production Management**, IEMS can maximize production efficiency through the analysis of recorded production parameters, converts from production-driven to consumption-oriented manufacturing (from push to pull) behavior to reduce inventory, overdue products and other inefficiencies from production. The optimization of production can save on average of 10.35% of energy cost and increase production efficiency up to 50%;

(2) **Production Scheduling**, which distributes the production loading to avoid inefficiency caused by overloading during peak-hours and idling in between them, and utilize lower electricity rates during off-peak hours in areas with variable utility rates, leading to an average utility cost saving of 13%;

(3) **Heating, Ventilation and Air Conditioning (HVAC) control**, methods such as improving heat insulation, recycling heat waste, and thermal energy storage that freezes coolant during off-peak hours to assist peak-hour cooling, can all decrease the energy needed by an average of 14%;

(4) **Variable Frequency Control (VFC) of Motors**, by strategically varying incoming alternating current (AC) to motor can reduce an average of 17% of energy needed to operate the same motor at identical output;

(5) **Lighting Optimization**, optimizing lighting intensity, applying daylight assisted energy management and replacing the incandescent light bulb with LED light can easily reduce energy consumption related to illumination over 50%.[8]

These five methods can be further amplified by installing Smart control units that operate these functions in tandem based on real-time analytics of surrounding environmental data collected by multiple sensors and interconnectivity of the apparatus.

Saving Measure	Description	Avg. Energy Saving
Production Management	Convert from production-driven to consumption-oriented manufacturing behavior	10.35%
Production Scheduling	Distribute the production loading to off-peak hours to prevent overloading and utilize lower electricity rates	13%
HVAC control	Improve heat insulation, recover heat waste, and thermal energy storage	14%
Variable Frequency Control	Strategically varying incoming alternating current to motors	17%
Lighting Optimization	Optimize lighting intensity, daylight assisted energy management and replacing light bulb with LED	39%

Table 1: Energy Saving Measures by IEMS. Dasheng Lee, and Cheng Chin-Chi, *Energy Savings by Energy Management Systems: A Review,* Renewable and Sustainable Energy Reviews 56 (2015): 760-77. Web.

There are two approaches to integrating the IEMS into the manufacturing facility, which are the pre- and post- construction approaches. With the pre-construction approach, an IEMS solution provider joins hands with the architect and client to design a facility that minimizes energy consumption by ways such as taking advantage of natural lighting, natural convection, recycling residual heat and other geographical and environmental architecture designs to minimize environmental impact and energy consumption.[12] The pre-construction approach has been gaining popularity with the rising environmental awareness and corporate social responsibility (CSR). The Leadership in Energy and Environmental Design (LEED) is a rating system for the design, construction, operation, and maintenance of green buildings, homes, and neighborhoods that aim to help the building owners and operators be environmentally responsible and use resources efficiently.[13] With the participation of over 80,000 building projects across 162 countries[14], the LEED is becoming ever popular among new construction projects that aim for a sustainable future.

Despite the growing popularity of LEED-certified green projects, these newly built structures and production facilities represent only a fraction of the total energy saving potential through energy management due to the comparatively small number of new industrial projects to existing ones. Therefore, the focus of this research will be on the post construction approach as it represents the dominating portion of the market and shows the greatest potential for energy saving. As the name suggested, a post-construction IEMS project deals with production sites that did not incorporate IEMS or other energy efficiency measures during the designing and planning phase, and are often currently in production. The post-construction IEMS solution provider has to assess, design, install and operate an add-on energy management apparatus to the project site with minimal disturbance of original production, further increasing the complexity of post-construction IEMS projects.

Few barriers to the implementation of IEMS exist, ranging from awareness, availability of technology. Among the list of obstacles, the economic barrier appears to be the dominating limiting factor for the adoption of IEMS.[15] The IEMS hardware and software, regardless of pre or post -construction approach, requires substantial upfront investments that significantly restrict the project leaders' willingness to incorporate IEMS. Therefore, the prevailing attitude towards IEMS has been that it is not essential for profitability and "if it ain't broke, don't fix it" during prosperous times and too expensive to execute during the economic downturn.[16] This attitude is particularly the case for SMEs, which account for over 99% of total businesses globally and lack resources and scale to justify such heavy upfront capital expenditure.[6] Under status quo, the priority and therefore the adoption rate of IEMS will continue to be low for SMEs unless the IEMS industry can come up with ways to minimize the cost and additional workload required by the IEMS.

The emphasis of this research is the manufacturing SMEs in Taiwan due to the following market characteristics and trends on top of the universal reasons stated earlier.

(1) **The high share of industrial energy consumption.** The industrial segment is responsible for 73.70% of the electricity consumption in Taiwan for 2016 according to statistics from state-owned TaiPower company.[17]

(2) **Increasing utility rate due to denuclearization.** The electricity rate is expected to rise from 10% up to 40% by 2025 due to termination of all three nuclear power plant according to published interview with the Minister of Economic Affairs.[18]

(3) **Emission protocols.** Though not a member of the United Nations, Taiwan is complying with the Kyoto Protocol and the Paris Accords. Taiwan is on track to bring projected 2020 carbon emission to the same level of 2005, stimulating improvements in energy efficiency in both public and private sectors.[19]

(4) **Energy dependence.** Taiwan relies on imports for more than 97.8% of its energy in 2015, which leaves the island's energy supply vulnerable to external disruption.[20]

With the reason listed above, engaging in energy efficiency improvement is both economical and sustainable for Taiwan. Therefore, this research will study the IEMS market opportunities and obstacles of the Taiwanese market to provide recommendations that stimulate the adoption of IEMS.

1.2. Purpose of Research

A revenue model is an essential part of the company's business model, which is the ability to convert its value to the customer into revenue streams. A company's revenue model can be composed of different revenue streams that can all have different pricing models.[21] Improvements in revenue model of IEMS providers can provide an opportunity to minimize the economic barrier in addition to the cost-reduction as a result of technological breakthroughs.

The goal of this research is to analyze the feasibility and market potential of alternative revenue models for IEMS to propose ways to accelerate the adoption of IEMS in the sector, in particular for the SMEs. An example of an innovative revenue model that led to rapid growth in an industry limited by the massive upfront cost is the Power Purchase Agreement (PPA) model used by solar power system provider SolarCity.[22] By providing zero upfront cost and instant savings from discounted electricity rate for the homeowner in exchange for roof space, SolarCity can align the interests of both parties (instant savings for homeowners while SolarCity uses the space for photovoltaic panels and profits from selling excess electricity back to the grid). As a result of such innovative model, SolarCity quickly rose to become the leading solar system provider in the US, with over 35% of market share in 2015[23]. This research thus aims to investigate into the possible barriers and drivers of IEMS to propose a solution that can provide similar prosperity to the IEMS services among the SMEs as the PPA did to the solar power system industry.

Figure 2. Terms of SolarCity's Power Purchase Agreement. *SolarPPA for home,* SolarCity, www.solarcity.com/residential/solar-ppa. Accessed 24 May 2017.[24]

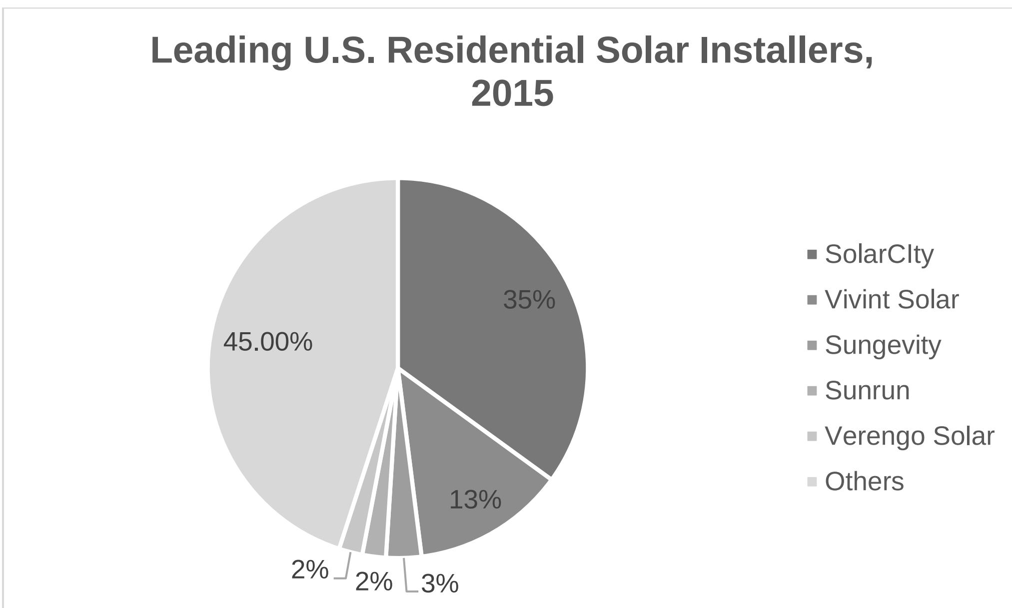

Figure 3. Leading U.S. Residential Solar Installers, 2015. Cedric Brehaut, *Global PV Monitoring 2016-2020: Markets, Trends and Leading Players,* (San Francisco: GTM Research, 2016). Web.

The findings of this research can provide insights for both public and private segments to introduce the right incentives to encourage the adoption of IEMS to SMEs in Taiwan. These recommendations and experiences may be further applied to the developing South East Asian (SEA) markets due to the high resemblance in SME environments and the enormous contributions of manufacturing industry to each nations' economy.

	Number of SMEs to Total Number of Companies	Industry's Contribution to National GDP	SMEs's Contributions to National GDP
Taiwan	**97.61%**	**36.10%**	**28.72%**
Indonesia	99.90%	40.30%	60.30%
Malaysia	97.30%	38.00%	33.10%
Philippines	99.60%	30.50%	35.00%
Thailand	97.20%	36.00%	37.40%
Vietnam	97.70%	39.00%	30.00%

Table 2: Comparison of Taiwan and SEA SME and manufacturing industries. Ministry of Economic Affairs[25], Asia Development Bank[26] and Central Intelligence Agency[27]. Web

To conclude, improving energy efficiency among the energy-thirsty industrial sector is a global trend due to economic, regulatory and CSR motives. However, even with the economic and sustainability benefits associating the application of IEMS, improvements in revenue model for IEMS is needed to accelerate the adoption process due to the high financial commitment and long payback period. This research will focus on the IEMS revenue models that best incentivise SMEs, which represent the greatest market potential due to the low adoption rate and lack motivation owing to financial limitations and other barriers. The findings of this research can provide insights for both public and provide sectors in Taiwan and other markets such as South East Asia.

2. Research Methods

2.1. The context of investigation

The focus of the research is the manufacturing SMEs in Taiwan due to its vast market potential. By the definition given by the Small and Medium Entreprise Administration, Ministry of Economic Affairs of Taiwan, a company in the manufacturing, construction, mining and cement industries with capital under NTD 80 million (~USD 2.5 million), or with less than 200 full-time employees; and in other industries with capital under NTD 100 million (~USD 3.3 million), or with less than 100 full-time employees is considered a SME. The SMEs represents 97.61% of the registered companies in Taiwan, with about 260 thousand enterprises and employing 2.2 million people. The manufacturing industry also contributed to 36.10% of national GDP[28]. In addition to the economic importance, this research focuses on manufacturing SMEs in Taiwan due to the following reasons:

- Manufacturing consumes 73.7% of energy in Taiwan
- Manufacturing SMEs are the backbone of the "Taiwan Miracle" in the 1980s[29], and is still the representative of Taiwan's economic activity
- Manufacturing SMEs are widely considered as less energy-efficient compared to larger enterprises due to lack of economy of scale[30]

	Number of SMEs to Total Number of Companies	Number of SMEs to Total Number of Manufacturing Companies	Manufacturing Industry's Contribution to National GDP	SMEs' Contributions to National GDP
Taiwan	**97.61%**[31]	**96.12%**[26]	**36.10%**	**28.72%**

Table 3. The SME environments in Taiwan in 2015. Asian Development Bank, Central Intelligence Agency, Ministry of Economic Affairs. Web

The research begins with identifying the types of revenue models available to the Taiwanese IEMS market and followed by an analysis of the strengths and weaknesses of the key features of these model through literature review and qualitative interview. To gain an in-depth understanding of the demand side of the IEMS industry, a market survey on the current market status and, possible key barriers and drivers to the adoption of IEMS is distributed among 50 decision makers of Taiwanese manufacturing companies to provide both quantitative and qualitative data. Decision makers include senior managers, executives or successor of Taiwanese manufacturing companies. To highlight the characteristics and needs of SMEs, the survey is distributed to both SMEs and non-SMEs to give the basis of comparisons between the response of all companies and that of the SMEs subgroup. To gain an in-depth understanding of the revenue models available, an interview is conducted with the sales director of BenQ ESCO, an IEMS company with multiple revenue models. Apart from the strengths and weaknesses of the individual company, the interview also covers the opportunities and threats of the IEMS market as a whole.

Once the key determinants for both supply and demand sides are identified, the research will then analyze the fit between these non-conventional revenue models with the needs of the Taiwan market. The result of the analysis is verified and adjusted by carrying out qualitative interviews with members from both supply and demand sides of the industry.

2.2. Market survey design

The market survey is based on Cagno and Trianni's list of drivers and barriers for energy efficiency among manufacturing SMEs in Lombardy, Italy.[32] The Italian market survey bears high similarity to Taiwan among the available literature as both economies rely heavily on manufacturing and SMEs.[33]

	Number of SMEs to Total Number of Companies	Number of SMEs to Total Number of Manufacturing Companies	Manufacturing Industry's Contribution to National GDP
Taiwan	**97.61%**[34]	**96.12%**[26]	**36.10%**[22]
Italy	99.9%	99.7%	23.9%

Table 4: Comparision of SME profile in Taiwan and Italy 2015. Small and Medium Enterprise Agency, Taiwan and European Commission. Web.

The survey first categorizes the audience into three consumer groups, which are the ones without any existing energy efficiency measures, the ones with in-house solution team and the ones with an external solution. Each subgroup will be provided with different questions regarding their experiences with IEMS. A printout of the online market survey using Google Form can be found the appendix.

For the subjects without existing efficiency measures, the survey will ask them to rank the importance of each barrier on a scale from 1 to 5, follow by ranking the list of incentives that may encourage them to adopt to of IEMS, and their interests in each of the three revenue models: 1)The Buyout model, 2)The Leasing model and 3)The Performance Energy Contract model. These models are explained in details in the following chapter. For those companies that have attempted to develop or purchase IEMS solution and given up will be presented with questions regarding the challenges they faced when adopting IEMS. The list of incentives as well as barriers are based on the list proposed by Cagno and Trianni in their research on Italian SMEs.[21]

Categories	Barriers
Information	Lack of information on cost and benefits
	Trustworthiness of the information source
	Information from providers was not clear
Technology	Technologies not available
Economic	Lack of funding
	The financial return is not attractive
	Disruptions to production
	Difficulty in quantifying performance
Behavioural	Energy efficiency is not a top priority
	Lack of interests from management
Organizational	Lack of workforce/time
	Complicated decision chain
Awareness	Lack of awareness of energy efficiency

Table 5. List of barriers adopted for empirical investigation. Rianni, Andrea, Enrico Cagno, and Stefano Farné, *Barriers, drivers and decision-making process for industrial energy efficiency: A broad study among manufacturing small and medium-sized enterprises,* Applied Energy 162 (2016): 1537-551. Web.

For the companies with internal IEMS solution, the questions will focus on the drivers behind the decision to develop IEMS internally, follow by questions regarding their satisfaction with the IEMS. Some companies may have tried to purchase external solutions prior to the internal development and will be asked a follow-up question about the reasons they switch to internal development instead. For businesses with existing external solution are given question similar in context to the one of the internal solution, the name and revenue model of the IEMS provider. Finally, companies that have attempted to develop in-house solution are asked to provide the reasoning for abandoning such project.

Categories	Drivers
Regulatory	Long-term energy strategy
	Green image of company
	Increasing energy prices
	Environmental regulations
	Clients demand energy efficiency improvement
Economic	Cost reduction from energy from lower energy use
	Information about real cost
	Support from management
	Government subsidies and financing
	Private financing
	Performance-based payment
Information	Awareness of energy efficiency
	Knowledge of non-energy benefits (CSR...etc)
	Availability of information of IEMS
	Competitor's involvement in IEMS
	Availability of vendors
Training	Programs of education and training
	Technical support

Table 6. List of barriers adopted for empirical investigation. Rianni, Andrea, Enrico Cagno, and Stefano Farné, *Barriers, drivers and decision-making process for industrial energy efficiency: A broad study among manufacturing small and medium-sized enterprises*, Applied Energy 162 (2016): 1537-551. Web.

In the case of unaligned or contradicting answers from respondents from the same company, the grading points will be averaged out while keeping all the qualitative answers to reflect the overall attitude towards the topic.

2.3. Interview Questions

Below is an outline of the questions asked during the interview with BenQ ESCO, a Taiwanese IEMS provider with multiple payment options. The versatility of BenQ ESCO makes it an ideal target to study all aspects of various revenue models. The interview with BenQ ESCO's sales director Eileen Huang was carried out on Jan 4th, 2017.

Categories	Details
Information on IEMS industry in Taiwan	IEMS History of General needs of the market Current and prospect market numbers Competitors Opportunities and threats Limitations and risks
Background of BenQ ESCO	Key numbers History and key people Company vision Approach: business model
Strengths and weaknesses	Top three key success factors of BenQ ESCO Three greatest weakness of BenQ ESCO
Moving forward	The key factors for BenQ to succeed in the future

Table 7. Interview Questions.

3. Results and Discussions

3.1. Analysis of IEMS Revenue Models

Three revenue models, the buyout model, the leasing model and energy performance contract (EPC) model were found during the literature review and verified during the interview with Eileen Huang of BenQ ESCO.

3.1.1. The Buyout Model

A buyout model is a straightforward two-way purchase contract between a client and an IEMS service provider. The buyout model is the most traditional and the most common type of revenue model in the IEMS industry. As the name suggests, the user pays for the design, installation and the equipment in full or in installments, while the IEMS provider provides hardware, software, and maintenance under limited warranty and may also operate the IEMS under a service contract. The following diagram demonstrates the payments required for an IEMS setup that is worth 1 million and expected to lower the utility bill by 35 thousand and require 1K service fee each month for three years.

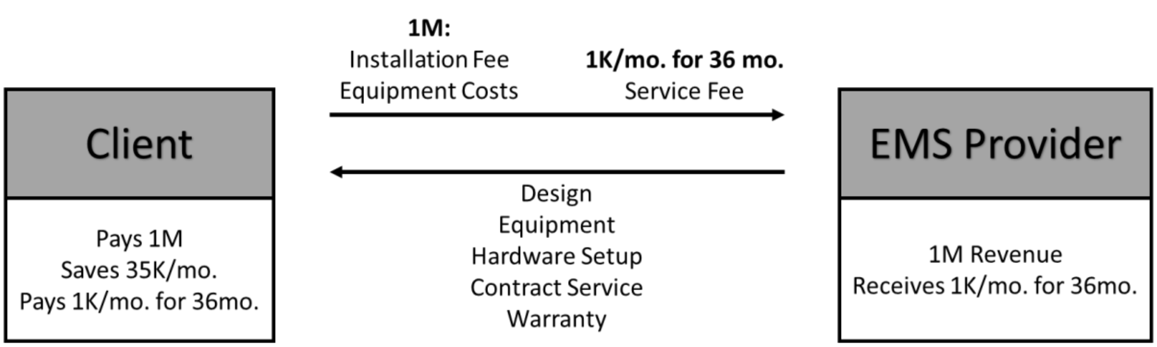

Figure 4: The Buyout Model**.** Processed by author according to interview with Eileen Huang[35]

This buyout model is straightforward and provides certain merits as well as demerits for both parties involved. From the standpoint of the provider, this model has the following merits:

(1) the lowest financial risk as the hardware equipment is either paid in full or recorded as debt.

(2) The service contract also provides the provider constant stream of cash flow during the term of the service contract.

(3) The user has high affinity to renew the service contract with the original provider even after the contract is over.

However, the simplicity of the model leads to low entry barrier as any contractor with access to energy consumption equipment can enter such market, which leads to vigorous price competition within the buy-out IEMS market.

From the perspective of the user, the buy-out model is ideal because it is

(1) straightforward, and is depreciable similar to other types of capital expenditure

(2) high availability and competitive pricing as plenty of providers available.

Apart from the availability of service, the buy-out model is also straightforward under the accounting principal as the ownership of equipment are transferred instantly and can be depreciated to fit the need of the user. However, there are also some fundamental flaws of the model that greatly hinders the growth of the IEMS market. The first being that the buyout model still requires heavy financial commitment from the user, making adoption of IEMS some of the lowest priorities for small and medium enterprises with financial constraints. Making matter worse is that similar to the fuel efficiency of vehicles, the effectiveness of energy saving is depended on the production behavior, weather, and other external factors, making the investments in IEMS a costly one without a guaranteed results. This uncertainty also encourages providers to overstate the effectiveness of their IEMS, creating distrusts between both sides. The result of such market of lemons is low willingness to invest from the vendor side unless energy efficiency is required or subsidized by government policies.

There exist two types of providers for the buy-out model: companies with and without a manufacturing background. Businesses that started by manufacturing equipment for energy management such as UPS, LED bulbs and such often choose to engage in the IEMS service market with their engineering and manufacturing expertise. These companies design, plan, install and sometimes operates the IEMS using their products. Companies such as Delta Electronics, Inc. and Foxlink started as a manufacturer of UPS and other energy management system hardware, Nan Ya Phototropic Inc. is expert in lighting solutions, and Siemens Building Technologies utilize their experiences with building and factory management accumulated through global development projects.

Other companies that have developed some expertise in energy management yet lack the manufacturing capability of those mentioned the in previous paragraph may choose to corporate with the equipment providers to contract IEMS projects. These companies buy equipment from different providers to build a system customized to the needs of the user then install and may operate the IEMS depending on the demand. Notable companies that function as contractors in the IEMS market include Chunghwa Telecom that leverage its telecommunication infrastructure for data collections and Formosa Plastics Group’s IEMS Department that has accumulated a vast amount of experience working within the group subsidiaries.

3.1.2. The Leasing Model

The first model that serves as an alternative to the buyout model is the leasing model. The industrial equipment leasing model has been around long before the energy management system became business sectors on its own. Companies that are unwilling to commit to the upfront cost often opt to pay for the usage instead of the ownership. One of the most commonly seen practices of the leasing model is when companies lease cars for business use instead of acquiring them.[34]

A leasing model for the IEMS is a three-way contract where a leasing company first buy the full ownership of equipment from the IEMS solution provider then lease the equipment to the user under long-term leasing contracts. The lessor acts similar to a credit card company where it collects rent over the term of the contract, which is usually between 3-5 years and may transfer the ownership of the equipment to the user when the contract expires. The IEMS provider then designs and install the system for the user and provide warranty or operate the system for the user. The lessor can have an active or passive role in business development, meaning the lessor may actively promote the IEMS directly to the user or co-work with IEMS provider as a financial option. The following diagram demonstrates the same setup that costs 1 million cost and 35 thousand monthly saving under a 24 months leasing contract.

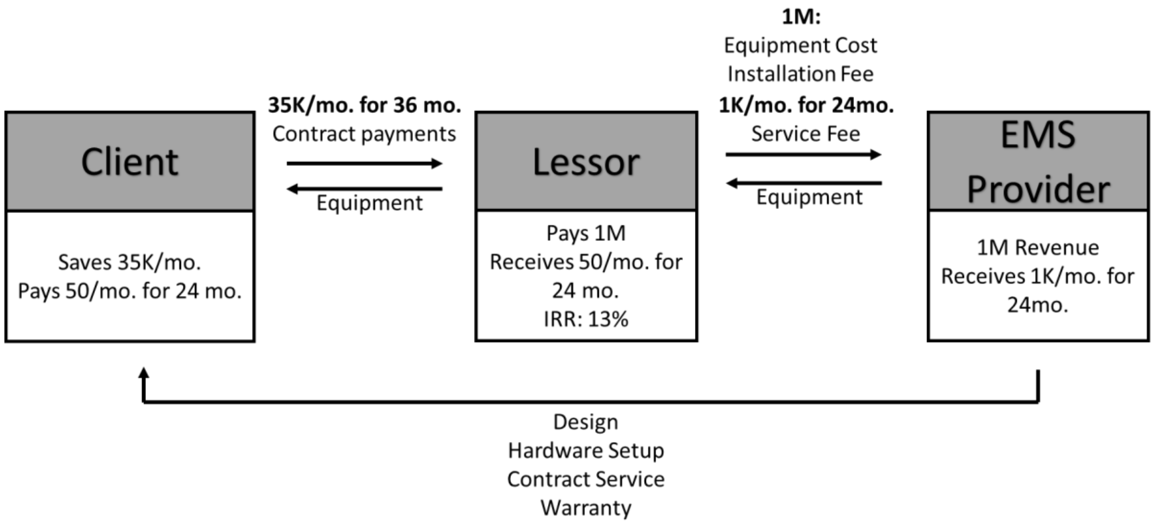

Figure 5: The Leasing Model. Processed by author according to interview with Eileen Huang [35]

From the perspective of the IEMS provider, involving a lessor can significantly increase the interests of customers while maintaining its financial interest, that is to receive 1M for the hardware. Since the leasing model makes no difference regarding the design, installation, operation and warranty aspects to the provider, many companies that employ buy-out models are partnering up with industrial leasing companies. From the perspective of the user, the leasing model provides a financial buffer for the greatest hindering factor of IEMS, the upfront investment. The user can redirect the saved utility expense into lease payment during the term of leasing contract and receive the equipment when the contract expires. Under the assumption that the saving outweighs the lease, the user can start saving from once the IEMS is operational. However, the leasing model does not solve the problem of inflated saving estimate as the lease payment is fixed while the saving remains difficult to measure and often fail to meet the estimate.

There exist many leasing companies that involve in the leasing of Property, Plant, and Equipment including IEMS equipment in Taiwan. However, most of them do not possess expertise in assessing the energy saving capability of IEMS provider. Chailease Finance is one of the most notable industrial leasing company that has a team specialized for energy management system.

3.1.3. Energy Performance Contracting (EPC) Model

The Energy Performance Contracting model, also known as a pay-by-saving model or nicknamed “no cure, no pay” model, is a relatively new and unexplored model designed to further popularize the IEMS by bundling the payment with the actual saving in utility fees. The model was developed to overcome the financial restrictions of the client, as it requires zero upfront cost by charging a fixed percentage of utility savings by the IEMS. Moreover, this model also improves the commitments of the service provider by aligning the interests of both parties to provide maximum energy saving effectiveness.

The provider of EPC is known as an energy service company (ESCO). ESCO is a corporation that is engaged in the development, installation and financing comprehensive, performance-based energy efficiency projects owned and operated by customers.[36] ESCOs are considered a crucial tool for promoting energy efficiency, as in 2012, ESCO-implemented projects in the United States delivered a total of 34TWh in energy reduction[37]. To put things into perspective, 34TWh is the annual output of Cattenom Nuclear Power Plant in France, the 8th largest nuclear power plant in the world by power capacity[38]. Still, the EPC model is still a new concept to the Taiwanese market, as no in-depth study on the Taiwanese EPC market could be found through online literature review.

Under the EPC model, the service provider (ESCO) also take up the role of the financial role by covering the initial investment of the system. The ESCO will first conduct a thorough energy audit of the facility to estimate the investments needed and saving potential to propose the profit sharing ratio. The two parties then sign a long-term, anywhere from a 3 to a 5-year service contract that specifies the sharing ratio of total saving that includes the initial investment, maintenance, and warranty cost, as well as gains for the provider. The following diagram demonstrates the same example used previously under a 60-month EPC contract with an 85/15 profit sharing ratio.

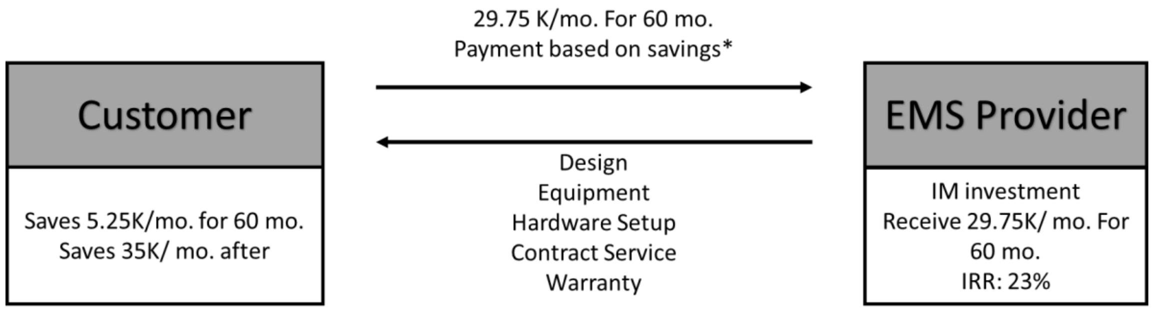

Figure 6: The Energy Performance Contract**.** Processed by author according to interview with Eileen Huang [35]

From the perspective of the user, this model provides a few obvious merits

(1) Zero down payment for user: Similar to the leasing model, there is no initial payment required as equipment cost is distributed in the contract payments;

(2) Aligned interests: This model also resolves the align the interests of the IEMS provider and user, as both sides will benefit from the greater amount of energy saving. This aligned interest encourages continuous optimization of the control system and responsiveness to equipment malfunction.

(3) Risk-free: Lastly and maybe most importantly, there is no risk from the perspective of the user as the worst-case scenario is status quo.

Even under the worst-case scenario, where the IEMS provides zero effect on energy savings, the user can still obtain the equipment after the contract terminates in 3 to 5 years.[35] The EPC model provides strong incentives for the user by providing financial insurance to the client.

However, the EPC model cannot work if the provider fails to convince the user with the amount of savings. The provider has to provide the monthly saving amount that is both measurable and credible to the user. Traditionally, the ESCO estimate the performance based on the data recorded at each cost centers at the end of the month and invoice accordingly. However, this scheme fails to objectively verify the extent of actual saving achieved due to lack of accurate dynamic baseline to provide real performance measurements.[39] Such gap can be filled with the implementation of Monitoring and Targeting (M&T) scheme, a tool that improves energy efficiency through detailed analysis of the metered energy and material use data at each cost centers.[40] The recent development of interconnectivity of the equipment and data analytics allow the ESCO to come up with credible and quantifiable performance measurements while continuously improving the performance by predicting and responding to the production environment.

3.1.4 Summary of Revenue Models

Following is a summary of the financial results of the same IEMS project under the three revenue models discussed in the previous chapters, assuming same initial investment, saving performance and independent of discount rate.

	Buyout	**Leasing**	**EPC**
Contract Term (Month)	$36.00	$24.00	$60.00
Initial Investment	$(1,000.00)	$-	$-
Monthly Savings	$35.00	$35.00	$35.00
Monthly Expense	$(1.00)	$(50.00)	$(29.75)
Net Monthly Savings	$34.00	$(15.00)	$5.25
Net Expense under Contract	$(1,036.00)	$(1,200.00)	$(1,785.00)

Table 8: Sample calculations of three revenue models. Processed by author according to interview with Eileen Huang

The underlined expenses are fixed regardless of the actual performance of the IEMS, while the cost under EPC contract is subject to the real saving performance of the month. The buyout model provides the most saving under perfect condition yet involves most initial investment and performance risk. The leasing model, on the other hand, requires no initial investment yet still carries performance risk. The energy performance model also requires zero initial investment while provides instant savings and transfers the performance risk to the supplier, therefore may ask for the highest net payment in the long run.

	Pros	**Cons**	**Technical Barrier**
Buy-out	Lowest net investment Availability of Venders	High initial cost Overstatement of performance	Low-Medium
Leasing	No initial cost	Overstatement of performance	Low-Medium
EPC	No initial cost Guaranteed savings Provider's commitment	High technical barrier Limited Providers Highest net payments	High

Table 9: Comparisons of the three revenue models. Processed by author according to interview with Eileen Huang

3.2. Analysis of Taiwanese IEMS Market

3.2.1. IEMS Adoption Rate

49 responses were collected from the 50 surveys distributed, 10 of the respondents fulfill the qualifications of Ministry of Economic Affairs of Taiwan as small-and-medium enterprises. The statistics of all 49 companies and that of the 10 SMEs are displayed separately in the following tables to highlight the SMEs unique needs and provide the basis for comparisons.

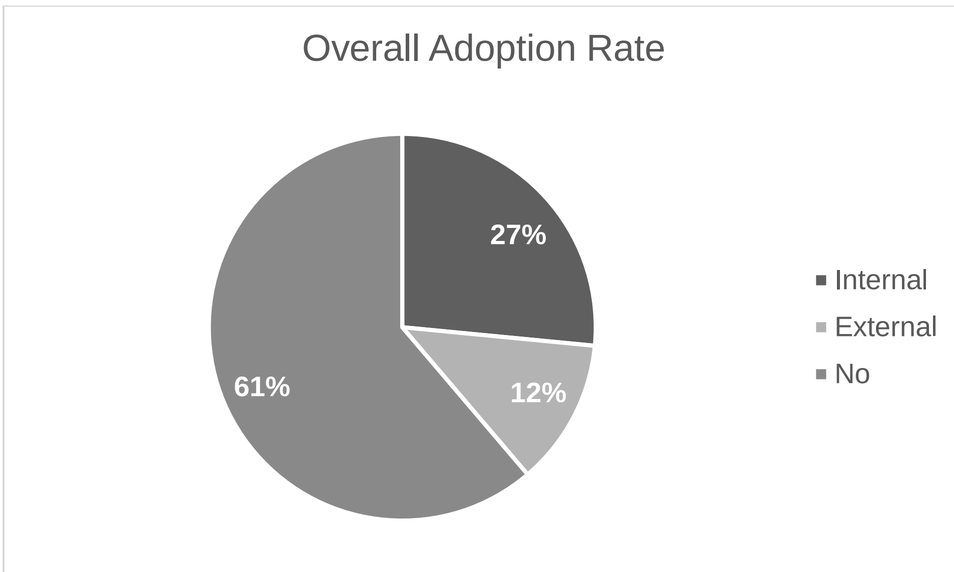

Figure 7. IEMS Adoption Rate.

19 out of 49 responses indicated that they are currently using IEMS or some other form of energy saving measure, which translates to an adoption rate of 39%. The high adoption rate may include both IEMS and non-systemized energy conservation equipment and cannot be differentiated due to the limited information provided by the market survey.

The collected data also suggests that bigger companies have higher tendency to adopt IEMS (67%). The huge saving potential can explain this phenomenon due to the saving potential from the vast amount of energy consumed and the availability of funding and human resource of large corporations. In addition to the economic reason, large corporations are more exposed to government supervision and corporate social responsibility, which are both important drivers for the adoption of IEMS and will be discussed in detail in the following section.

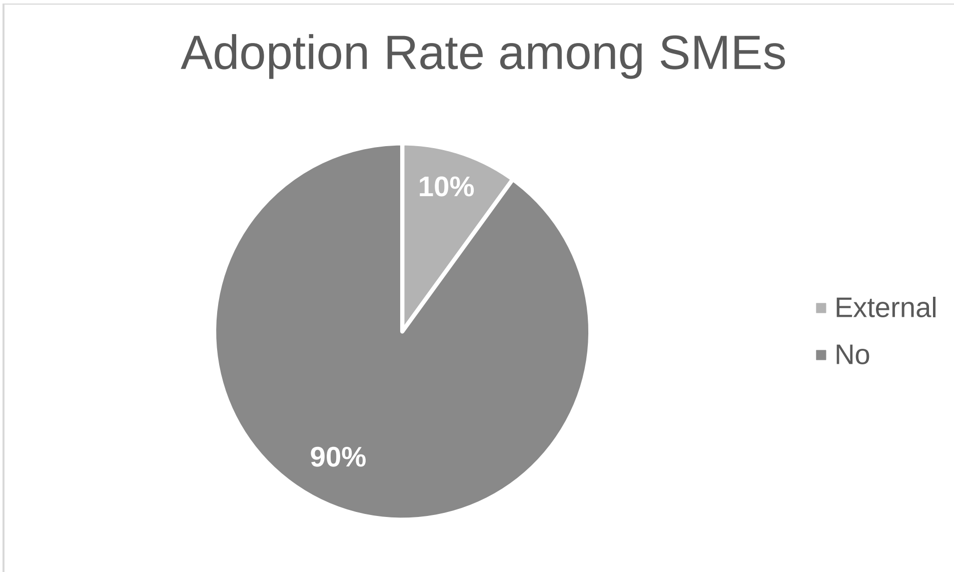

Figure 8. IEMS Adoption Rate of SMEs.

On the other hand, the adoption rate among SMEs is significantly lower than that of the larger companies and the 49 companies (10% versus 67% and 39%, respectively). This finding corresponds to the conclusion from literature reviews that the SMEs are less energy efficient and faces more constraints in implementing energy conservation measures due to economic limitation.

3.2.2. Companies without IEMS

Categories	Barriers	OverallAvg (30)	SME Avg (9)
Information	Lack of information on cost and benefits	3.46	3.22
	Trustworthiness of the information source	3.20	2.63
	Information from providers was not clear	3.08	2.67
	Technologies not available	3.23	2.89
	Average	**3.24**	**2.85**
Economic	Lack of funding	2.92	2.89
	The financial return is not attractive	3.12	3.33
	Disruptions to production	2.56	2.67
	Difficulty in quantifying performance	3.46	3.22
	Average	**3.02**	**3.03**
Behavioral	Energy efficiency is not a top priority	2.96	3.44
	Lack of interests from management	2.88	2.88
	Average	**2.92**	**3.16**
Organizational	Lack of manpower/time	2.92	2.89
	Complicated decision chain	2.62	2.56
	Average	**2.77**	**2.72**
Awareness	Lack of awareness of energy efficiency	2.81	3.11
	Average	**2.81**	**3.11**

Table 10. The importance of barriers to non-IEMS companies.

Table 10 shows the importance of each barrier from all responses and the SME subgroup, respectively. While the economic barriers such as difficulty in quantifying performance (3.46/5.00), are considered one of the most fundamental obstacles as the earlier literature suggests, the information barriers (3.24/5.00), especially the lack of information on cost and benefits (3.46/5.00), appear to be even more crucial to the respondents. The lack of thorough understanding of the topic of IEMS may have contributed to such outcome, as many participants that do not currently have IEMS left comments showing their interests in learning more about IEMS.

There are some interesting observations when narrowing down to the SME subgroup. While the behavioral barriers have the highest average score among all barrier types, there is a huge split between the two options (3.44 vs. 2.88). This can be translated to that even though SMEs have less bureaucratic obstacles and the top management are willing to engage in energy efficiency improvements, the attitude toward the topic is that it is not essential for the daily operation and should not be treated with high priority, this “If it ain't broke, don't fix it.” attitude correlates to the findings by Navigant Research.[16]

Incentives	Average Score (30)	SME Score (9)
Lower initial investments	3.73	3.67
Quantifiable performance	3.77	3.67
Minimum impact on production	3.46	3.33
Increase in utility rates	3.42	3.11
Environment regulations	3.38	3.22
Multiple financing options	2.88	2.78
Performance-based payments	3.27	3.44
Easy to manage, requires minimal maintenance	3.58	3.22

Table 11. The importance of incentives to non-IEMS companies.

Table 11 shows the importance of incentives that can encourage the adoption of IEMS. It is clear that lower initial investment (3.73 and 3.67) and quantifiable performance (3.77 and 3.67) are the two strongest stimuli regardless of company size. One interesting phenomenon is that although the possibility of disturbances to production scored low as a barrier (~2.6), being able to minimize impact to production and the ease of use scored comparatively high as incentives (~3.4-3.5). This paradox can be interpreted that although companies are willing to endure the necessary disruptions on production for the economic benefits that associate with IEMS, minimizing impact to production may play a vital role in which IEMS service to choose.

5 out of 30 companies that do not currently have IEMS or other energy saving measures had attempted to develop or purchase IEMS solution. Among the businesses that tried to develop IEMS internally, the two most dominant deal breakers are the lack of technology (60% of the responses) and the dependability of such system (60%). For those that tried to procure external

solution, the main barriers are the ability to quantify performance (40%), the high initial cost (40%), and the security concern (40%).

Revenue Model	Average Score (30)	SME Score (9)
Buy-out	2.35	2.22
Leasing	2.65	2.44
EPC	3.50	3.56

Table 12. Interests in each revenue model.

When giving the opportunity to choose from the three revenue models, the EPC revenue model is the most popular and the most frequently asked model by the respondents. Nevertheless, there appears to be a wide information gap that leads to low awareness, trust and overall understandings of the EPC model. Reducing such knowledge gap will be the top priority for ESCOs and government to promote IEMS adoption in Taiwan.

With all things considered, there exist the enormous potential for growth for IEMS among the SMEs in Taiwan. Nevertheless, educating the potential customers about the economic and other benefits, and the decreasing disturbance to the production must be done to overcome all the skepticisms and passiveness expressed by the SMEs.

3.2.3. Companies with In-house Solution

The in-house solution is the more popular option over external solution as 13 out of the 19 companies with IEMS have developed their IEMS solution internally. However, none of the SME in the study uses the internal solution as the in-house development of IMES is limited to larger companies with the resource and scale for such investment.

Categories	Drivers	Companies Avg (13)
Regulatory	Long-term energy strategy	4.08
	Green image of company	4.08
	Increasing energy prices	3.92
	Environmental regulations	4.00
	Clients demand energy efficiency improvement	3.46
	Average	**3.91**
Economic	Cost reduction from energy from lower energy use	3.62
	Information about real cost	3.92
	Support from management	3.62
	Government subsidies and financing	2.54
	Private financing	2.46
	Performance-based payment	3.46
	Average	**3.27**
Information	Awareness of energy efficiency	4.00
	Knowledge of non-energy benefits	3.54
	Availability of information of IEMS	3.69
	Competitor's involvement in IEMS	2.85
	Availability of vendors	3.85
	Average	**3.58**
Training	Programs of education and training	3.77
	Average	**3.77**

Table 13. The importance of drivers for companies with internal solution.

The regulatory drivers play a crucial role in the decision to develop in-house IEMS solutions in Table 13 as the decisions of larger companies are the tightly influenced by environmental policy and corporate social responsibility for their dominant presence. On the other hand, the average score for economic barriers was lowered by the low importance score of public and private financing options as the cost of IEMS development is only a fraction of the capital expenditure of larger establishments.

When being asked about the challenges faced during the development of IEMS, 69.2% of the respondents pointed at the dependability of the system, and 61.5% had difficulty in quantifying performance. This demonstrates the technical barriers and learning curve needed for the development of IEMS, which further explains why no SME in the study could develop in-house IEMS solution.

Description	Company Avg (13)
The IEMS provides significant savings	3.54
The IEMS is easy to operate	3.31
The IEMS was well received in the company	3.31
The IEMS has positive effect on the corporate image	3.77
The IEMS has minimal impact on production	3.42
The IEMS requires minimal repair and maintenance	3.31
In general, I am satisfied with the benefits of the IEMS	3.46
Average	**3.44**

Table 14. Satisfaction towards In-house IEMS.

Current in-house IEMS users hold a moderate positive attitude (with 3.00 being neutral) towards the overall performance of their energy management system. The positive effect on the corporate image (3.77) and financial return (3.54) are the two most highlighted benefits of IEMS. This corresponds to the public image, and the scale of operation are some of the most important drivers of developing IEMS.

Among the companies that currently use in-house solution, more than half (53%) attempted to purchase external solutions from providers but ultimately failed. The top three reasons being the high initial cost (57.1%), security concerns (57.1%) and measurability of performance (42.9%).

Overall, it may be said that internal development of IEMS is an expensive game that only large and energy-thirsty companies can afford to play. Not only because the large firms have the financial and human capital, and greater cost savings by IEMS, their decisions are often influenced by the government policies and corporate image due to their role in the society. The in-house solution is also the more desired option for larger businesses due to their concerns for trade secrets. As the primary focus of this study is the SMEs, to develop in-house IEMS solution is not a viable option for the interest of this study.

3.2.4. Companies with External Solution

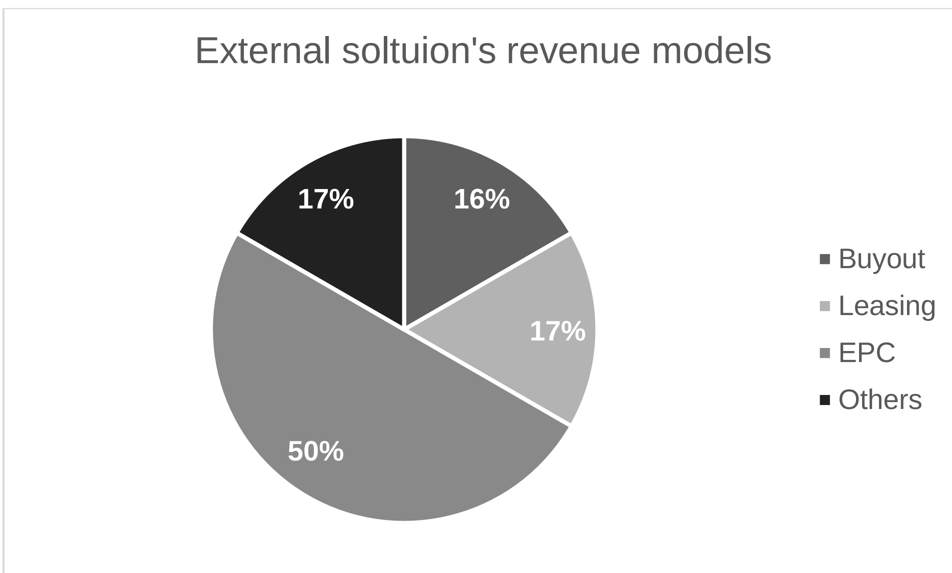

Figure 9. External solution's revenue model.

Six companies currently adopt IEMS from external providers, with three under EPC contract from BenQ, one buy-out from an anonymous source, one leases from Delta Electronics and one "other." The "other" being the IEMS by Gigastorage, a major photovoltaic system solution provider in Taiwan, includes the IEMS as a part of the solar energy package. This finding points out an important value-adding scheme by the IEMS solution provider, that is the ability to provide all-around energy solution apart from the IEMS solution itself. As 50% of the respondents indicated that the reason they choose their current IEMS solution is that the vendor provides additional services such as factory automation and solar energy solution. The ability to provide additional value and ease of operation can have a substantial impact on the final purchase decision and cannot be overlooked.

Consistent with the results from companies with in-house IEMS solution, the economic and regulatory drivers play a vital role in the decision-making process (see Table 15.). What stands out from the scoring is that the training drivers are even more valued by the respondents, which suggests that bridging the knowledge gap is vital to the success of an IEMS solution provider.

Categories	Drivers	Overall Avg (6)	SME (1)
Regulatory	Long-term energy strategy	4.17	4.00
	Green image of company	4.17	5.00
	Increasing energy prices	4.00	5.00
	Environmental regulations	4.17	5.00
	Clients demand energy efficiency improvement	3.00	3.00
	Average	**3.90**	**4.40**
Economic	Cost reduction from energy from lower energy use	4.00	5.00
	Information about real cost	4.00	5.00
	Support from management	4.17	5.00
	Government subsidies and financing	3.00	3.00
	Private financing	2.50	3.00
	Performance-based payment	3.17	3.00
	Average	**3.47**	**4.00**
Information	Awareness of energy efficiency	4.00	5.00
	Knowledge of non-energy benefits	3.17	3.00
	Availability of information of IEMS	3.83	4.00
	Competitor's involvement in IEMS	2.50	2.00
	Availability of vendors	3.50	4.00
	Average	**3.40**	**3.60**
Training	Programs of education and training	4.17	4.00
	Technical support	3.83	5.00
	Average	**4.00**	**4.50**

Table 15. The importance of drivers to companies with an external solution.

Description	Company Avg (6)	SME (1)
The IEMS provides significant savings	3.60	4.00
The IEMS is easy to operate	3.80	4.00
The IEMS was well received in the company	3.00	3.00
The IEMS has positive effect on the corporate image	3.80	5.00
The IEMS has minimal impact on original production	4.00	5.00
The IEMS requires minimal repair and maintenance	3.20	4.00
In general, I am satisfied with the benefits of the IEMS	3.00	3.00
Average	**3.49**	**4.00**

Table 16. Satisfaction towards external IEMS.

The respondents with external IEMS solution show the slightly more positive attitude towards their current solution as compare to the ones with internal solution. Likewise, clients have high regards toward the IEMS's positive effect on the corporate image, while the minimal impact on production and ease of operation also receive a high score. This can be interpreted as the expertise and performance of external solutions are well recognized by the clients.

However, the neutral attitude toward the question "The IEMS was well received in the company" and "In general, I am satisfied with the benefits of the IEMS" suggests that there are still doubts within the firm. Since every user has come from a non-user, these skepticisms are likely to be the same concerns as the current on-IEMS users that withdrew from their attempt, meaning the doubts in performance and security.

In closing, there is an overall positive attitude towards the performance of external IEMS solution as it provides significant savings, positive corporate image and brings few disruptions to the factory site. Combine this outcome with the concerns from the non-IEMS users in the previous section;

it can be concluded that the key to promote IEMS is to lower the information gap regarding the cost benefits, minimal disturbance of production and security threats.

3.3. Case Study: BenQ ESCO

Source: BenQ company profile and interview with Eileen Huang[35]

Figure 10: BenQ Logo. Digital image. Logopedia. Web. 16 Mar. 2017. [41]

BenQ ESCO began as an in-house energy management team of the BenQ Corporation and was established as a subsidiary in 2013. BenQ Corporation is well-known globally for its consumer electronics, LCD panels, and solar system. BenQ is one of the first company in Taiwan to put great emphasis on minimizing its impact on the environment well before the concept of corporate social responsibility gained its awareness in Taiwan. BenQ Corporation holds a total of 4 LEED-certified office and manufacturing buildings and its AUO TFT/LCD Fab L8B is the world's first LEED Platinum-certified TFT-LCD plant and currently holds the title of the largest LEED plant in the world.[42] With over 16 years of experience in automation and energy management accumulated throughout countless internal improvement projects, BenQ group decided to commercialize the team's expertise in 2013.

Even though BenQ ESCO also works on buy-out and leasing projects, it is the sole IEMS provider of the EPC revenue model in Taiwan. BenQ ESCO can provide EPC because of its ability to provide measurable and unbiased saving statistics for its customer through its real-time cloud database and the transparency of those data. To provide such data, BenQ ESCO installs ammeters with internet connectivity to every circuit loop to provide real-time energy consumption data, providing a breakdown of their monthly utility bill down to the respective production unit. This connectivity combined with data analytics, allows the master control to react to its surrounding environment to operate at maximum efficiency. To verify the neutrality of its saving amount, BenQ ESCO conducts monthly calibration of energy management effectiveness for 24-hrs by bypassing the IEMS and run in the pre-optimized mode. BenQ ESCO conducts the calibration on a fixed date of every month to avoid human interference and weather abnormality. By providing and benchmarking these energy management data, BenQ ESCO was able to provide measurable and credible effectiveness to build a reputation among current and potential customers.

	Heating and A/C	HVAC	Lighting
Percentage of energy savings by BenQ ESCO	30%	10%	60%
Industry average percentage of savings	14.07%	14.07%	39.5%
Amount energy savings (kWh/yr)	13 Million	1.5 Million	6 Million

Table 17: BenQ ESCO's performance compared the industry average. **B**enQ ESCO company profile and "Energy Savings by Energy Management Systems: A Review."

Apart from being the sole IEMS provider with the EPC model, the technical ability and credibility of BenQ ESCO provide a few decisive competitive advantages over its competitors in Taiwan.

1. **<u>The Maintenance and Operation Commitment:</u>** Companies using buy-out or leasing models typically take a passive role once the system is up and running, only carry routine system maintenance or repair under warranty. BenQ ESCO, on the other hand, takes an active role in continuous system optimization as BenQ ESCO shares the aligned interest of maximizing energy efficiency and savings with is customers.

2. **Cloud Management System:** Bearing the heritage of continuous operation optimization, BenQ ESCO had incorporated sensibility and connectivity into their energy management system since operating as a project team in BenQ Corporation, long before the concepts of the Internet of Things and Industry 4.0 surfaced in recent years. With years of head start, BenQ ESCO holds more control data needed for optimization than its competitors who had just incorporated data monitoring and connectivity into their management systems.
3. **Top-down Sales Approach:** In contrast to other improvement projects, which are typically initiated by production engineers and pass up to top management and financial department, BenQ ESCO takes a top-down approach by delivering an easily comprehensible message, "Let's fight against the utility bill, start saving instantly at no cost!" combine with BenQ brand, BenQ ESCO is capable of drawing interests from top executives. This approach allows BenQ ESCO to initiate projects from the toughest obstacles within the corporate decision-making process which also have little understanding of factory logistics and utility engineering.

With these strengths mentioned above, BenQ ESCO tripled its total contract value during 2016 fiscal year. Many of the new projects came from referral between top executives among the high-tech community and service sectors. However, BenQ ESCO's success is not without challenges ranging from government policy to business culture in Taiwan.

1. **Low Electricity Rate in Taiwan:** Lower electricity rate decrease the business owners' willingness to invest in energy management as well as prolongs the payback period of the EPC model. In the attempt to keep inflation at a moderate rate, the state-monopoly Taiwan Power

Company provides the 8th cheapest industrial electricity in the world, at $0.086 per kWh due to government subsidy.[9]

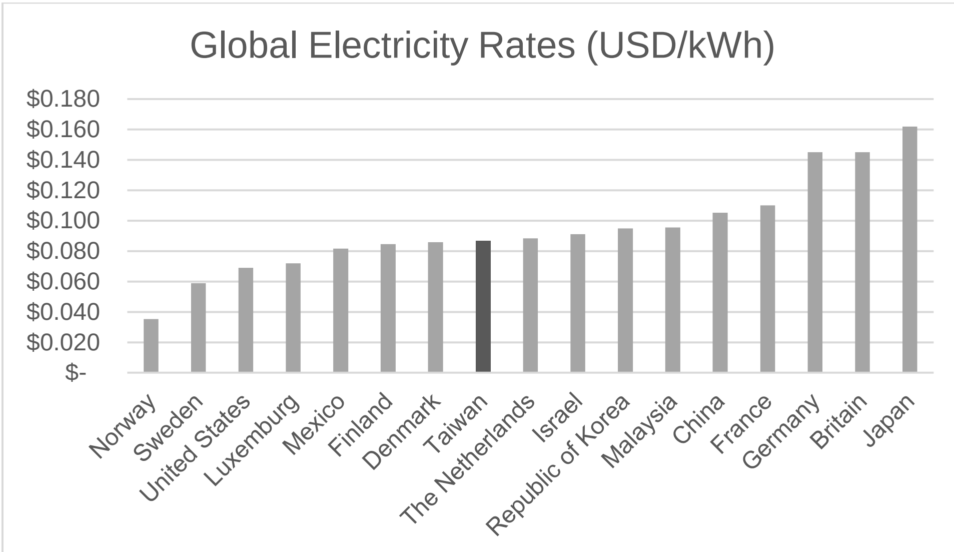

Figure 11. Global electricity rates. Key World Energy Statistics, *Rep. International Energy Agency*, (International Energy Agency). Web. 17 Nov. 2016.

The extraordinarily low electricity rate in Taiwan results in longer payback period compared to neighboring countries such as China or Japan, extending the EPC contract term. A longer contract term increases the financial uncertainty from clients' operation, government policy, and the global economy as it is dependent upon the utilization rate of the customer and electricity rates.

2. **Financial and Accounting Constraints:** The rate of operational expansion for BenQ ESCO is restricted as the EPC model requires heavy initial investment to generate long-term future revenue. This uncertain future cash flow is not recognized as account receivables nor debt on balance sheet, making BenQ ESCO seemingly unprofitable on paper and prohibiting BenQ ESCO to rely on debt financing. Therefore, BenQ ESCO is dependent on capital injection from the parent company and continuous faith from BenQ Corporation board members.

3. **Customer's Commitments:** The business of ESCOs is based on careful selection of the clients and upon mutual trust due to the risks involved. BenQ ESCO faces challenges as the respect for intellectual property and commitment is still not fully developed in Taiwan. BenQ ESCO has a few unpleasant experiences with companies trying to copy their design to pass onto private contractors to save on cost after BenQ ESCO carried out the energy audit at their site. However, the greatest challenge comes from the lack of respect for commitments from clients. The guaranteed saving of the EPC means BenQ bears the risk of a decrease in production as lower production leads to less overall energy consumption thus savings. Customers that failed to keep the committed utilization rate often blame the market conditions and request to extend the service contract instead. The client company may even decide to relocate its operation before contract termination, resulting in dispute. Even though many of the situations may be addressed in the contract terms, it is not uncommon for businesses to try to negotiate their way out of a signed agreement when the cost of legal action outweighs the compensation for the ESCOs around the world.[39]

In summary, BenQ ESCO is a company that leverages their experience as an in-house IEMS team of BenQ corporate to utilize the EPC revenue model, allowing them to overcome the economic barrier and to initiate interests from top management. Their rapid expansion proves this despite being a young player in the IEMS market. Nevertheless, BenQ ESCO must overcome obstacles including the low electricity rate, financial constraints and customer's commitment to making a greater difference in the IEMS market.

4. Conclusion

The Industrial Energy Management system is a tested-and-proved method to minimize energy inefficiencies at the biggest source of energy consumption, the industrial facilities. Minimizing energy inefficiencies provides a variety of benefits to the company whether economically, regulatory or CSR. The IEMS can cut down on energy waste by means of production management, production scheduling, HVAC control, VFC of motors and lighting optimization, and the performance can be further amplified by combining them systematically. However, even with all the benefits that of the IEMS, the public's impression of high initial investments, dubious performance and possible disturbance to the production greatly discourages the adoption of IEMS.

To address the financial burden, which is the most fundamental obstacle of adopting IEMS, the buyout model, the leasing model and the EPC model were studied. The client does not pay for the cost of the IEMS but instead pay a fraction of the energy savings to cover the initial investment, the operations and the profits of the provider. The EPC is an ideal revenue option because it aligns the interests of both the vendor and client to maximize the energy savings. To provide creditable performance measurements, the ESCO must provide real-time consumption data through the connectivity of the equipment and conduct routine calibrations to ensure the accuracy of the measurements.

The focus of this study is on the Taiwanese IEMS market for SME as it is currently well-underserved, with only 1 out of 10 SMEs in the survey engaging in energy management due to financial priorities and information gap. The market survey also shows that there exists a keen interest in the EPC model when given the information, suggesting that bridging the knowledge gap through marketing, and government communication may be the key to convert these SMEs into clients. The response from current IEMS users also suggests that in-house development of IEMS is a rich man's game due to financial resource and security concern, and is not feasible for SMEs. External solutions, such as ones utilizing EPC model, on the other hand, are perceived with a positive attitude by current clients. The pressing concerns for performance and disturbance to the production of non-IEMS users are well-received (~3.8/5.0) by the current users. What the market needs is more happy users and success stories from the pioneers to start the momentum, and the EPC model can be a powerful catalyst to accelerate such trend.

The interview with BenQ ESCO provides a more in-depth understanding to the real-life executions of the EPC model. The EPC model undeniably provides strong incentives to companies that were hesitant in the performance and necessity of IEMS with its zero-down and risk-free investment. BenQ ESCO's operation commitment, cloud management capability and top-down sales approach allowed it to expand rapidly as a newcomer to the market. However, challenges such as low electricity price, accounting constraints and customer's commitments do cripple BenQ ESCO from achieving its full market potential. Nevertheless, the EPC model is without question, a powerful driver for IEMS among the SMEs in Taiwan.

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Appendix:

Market Survey on Industrial Energy Management Systems in Taiwan