

Industrial Engineering and Service Science 2015, IESS 2015

Challenges in implementing renewable energy supply chain in service economy era

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Abstract

Climate change with the rise of greenhouse gas emissions due to the massive use of fossil-fuels could negatively affect the quality of natural environment over the globe. With this, renewable energy should be promoted as the alternative source of energy among the electronic and electrical (E&E) firms in order to reduce the dependency on fossil-fuels and move towards to energy efficiency. In Malaysia, government has committed to optimising use of green technology which is capable of assisting the E&E industry to produce products with less impact to the environment and socio-economy improvement to the society. The E&E firms have limited resources to manage renewable energy (RE) internally that currently gained suppliers supports to assist the implementation of green technology and energy management. Thus, this study aims to explore the challenges of renewable energy management implementation and how the firms managed low carbon issue in the supply chain. The outcome of this paper is expected to be the basis for the concept development of renewable energy supply chain.

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Peer review under responsibility of the organizing committee of the Industrial Engineering and Service Science 2015 (IESS 2015)

Keywords: Green supply chain, energy efficiency, greenhouse, gas emissions, Malaysia

1. Introduction

The awareness and concern among citizens of any country have brought forward the focus to understand the increasing significance of the service industries' output that contributes to a country's economy. Johnston's study has revealed that the focus placed on the 1955 service sector contributes around 50 percent of the UK's gross domestic product and overtakes the product-based sector [1]. Additionally, Kotler [2] has expressed the intention

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placed upon the occupational aspect, in which service jobs in the United States have accounted for 79 percent of all jobs and 74 percent of gross domestic products in 2003 [2]. The United States Bureau of Labour Statistics reports that the service-producing sector will continue to be the dominant employment generator in the economy, adding about 14.6 million jobs through 2018, or 96 percent of the expected increase in total employment [3].

In particular, the service industry is a pivotal area, where it exchanges the rapid global changes with the attention placed upon the service sector as well as the issue of efficiency of service industries being addressed. In addition, the service sector is predicted to be among major drivers of the future growth [4]. These manufacturing firms are not only expected to create products meeting customers' needs for high quality and lower price but also provide environmental solutions for consumers and society. Manufacturing firms focus on customers, offering better packages of products, services, support, self-service, knowledge or combination of them to add value to core product offerings [5]. One frequent solution is providing an extra service to add value to the products offered. Services are economic activities not resulting in the ownership of a tangible asset [6], and servitization means that the manufacturing firms offer added value beyond past traditional business patterns. In the service economy, the E&E firms should provide the solution to the end users. One of the issues related was the sustainability solution. Most of energy usage to manufacture products came from fossil-fuels. The E&E sector is considered one of immense energy consumption. In Malaysia, E&E sector is included as the second largest consumer of energy. It is account for 40.5 percent of the total final commercial energy demand in 2005. Industrial sector will continue to grow to become the major energy consumers of the total energy demand in the future [7].

The expected growth rate of energy consumption is at 5.4 percent per annum which largely contributed by industrialization especially in manufacturing and transportation sectors. In other words, Malaysia's total energy demand is expected to grow from 33.9 Mtoe in 2003 to 83.5 Mtoe (971 TWH) in 2020 [8]. The government encourages E&E sector to lower operation cost by utilizing renewable energy like hydro, biomass, biogas and solar as clean alternatives to produce energy instead from fossil fuels. RE can assist the company to lower cost of operations but needs huge of investment on technology. According to YB Dato' Sri Peter Chin Fah Kui who is Minister of Energy, Green Technology And Water (KeTTHA) during his speech at the Electrical And Electronics Association of Malaysia (TEEAM) in 2010, the development of RE in Malaysia has been rather slow due to the many constraints and barriers faced by the industry. Among them is the high cost of energy generation from RE sources as compared to fossil based electricity. Coupled with relatively low electricity tariff, it is currently very difficult for RE projects to become economically viable. The introduction of the Feed-in Tariff mechanism is to spur the utilization of indigenous renewable energy resources to contribute towards enhanced electricity supply security and sustainable socio-economic development [9].

RE is getting crucial to replace non-renewable fossil-fuels and natural gas. A clear understanding on RE concept and the internal and external challenges that contribute to RESC implementation are needed to advance the field. This will be a new area for the researchers to further investigate the drivers and the opportunities associated with RESC by not only focusing on the policies implementation. It is important to understand the RE in supply chain concept in order for everyone in the chain work toward a same target which is to achieve sustainable business performance in term of economic, social and environment. Meanwhile, this study shall also raise academic's awareness about the global warming issue and the need change to alternative energy supply source from dependence on fossil-fuels. Despite many various ways have been done to meet the government expectations, challenges remains to understand what the constraints faced by the E&E sector in the RE implementation. The authors have interviewed seven persons in charge from four firms in regard to RE implementation.

2. Literature review

The theme of sustainability for a low carbon economy is increasingly crucial nowadays where the economic growth based largely on industrialization and population growth has created an expanding demand for energy. This makes the renewable energy (RE) that represent as economically and environmentally become a new growth area for many countries across the globe. According to [8], the rise of greenhouse gas emissions is one of the key reasons for

Malaysia to turn towards the RE solution. In 2011, the government introduces Feed-in-Tariff (FiT) which has encouraged the usage of RE in the country. This mechanism allows electricity produced from indigenous renewable energy resources to be sold to power utilities at a fixed premium price for a specific duration [9]. The government launching programmes to head Malaysian economy towards greener technology. It is undisputed where the EE industry's future will be shaped [10].

Government, research institutions and the investors are moving fast to exploit the available potential of renewable energy worldwide because the world energy crisis is escalating year after year with the exhaustion of fossils fuel [11]. Recent years, there are a lot of RE policies, investment and industries been introduced [12] and included in the Malaysia Plan in order to reduce or stop the rising temperature and the rise of greenhouse gas emissions such as carbon dioxide into the earth's atmosphere. One of the bodies is The Sustainable Energy Development Authority of Malaysia (SEDA) which is the statutory body formed under the Sustainable Energy Development Authority Act 2011 [Act 726] to promote and implement the national policy objectives for RE, and all matters relating to sustainable energy [13].

2.1. Renewable energy supply chain (RESC)

Bazmi and Zahedi [14] has found that there is a lot of literature available regarding the issues, problems and progress in the power sector where most of the study are more focus on the policies and level of greenhouse gas emissions. Anyway, improvement of the policies alone is insufficient to make RE become commonly use as the alternative source to fossil fuels. One of the strategies that the government could adopt is effective renewable energy supply chain (RESC) because it is important to analyze the industry in an integrated perspective [15], as a network of renewable energy supply chain (RESCs) where everyone in the chain could collaborate and move toward the targeted goals together by exploiting the internal and external business drivers. According to [16], the elements of RESC are similar to many typical supply chains which include the physical, information, and financial flows. From physical flow perspectives, industries increasing awareness of green manufacturing processes, logistics, and products has become relevant to its supply chain management (SCM) performance. Hence, by having an efficient RESC, this indeed will make Malaysia become more energy independent and move towards sustainable business performance.

3. Method

This paper uses the interview as a qualitative method of the source of data collection and data interpretation. To achieve the objectives of this study, E&E manufacturing firms have been identified from the Federation of Malaysian Manufacturers directory. A filter question was asked regarding their RE implementation, and four firms were identified that met the desired criteria and agreed to participate. These four E&E manufacturers were requested to answer the interview questions in advance, given an estimate of the time needed to answer those questions, and a cover letter from sponsoring educational institution. All firms were located in Northern Region of Malaysia. The authors agreed to keep the identity of the respondents and their companies anonymous; otherwise the firms would not be involved in this study. Due to the complexity of the topic to the industry, the four firms allow us to interview seven of key respondents. It means one firm was allowed to send more than one manager. Thus, the firms were then named as firm Alpha, Beta, Gamma and Delta. The profile of the firms can be described in Table 1.

Table 1. Profile of the firms

Firm	Nature of business	Interviewees
Alpha	The programmable logic solutions, enabling system & semiconductor firms. The Malaysia site is houses of largest offshore R&D technical with 1,200 employees.	Facilities Manager Purchasing Manager
Beta	Developer of integrated digital technology platforms. Malaysia site is including assembly and test sites and a design and development center. Malaysia site has over than 9,000 employees.	Environment, health and safety manager Senior Engineer
Gamma	A local electronics contract manufacturer with 2 decades experience in the industry. The firm's line of business includes the manufacturing of communications and related equipment.	Purchasing Manager

Delta	Original equipment manufacturer (OEM) firm provides mechanical engineering and electrical design. The Company offers printed circuit board assemblies, plastic molding, metal stamping, machining, enclosures, and tooling.	Facilities Manager Purchasing and Supplier Chain Staff
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4. Results

The interview results with corporate leaders in their understanding of RE were recorded. The authors analyzed and interpreted the interviews based on the transcript of the recorded interviews. The transcript, then converted to the qualitative software. We are using the professional mind mapping tool for windows. The interview scripts have divided into two main subthemes. The first one, the theme related to internal challenges. The details of the themes are discussed in following section.

4.1. Internal challenges

The first internal challenge relates to the logical cost benefit scenario.

1. RE is not profitable.
Most of interviewees' agreed that the RE is not profitable in the short term. Despite the RE has involved high investment, the interviewees have mentioned the current lack of incentive provided and unclear RE policies.
2. Not Long Term Business
Other than that, the managers also view the RE is not very long period kind of business efforts. The industry only will fully apply if there is a few success firms generate positive outcomes. The current policy does not provide the effectiveness of RE implementation.
3. Investment cost
It is not far from profit and cost, again the interviewees mentioned on the huge investment costs that consist of maintenance cost, hidden costs, high financial risks and unable to maximize profit with the costs involved makes E&E firms are reluctant to install the device RE in the firm's operations .
4. Lack of Knowledge
Despite the interviews have agreed that solar energy technology as the most appropriate RE equipment, knowledge among the employees is barrier makes E&E firms reluctant to invest in it. Some of changeless comes from no technical team who has sufficient knowledge on RE. The firms should find a new people to work for RE and existing engineers who have knowledge do not share with others. This is because the absence of a culture of knowledge sharing and medium to share.
5. Lack of infrastructure
Large initial investments to build infrastructure has a relationship with the cost and profit analysis that we have mentioned in the earlier discussion. Current scenario, the E&E firms have no sufficient green infrastructure to support renewable electricity. The firms need to specifically find the regulatory acceptable sites with good resources and with access to transmission lines. The RE issue of installation and lack of infrastructure will be a threat if the supply disruption occurs.
6. Lack of technology
The E&E firms are aware the important of RE technology for business sustainability and updating the energy engineers with latest renewable technology. Yet, the RE devices are not as the plug and play systems where the engineers also need to consider the employees and society wellbeing. The technology of green gas emission should also view as the prevention action, not cure. The successful implementation of RE installation should be measurable.

7. Top management support

The institutional barriers has own internal challenge, the succession of RE installation in the firms because of institutional supports. As most of the firms involves during interview, the bureaucracy became main barrier. The firms which operating in Malaysia needs to get the headquarter office endorsement to make decision on RE implementation. Besides that, the interviewees need rely on the government regulation and supports, the government should give more opportunity to universities to develop affordable RE devices and responsible for talents supply. The industry association, should organize more conferences or roundtable to discuss the cost and profit analysis, this will enhance the E&E understanding on the concept.

4.2. External challenges

The interview transcript has been grouped into several subthemes.

1. Government policy

The interview transcript has been grouped into several subthemes. The government is playing an important role to encourage industry to implement RE movement. The E&E are aware that the FiTs policy benefited industry and they suggested that the government should do more R&D activities and assist the industry to facilitate the RE investment. The E&E firms have suggested the government to charge more on the taxation on fossil fuels with condition. The condition is that the government already provides all necessary infrastructure and loan facilities. A government policy is agreeable as the main challenge of external factors.

2. Supplier involvement

The strength of the firm nowadays lays on suppliers supports. The stiff competition makes the suppliers competing to offer better solution to the industry. Currently to get the reliable RE suppliers are not that easy in Malaysia, they are employed the suppliers from China and most of suppliers' not available when technical issue happens. This is because the distance between China and Malaysia. The China suppliers seemed reluctant to share knowledge and develop firms' engineers. The leveraging solely on the suppliers expertise is not recommended in the long term.

3. Social acceptance

The interviewees have agreed that there is lack of social pressure from consumers and non-government organizations (NGOs) to force firms to install the RE devices. This is good for the shareholder as they do not need to spend for investment. There is no different in the public eyes firm which implementing RE technology and do not implement it. The interviewees have mentioned that the investor also consider the firms green compliance before decide to invest. This is to avoid the risk for penalty of incompliance green activities.

Fig. 1 shows a complete model of internal and external challenges of RE implementation. Each challenge has assigned the specific number based on the urgency.

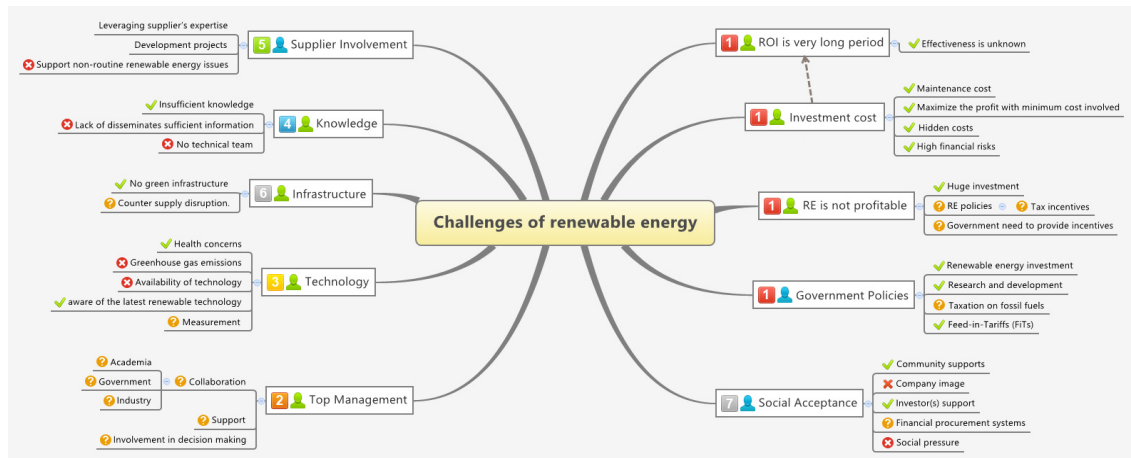


Fig. 1. A complete model of internal and external challenges

5. Discussions

Business practitioner especially in electric and electronic firms, renewable energy and green technology industry could benefit from the discussion of RE implementation in this study. The government, top management supports and suppliers have suggested as the cornerstones of RE implementation. The electricity generated from RE implementation should be done by involvement of many parties. The intuitional and regulatory barriers have to be included in developing future RESC. The industry who concern on RE expertise will be stay longer in the future as many firms looking the reliable suppliers if the government enforce the RE implementation. This study has identified that the internal drivers (i.e. top management, technology, infrastructure, knowledge) and external drivers (i.e. government policies, supplier involvement and public awareness) that contribute as challenges of RE implementation. The know how is needed to manage RESC effectively and efficiently in order to achieve sustainable business performance. Furthermore, government and policy maker may make use of this finding to develop a proper strategic plan to make the national RE goal become reality. [17] states that renewable energy should be practiced because unsustainable energy source such as fossil fuels is not going to last long and will cause serious environmental problems to the earth. Non-renewable fossil fuels are going to diminish gradually due to the high consumption and thus will lead to the increase in price over the years. Therefore, there is a need to switch from a fossil-fuels based energy such as coal, oil and natural gas as the primary source of energy to renewable energy in order to achieve sustainability. In addition, renewable energy is one of the promising alternatives that will cut down over-dependent on fossil fuels with their attendant unstable prices and occasional supply interruptions [18]. Based on projections by experts, RE sector could provide at least RM70bil worth of business revenue to the private sector, and could potentially generate tax revenue of at least RM1.7bil for the Government by 2020. Another economic benefit arising from the RE sector is job creation. Experts have estimated that at least 52,000 jobs could be created from the construction, operation and maintenance of RE plants by 2020 [19].

6. Conclusions

Conclusion could be drawn that RE is getting important nowadays while renewable energy supply chain (RESC) could play a significant role towards the sustainable business performance by exploring the internal drivers (i.e. top management, technology, infrastructure, knowledge) and external drivers (i.e. government policies, supplier involvement and public awareness). A reliable energy supply is very important to sustain human being's living conditions as it is one of the essential inputs for economic development and industrialization [20]. Malaysia's RE target thus should be more ambitious because the country is blessed with natural resources. This would be beneficial to the country in the long term as the country will have a better control on fuel imports and less impact on the scarce resources' price changes by producing and consuming more RE. Future studies can consider all mentioned factors to

be tested as the drivers of RE implementation.

Acknowledgements

The authors convey their appreciation to the Division of Research & Innovation, Universiti Sains Malaysia for funding the research (short-term grant no: 304/PPAMC/6313108).

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