

Challenges of Biomass Energy Implementation in Malaysia

Nur Hafizah Mohd Fadzil, Goh Kai Chen and Goh Hui Hwang
Department of Construction Management, Faculty of Technology Management and Business,
University of Tun Hussein Onn Malaysia, 86400 Batu Pahat, Johor Malaysia

Abstract: Biomass can be defined as any organic material derived from living organisms and it is one of the most used source of renewable energy. The objective of this study is to identify the challenges arising in implementing biomass energy in Malaysia. Challenges of implementing biomass energy have been classified into six categories, technical, financial, social, environmental, policy/regulatory and institutional/organizational issues. Intensive literature review approach is used to identify the challenges. Malaysia has abundant of biomass resources, these make the biomass most promising option, compare to others various sources of renewable energy at Malaysia. The research is expected to be able to come out with a list of biomass energy challenges in Malaysia.

Key words: Energy, biomass energy, challenges, identity, policy

INTRODUCTION

Biomass is considered a sustainable energy source and can be renewed with the highest potential to contribute to the energy needs of modern society and to replace conventional fuels available that are subject to deficiency as they are consumed (Meher *et al.*, 2006). Interests towards biomass are growing in recent years as an alternative raw material for the production of energy, chemicals and other biobased products. Especially the use of biomass for the production of biofuels and bioenergy in the form of electricity and heat has triggered the development of new markets. Countries in Southeast Asia are fast becoming an attractive market for producing sources to develop biomass energy.

Research on biomass energy has been conducted constantly and research results have been published in many academic journals. Much research work has been focusing on the discussion of types and status of biomass energy in many countries. However, little literature has been focused on challenges of biomass energy implementation, particularly in Malaysia.

This study summarizes existing research in the area of biomass energy. Specifically, this study indicates that previous research efforts have dealt with the issues regarding biomass energy implementation in their respective countries. Meanwhile, the study reveals that relatively less attention has been paid to the issues of biomass energy implementation in Malaysia. That is the importance of this study to determine the main issues of

biomass energy implementation in most of the countries that can be related to the biomass industry in Malaysia.

Literature review: Biomass fuels consist of both woody and non-woody biomass. Woody come from trees and shrubs, meanwhile, the non-woody from crop residues and other vegetation (Sulaiman *et al.*, 2011). Both can be converted into charcoal. Wood and residues from coconut, rubber and oil palm trees are important biomass fuels in Malaysian economies. Same goes to sawdust, biogases and husks and straw from rice plants. They are used in both traditional and modern applications (Sulaiman *et al.*, 2011). Figure 1 shows sources available for biomass energy in Malaysia.

Recently, continuous efforts and researches focus on biomass as an alternative for power generation. At the same time, numerous agricultural and forest residues are turning out to be useful energy and applicable products. Figure 2 shows the scope of biomass initiatives as renewable energy.

From a previous research, an irregular biomass supply, unattractive electricity tariffs and high capital expenditures are ranked as the top barriers that limited developers participation in the industry (Umar *et al.*, 2014). These results correlate with the weaknesses identified in the former policy systems, SREP (Small Renewable Energy Power) which are unattractive connection price to the grid, irregular biomass supply, low efficiency of combustion technology, poor supporting systems, institutional fragmentation, obstacles to

Corresponding Author: Nur Hafizah Mohd Fadzil, Department of Construction Management,
Faculty of Technology Management and Business, University of Tun Hussein Onn Malaysia,
86400 Batu Pahat, Malaysia

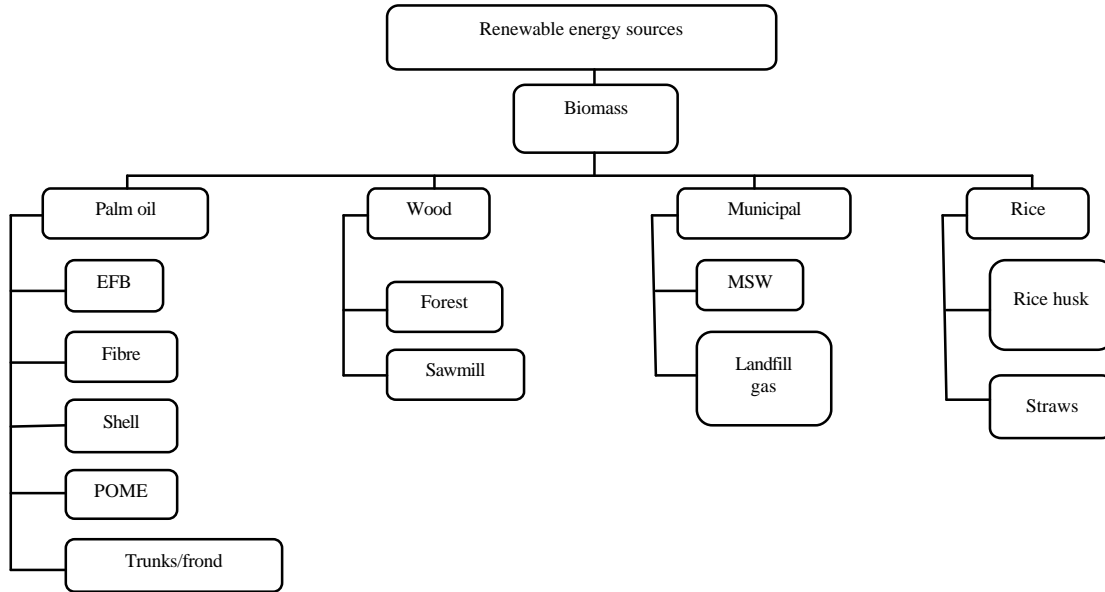


Fig. 1: Malaysia biomass energy source

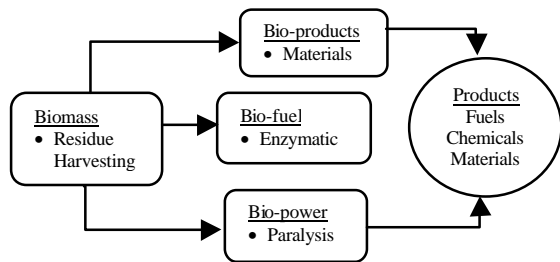


Fig. 2: Biomass initiatives as renewable energy (Sumathi *et al.*, 2008)

obtaining funding from financial institutions and other utilities' non-compliant procedures amongst the reasons that discouraged new entries, subsequently contributing to the overall national renewable capacity shortage (Umar *et al.*, 2013, 2014).

MATERIALS AND METHODS

The methodology of the study will answer the research questions with the acquired data. Before the study was conducted, the researcher needs to understand its own study with a good topic. After understanding the topics to be studied, the method to be used in conducting the study will be determined and hence the process of analyzing research data will be made. This conceptual study is merely based on a review and analysis of research and data from the literature. Several methods were used to collect and analyze literature.

Table 1: Different terms searched in databases

Terms	ASCE library	Emerald	IEEE Xplore	Science direct
Biomass energy	1,272	623	1,293	177,472
Biomass energy in malaysia	419	372	116	45,066
Challenges of biomass energy	21	45	42	7,443

Step one is gathering information from secondary data which obtained through the study of literature. This method of secondary data is carried out with reference to the written referral sources such as journals and books that serve as the main reference for this study. First, research was conducted using the Google search engine. Terms such as 'biomass energy' and 'challenges of biomass energy' were used and a limited amount of information was found.

Second, research on 4 databases related to multidisciplinary areas such as engineering, materials science and management were examined. The databases were ASCE (American Society of Civil Engineers) Library, emerald management XTRA, IEEE xplore digital library and ScienceDirect. When 'challenges of biomass energy' was searched in the ASCE Library database, 21 journals/study were found. Of the 21 found, only a few were deemed to be relevant to this conceptual study. The study were retrieved and reviewed. Other terms were searched and sorted in the same manner. The terms searched on each database are listed in Table 1 along with the amount of study that came up.

Third, books on the topic for this conceptual study were searched using the University of Tun Hussein Onn Malaysia catalogue. The same terms used in the database search was used to find books related to the topic. Three

books were deemed useful and were borrowed from the library for further reading. A dissertation database which is ProQuest Dissertation and Theses database was explored too in order to gain insight on how to prepare a scholarly study.

RESULTS AND DISCUSSION

Intensive review of existing studies throughout the world are able to answer the research question, the challenges of biomass energy implementation in Malaysia. Malaysia is a leader as one of the foremost agricultural countries in the world (Mekhilef *et al.*, 2011). However, certain issues and challenges have been identified from the existing literature regarding biomass. They have been classified into six categories, technical, financial, social, environmental, policy and institutional/organizational issues. United Kingdom, Thailand, Nepal and Oman are chosen in this study because the main issues of biomass energy implementation in the selected countries can be related to the biomass industry in Malaysia.

Technical issues: In the United Kingdom, there exists a shortage of biomass supply for power plants. The current feedstock management systems are not able to meet the requirements of large scale biomass energy developments, because they are only designed for small to medium scale handling and logistics requirements (Hoogwijk *et al.*, 2003). Because of this limitation of feedstocks, large-scale biomass energy plants could not survive in the industry. Therefore, it is time for stakeholders to carefully planning on how to supply feedstocks equally to all-scale biomass energy plants for their survival in the industry.

Meanwhile in Thailand, technical barriers were resulted from the lack of standards on biomass energy systems and equipment, especially where the energy sources are so diverse (Prasertsan *et al.*, 2006). Because of lack of standards on biomass energy systems and equipment, it is hard for developers to produce power and commercialize its technologies without any performance insurance. Thus, it is vital for the government agency in particular, The Energy Ministry to come out with a clear policy or standard on biomass energy.

Besides that in Nepal there is not much coverage of energy technologies in most of the engineering and technical courses currently taught at universities and colleges in the country. Then, there is a lack on technical knowledge for rural communities to operate and maintain established renewable technologies (Surendra *et al.*, 2011). Thus, it is a concern for the country's stakeholders to provide knowledge on biomass energy to its people so that they can use the energy sources available in their country wisely.

Also, in Oman, there is an inadequate investment in technical research and development for renewable energy. There is no investment in any renewable energy allocated in the budget by the end of 2011 (AlHatmi and Tan, 2013). Renewable energy is a technique and fund intensive industry, thus it is important to provide a training program for all levels of operation and support employee, so that more research and development of this renewable energy can be conducted.

Financial issues: The next important barrier is the lack of accessible and favorable financial, institutional and legal issues' financing schemes has to be resolved to make the best use of available technologies (Sulaiman *et al.*, 2011). It is difficult to obtain financing for biomass-based power generation projects in Malaysia due to less support policies and information. It is worst by the fact that financial institutions in the country are not familiar with the financing of such business ventures (Sulaiman *et al.*, 2011).

Meanwhile, in the United Kingdom, the biomass energy production capital intensity is known as the main obstacle of meeting energy demand of the biomass resources utilization (Rentizelas *et al.*, 2009). Thus, causing the operational costs of biomass energy production to decline because these costs is linked with biomass supply chain which comprised of harvesting, collection, storage and transportation costs (Diamantopoulou *et al.*, 2011). The uncertainty of biomass source availability and the scale of delivery causing difficulties in estimating the costs. Therefore, many researchers have come out with a programming model to help in estimating for strategic and operational costs (Mafakheri and Nasiri, 2014).

In Thailand most bioenergy projects are still new and small and therefore their transaction costs are high. Bioenergy project developers face more difficulty in getting finance because the financiers find the projects as highly risky (Prasertsan and Sajjakulnukit, 2006). This will make it hard for the developers to get a loan from a financial institution and may cause the developers to give up on their efforts in the bioenergy industry. Thus, the effort to implement this type of renewable energy will be depleted.

Besides that in Nepal, the government does not have enough financial resources for investing in renewable energy projects and biogas is equally expensive for rural communities (Surendra *et al.*, 2011). Without support from other organizations, rural people and government cannot afford the cost of this project. This is because the financial institutions are not motivated and have less knowledge about the bioenergy industry, making them concern about the risks of the business. Thus, financial

institutions should be convinced by stakeholders about the benefits of implementing biomass energy to the country so that implementation of this biomass energy can be continued.

Like Nepal, the same issue occurred in Oman where there is no financing system for renewable energy projects in the country (AlHatmi and Tan, 2013). The bioenergy industry in Oman face difficulties to continue their project because they need to start everything by themselves, starting with the necessary equipments, working capital, initial overheads and also experienced management.

Social issues: Another issue in the United Kingdom is the lack of a participation in decision making of many biomass energy projects that led to conflicts with society. This is due to the fact that the social benefits were not seen locally and the negative impacts of biomass supply chains and power plants on the local environments were poorly understood (Upreti, 2004). Besides, a recent study concludes that on average, there are more occupational injuries and illnesses related to the entire supply chain of biomass boilers compared to conventional ones (Saidur *et al.*, 2011). If this continues, it will lead to shortage of skilled workers for harvesting and collecting biomass. Employers should know that it may not be easy to find workers who are willing to do the difficult and repetitive work in the biomass energy sector.

Whereby, in Thailand, there is a lack of awareness and confidence in technologies for biomass energy among the Thai people. Besides, the energy supply restructuring policy has not received a strong support from the public because they still doubtful about its result (Prasertsan and Sajjakulnukit, 2006). Thus, there is a need for the government to come out with a better policy for public to be able to understand and accept it.

Nepal also faces the same issues as Thailand where there is a lack of awareness among rural communities (Surendra *et al.*, 2011). They are unaware of the benefits of bioenergy on health, economy and the environment. So, the stakeholders should conduct more programs relating to bioenergy in the rural areas to give more knowledge about it to the communities.

Environmental issues: In the United Kingdom, there are many environmental challenges associated with biomass supply chains which are loss of biodiversity, loss of natural habitats and wildlife and soil degradation (Rentizelas *et al.*, 2009; Diamantopoulou *et al.*, 2011).

These effects occur mainly due to the activities of transportation and space requirements. In addition, obtaining raw materials from sources that are not sustainable is another major challenge (Meher *et al.*, 2006; Mafakheri and Nasiri, 2014).

The use of biomass produce relatively high levels of particulate emissions coming from open fires or from poorly designed biomass energy plants (Sims, 2002). This emission can lead to health problems to the workers and even to the public which happen to live near the plant.

Policy/regulatory issues: Another significant barrier are regulatory challenges often occur include the lack of market effectiveness, such as green pricing to promote the biomass industry (Sims, 2002). In the United Kingdom, biomass energy is difficult to enter the market because of continued subsidies for fossil fuel energy, including incentives for its further exploration, the continued government R and D investment and the fact that no value is used for associated externalities. Furthermore, policy measures and regulations that are available to support the production of biomass energy affected the capital and operational performance of the biomass supply chain. These support mechanisms which are policy measures and regulations are varied from indirect incentives or direct payments to renewable energy producers and to the ones assigned to promote biomass energy production (Mafakheri and Nasiri, 2014). Thus, many countries has been practicing fossil fuel tax as an indirect way of supporting renewable energy (Berry and Jaccard, 2001). Unfortunately, this tax only for the transportation sector and not to support biomass to electricity projects. This issue can lead to a burden to the bioenergy production industry as it may cause an increasing cost on transportation and lowering the commercialization of the products.

In Thailand, policy to support renewable energy is seems to be bias in favor of large scale and low power generating cost and will limit the renewable resources exploited under this scheme (Prasertsan and Sajjakulnukit, 2006). Therefore, Thailand should come out with different policies for different type of energy sources and scales of power generation, especially policy for smaller scale or higher cost of biomass sources that have potential.

Meanwhile, in Nepal, renewable energy does not received attention in policy debates. The government seem to be more interested in providing subsidy to import fossil fuels rather than investing in renewable energy (Surendra *et al.*, 2011). The government should not only provide subsidy for fossil fuels. They should balance out

Table 2: Summary of the challenges and issues associated with biomass energy

Challenges	Country	Description
Technical	United Kingdom	Shortage of biomass supply for power plants (Hoogwijk <i>et al.</i> , 2003)
	Thailand	Lack of standards on biomass energy systems and equipment (Prasertsan and Sajjakulnukit, 2006)
	Nepal	Less coverage of energy technologies in most of engineering and technical courses taught at universities (Surendra <i>et al.</i> , 2011)
Financial	Oman	Inadequate investment in technical research and development in renewable energy (AlHatmi and Tan, 2013)
	Malaysia	Lack of accessible and favorable financial, institutional and legal issues' financing schemes (Sulaiman <i>et al.</i> , 2011)
	United Kingdom	Biomass energy production capital intensity does not meet the energy demand of the biomass resource utilization (Rentizelas <i>et al.</i> , 2009)
	Thailand	Most bioenergy projects transaction costs are high because still new and small (Prasertsan and Sajjakulnukit, 2006)
	Nepal	The government does not have enough financial resources for investing in renewable energy projects (Surendra <i>et al.</i> , 2011)
Social	Oman	No financing system for renewable energy projects in the country (AlHatmi and Tan, 2013)
	United Kingdom	Lack of a participation in decision making of many biomass energy projects that led to conflicts with societ (Upreti, 2004)
	Thailand	Lack of awareness and confidence in technologies for biomass energy among the Thai peopl (Prasertsan and Sajjakulnukit, 2006)
	Nepal	Lack of awareness among rural communities (Surendra <i>et al.</i> , 2011)
Environmental	United Kingdom	Loss of biodiversity, loss of natural habitats and wildlife and soil degradation (Rentizelas <i>et al.</i> , 2009; Diamantopoulou <i>et al.</i> , 2011)

between fossil fuels and renewable energy, because in long term renewable energy will give profit to the country by saving cost for importing fossil fuels.

Different with Nepal, the government of Oman has developed policies in renewable energy in 2008 but it is still unable to compete with fossil energy (AlHatmi and Tan, 2013). Thus, the government should support renewable energy more than fossil fuels in order to promote renewable energy. They should conduct a program or forum that might be able to gather more experienced and ability workers to provide better initiative to promote renewable energy in the country.

Institutional/organizational issues: In the United Kingdom, differences in the organizational and cultural norms also are a major barrier among parties involved in the biomass supply chain (McCormick and Kaberger, 2007). Seasonal supply of biomass, variation in the types of biomass materials and energy market dynamics requires that the organizations involved in biomass supply chains to wisely look at the uncertainties and response to change accordingly. However, change management practices in biomass supply chains are still in early stage (McCormick and Kaberger, 2007; Sims, 2002). Therefore, it is a need for the organization to use models which capable in helping organizational readiness toward change and uncertainties in biomass supply chain decisions to ensure the operational efficiency and contingency.

Meanwhile, in Thailand, there exist several energy agencies with different roles, functions and responsibility that work under several ministries resulting in poor coordination among government agencies and with the private sector. Since October 2008, the situation does not improve and the fund was not active since then

Prasertsan and Sajjakulnukit, 2006). Therefore, the government of Thailand should restructure their bodies for effective coordination in the future so that, renewable energy program will be a success.

In Nepal, the institutional barrier for the country is the single governmental agency for promoting the renewable energy is only focusing on dissemination of proven technologies through subsidy (Surendra *et al.*, 2011). The government should not only focus on dissemination of proven technologies but they should also show responsibility towards research and development of the renewable energy to make it compatible with the socioeconomic conditions of the country. A summary of the challenges and issues associated with biomass energy is shown in Table 2.

CONCLUSION

Efficient use of renewable energy resources has a significant impact on the natural flows of energy in the environment. Efficient use of resources makes the energy refillable. Malaysia is an agricultural country and it generates a significant amount of agro-industrial waste that is a potential energy resource. To date, the development of renewable energy has already been started in Malaysia. Malaysia has abundant of biomass resources, these make the biomass most promising option, compare to others various sources of renewable energy at Malaysia.

The research in the future is expected to be able to come out with a list of biomass energy challenges in Malaysia for helping stakeholders to find solutions to solve it, so that this type of renewable energy can be used optimally for future generations. Since, future research will rely on an interview, strategies for data analysis would be

to separate the surveys from those who in the government sector and from those who in the private sector. This is because of the possibilities of their difference in perceptions towards the challenges of biomass energy. From the responses, conclusions will be made about the challenges of biomass energy in Malaysia.

ACKNOWLEDGEMENTS

Researcher express gratefully acknowledgment to the Ministry of Higher Education Malaysia and Universiti Tun Hussein Onn Malaysia (UTHM) for the valuable contributions towards the success of this research. This research is fully funded by Ministry of Education (Malaysia) and Universiti Tun Hussein Onn Malaysia (UTHM) under Vot: 1445, Research Acculturation Collaborative Effort (RACE) and Vot: E043, Exploratory Research Grant Scheme (ERGS) Phase 1/2013.

REFERENCES

- AlHatmi, Y. and C.S. Tan, 2013. Issues and challenges with renewable energy in Oman. *Int. J. Res. Eng. Technol.*, 2: 212-219.
- Berry, T. and M. Jaccard, 2001. The renewable portfolio standard: Design considerations and an implementation survey. *Energy Policy*, 29: 263-277.
- Diamantopoulou, L.K., L.S. Karaoglou and E.G. Koukios, 2011. Biomass cost index: Mapping biomass-to-biohydrogen feedstock costs by a new approach. *Bioresour. Technol.*, 102: 2641-2650.
- Hoogwijk, M., A. Faaij, R.D.V. Broek, G. Berndes and D. Gielen *et al.*, 2003. Exploration of the ranges of the global potential of biomass for energy. *Biomass Bioenergy*, 25: 119-133.
- Mafakheri, F. and F. Nasiri, 2014. Modeling of biomass-to-energy supply chain operations: Applications challenges and research directions. *Energy Policy*, 67: 116-126.
- McCormick, K. and T. Kaberger, 2007. Key barriers for bioenergy in Europe: Economic conditions know-how and institutional capacity and supply chain co-ordination. *Biomass Bioenergy*, 31: 443-452.
- Meher, L.C., D.V. Sagar and S.N. Naik, 2006. Technical aspects of biodiesel production by transesterification-a review. *Renewable Sustainable Energy Rev.*, 10: 248-268.
- Mekhilef, S., R. Saidur, A. Safari and W.E.S.B. Mustaffa, 2011. Biomass energy in Malaysia: Current state and prospects. *Renewable Sustainable Energy Rev.*, 15: 3360-3370.
- Prasertsan, S. and B. Sajjakulnukit, 2006. Biomass and biogas energy in Thailand: Potential opportunity and barriers. *Renewable Energy*, 31: 599-610.
- Rentizelas, A.A., I.P. Tatsiopoulos and A. Tolis, 2009. An optimization model for multi-biomass tri-generation energy supply. *Biomass and Bioenergy*, 33: 223-233.
- Saidur, R., E.A. Abdelaziz, A. Demirbas, M.S. Hossain and S. Mekhilef, 2011. A review on biomass as a fuel for boilers. *Renewable Sustainable Energy Rev.*, 15: 2262-2289.
- Sims, R.E., 2002. *The Brilliance of Bioenergy in Business and in Practice*. Science Publishers, New York, USA., ISBN: 1-902916-28-X, Pages: 300.
- Sulaiman, O.O., A.H. Saharuddin and W.W.B. Nik, 2011. Potential of waste based biomass cogeneration for Malaysia energy sector. *Arabian J. Bus. Manage. Rev.*, 1: 77-101.
- Sumathi, S., S.P. Chai and A.R. Mohamed, 2008. Utilization of oil palm as a source of renewable energy in Malaysia. *Renewable Sustainable Energy Rev.*, 9: 2404-2421.
- Surendra, K.C., S.K. Khanal, P. Shrestha and B. Lamsal, 2011. Current status of renewable energy in Nepal: Opportunities and challenges. *Renewable Sustainable Energy Rev.*, 15: 4107-4117.
- Umar, M.S., P. Jennings and T. Urmees, 2013. Strengthening the palm oil biomass Renewable Energy industry in Malaysia. *Renewable Energy*, 60: 107-115.
- Umar, M.S., P. Jennings and T. Urmees, 2014. Sustainable electricity generation from oil palm biomass wastes in Malaysia: An industry survey. *Energy*, 67: 496-505.
- Upreti, B.R., 2004. Conflict over biomass energy development in the United Kingdom: Some observations and lessons from England and Wales. *Energy Policy*, 32: 785-800.