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Strengthening the palm oil biomass Renewable Energy industry in Malaysia

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ABSTRACT

The palm oil industry contributes 85.5% of the total biomass production in Malaysia, hence offering great potential for large-scale power generation. Despite being a tool that was designed to steer renewable energy development, the Small Renewable Energy Power (SREP) scheme has failed to stimulate the growth of the industry. To assist the industry, a new Feed-in Tariff (FiT) regime was introduced in 2011 with an ambitious 2080 MW national renewable energy target by the year 2020. Palm oil biomass is projected to contribute 800 MW of grid-connected capacity towards this target, a huge step up from the 40 MW capacity reached during the SREP period. This study investigates whether the current downstream value chain mechanism under the new policy system is capable of supporting such a high capacity goal. The main objective of this study therefore is to evaluate the sustainability of components that constitute the value chain, including the availability of palm oil biomass supply, bio-energy conversion technology and the costs and alternatives to grid extension. In order to understand the industry problems, this study uses a mixed methodology approach involving a combination of market survey and regulators' interviews. The aggregated results from these techniques were later discussed by focus group experts representing both industry and government stakeholders before arriving at a final consensus. Potential future strategies deriving from this research include options to explore the potential use of less sought after large fibre and palm frond. Centralising a technology hub facility offers an alternative approach to encourage conversion to a low carbon technology at the existing mills. Smart-partnership collaboration for building a large-scale biomass plant is worth consideration as it lowers the business risks and enhances economies of scale. Finally, off-grid solutions involving decentralized generation would help to avoid further grid infrastructure investment.

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1. Introduction

The palm oil industry is one of Malaysia's major agricultural enterprises. There is considerable controversy about its environmental impacts and a major effort is underway to make it more sustainable. One approach to this objective is to minimize the waste from this industry by converting it into useful products, such as renewable energy.

In Malaysia, biomass disposal from this industry is a major sustainable energy resource. According to the Malaysia Palm Oil Board, the annual production of palm oil biomass residue in Malaysia stands at an average of 53 million tonnes with a 5% annual growth projection [1]. In 2010, the palm oil biomass solid wastes accounted for 80 million tonnes of dry biomass and it is projected to rise to a significant 100 million dry tonnes by the year 2020 [2]. The present palm oil biomass volume growth makes the crop attractive and an ideal candidate for large-scale power production [3]. Nonetheless, the country requires a bold, affirmative and consistent policy direction to capitalise the competitive advantage of the palm oil industry towards strengthening its commitment in reducing the future carbon footprint [4].

The sustainable energy industry in Malaysia began in 2001, notably to integrate economic growth and environmental benefits. The Fifth-Fuel Diversification Policy 2001 is embedded in the Eighth Malaysia Plan (2001–2005) policy document aiming at promoting the sustainable energy market development. In response to this initiative, the Small Renewable Energy Power programme (SREP) has been created to catalyse the growth of the renewable energy industry. Nevertheless, after a decade on stream the scheme failed either to expand the industry or to achieve its original five-year national 500 MW capacity target or 5% share of the total energy mix. It has been scaled down to 350 MW in the Ninth Malaysia Plan (2006–2010), due to the low participation from the market communities. The SREP debacle is discussed in the

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Sovacool and Drupady [5] work, which extensively discusses the reasons for its poor performance. The common factors contributing to the shortcomings are non-feasible energy business due to irregular supply of fuel, low grid-connected pay rate, and distance from the national grid. Other popular comments by the market communities include the lopsided and biased power purchase agreement, low efficiency of the boiler and Combined and Heat Power (CHP) technology that is designed mainly for oil palm production rather than for power generation and the infamous 'willing buyer willing seller' model that is favoured to the utility.

The previous predicament reminds the government not to replicate the same mistake if it intends to increase the renewable share of the country's energy mix, particularly in exploiting the abundance of palm oil solid wastes. The Feed-in Tariff (FiT) system sets an ambitious national renewable energy target of 2080 MW by the year 2020 and 21,370 MW by 2050. This in turn would translate to an estimated cumulative total of 45.7 and 629.2 million tonnes of CO_2 eq emissions avoided by 2020 and 2050 respectively. The palm oil solid wastes are projected to contribute a significant 800 MW of grid-connected capacity share by the same year and 1,340 MW in 2030 [6]. These capacities correspond to a cumulative total of 17.6 million tonnes CO_2 eq and 29.5 million tonnes CO_2 eq emissions removal by considering that bio-energy generation displaces the electricity generation from conventional fuels. On the other hand, methane gas (biogas) produced from the palm oil liquid waste is projected to generate 240 MW in year 2020 and 410 MW in 2028, which would translate to 1.2 tonnes CO_2 eq and 258.3 tonnes CO_2 eq annual avoidance in the respective year.

It is a relatively large step up from the 40 MW of grid-connected capacity during the SREP period. Thus, this study investigates whether the current downstream processing system is capable of supporting such a high capacity goal. The outcome of this study would reflect the market readiness for sustainable growth of the industry.

In that context, this study endeavours to examine whether adequate pre-emptive measures have been considered in the present FiT instrument in order to avoid the recurrence of past defects that could hinder the further development of the Renewable Energy (RE) biomass industry. More importantly, the authors have undertaken this study, realizing that this is a relatively new policy area with very little literature or published academic research that investigates the strengths and weaknesses of the new FiT law. Three main variables have been selected for this evaluation, include resource availability, technological innovation, and network extension to the main grid. All of these determinants are primarily associated with the palm oil facilities' compound.

2. Methodology

The evaluation of the present system was achieved by combining quantitative and qualitative case study techniques. As a means of attaining insights and knowledge about the investigated parameters within the market communities, the author disseminated questionnaire surveys to 417 palm oil millers all over the country. The survey document which contained 72 questions under 6 different headings had been pilot tested and modified according to comments from a small group of biomass producers before final delivery to members of the industry. The survey questions covered key issues on sustainability of resource supply, biomass technology, grid-extension scheme, market barriers, awareness campaign and future prospects. Overall, this survey received 85 returned questionnaires or a 20.4% response rate, consisting of 51 electronically returned surveys and 34 postal mode surveys. In-depth interviews were conducted with the stakeholders to understand the market behaviour involving 4 major Ministries that have direct or indirect control of the industry. To ensure consistency, producer survey's outputs were used as a basis to design the interview questions. The sample was purposively selected comprise of articulate participants to ensure effective result [7]. To conclude, a focus group meeting consisting of the government and market experts was set up to deliberate on the early findings before arriving at a final consensus. An extensive reference to secondary data materials such as periodic academic publications and other public documents and reports was made throughout the study to understand the latest information about the industry.

The integration of multiple methods helps to eliminate any data bias from early techniques [8,9]. The deployment of various approaches, on the other hand, would triangulate the investigated data and enhance results of one method by using the strengths of others [10,11]. The numerical and narrative data of the study have been analysed by using two main tools, a computer-based Statistical Package for the Social Sciences (SPSS) version 17 software and a computer-aided NVivo Version 8. Fig. 1 illustrates the flowchart of the data gathering process undertaken for the study.

3. The industry landscape

It is essential to describe the overall market structure and renewable energy policy system that governs the industry, so that one can understand the potential and foreseeable obstacles facing the industry. Subsequently, a comprehensive examination of the sustainability of downstream components would help to identify factors that could impede the rapid growth of this non-hydrocarbon based energy industry.

After several decades of being the world's major palm oil producer and exporter, Malaysia maintains its global leading position in palm oil plantation with a total of 6 million hectares in 2008. Even though, Malaysia is now the second largest palm oil producer, it remains competitive by capitalising large quantities of processing residues which can be used for a commercial scale bio-energy industry. In terms of volume, biomass from the palm oil sector accounts for 85.5% of the total biomass share in the country, vastly outpacing other available biomass sources such as wood (3.7%), rice husks (0.7%) and sugarcane (0.5%) [12].

Despite the current abundance of resources, it is vital to include the palm oil contribution towards sustaining environmental protection and food security. Without a long-term plantation expansion plan, the industry will have to depend on replanting of low

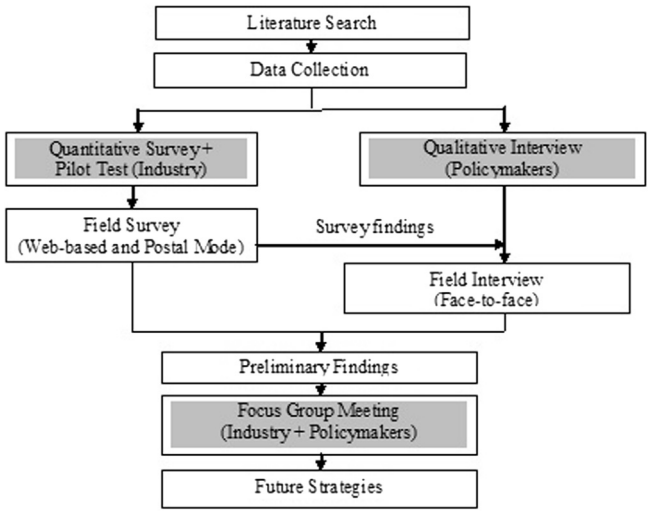

Fig. 1. Data gathering process for the study.

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