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Sustainable Utilisation of Pelletised Biomass Wastes as Fuel for Power Generation in Sarawak

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Doctor of Philosophy
(Alternative and Renewable Energy)
2016

Sustainable Utilisation of Pelletised Biomass Wastes as Fuel for Power Generation in Sarawak

Nazeri Abdul Rahman

A thesis submitted
In fulfilment of the requirements for the degree of Doctor of Philosophy

Faculty of Engineering
UNIVERSITI MALAYSIA SARAWAK
2016

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Bismillahirrahmanirrahim

Dedicated to my late mother and brother, my family,

and foremost to Abang Zaizakrani Md Salleh and Cikgu Juliana who always bestow me sustainable motivations, inspirations and encouragements

Acknowledgement

In The Name of Allah, The Most Gracious, The Most Merciful

The author would like to express his grateful appreciations to all individuals, parties and organisations that have contributed and cooperated throughout the completion of this thesis. Special thanks are dedicated to his supervisors, Assoc. Prof. Dr Rubiyah Hj Baini and Prof. Mohammad Omar Bin Abdullah for their willingness to share their knowledge and experiences as well as for their constant support towards the completion of this thesis. The authors also would like to express his thankfulness to his beloved family members, all his friends and students, and the respondents for the survey study from various palm oil mills in Sarawak, who either directly or indirectly involved in providing their supports and motivations toward the completion of this thesis. Last but not least, the author is extremely indebted to Abang Zaizakrani Md. Salleh and Cikgu Juliana for showing the path towards further education. May Allah S.W.T bless you all always.

Abstract

Sarawak Corridor of Renewable Energy (SCORE), incepted in 2008, aims to accelerate Sarawak economic growth especially for the central region of the state. SCORE establishment is largely due to the availability of abundant indigenous energy resources specifically hydropower, coal, and natural gas. Despite 1.35 million hectares of land in Sarawak is dedicated to agricultural activities, the potential for power generation from biomass wastes produced from agricultural industry has not been considered as part of power generation fuels mix for SCORE. As such, the aim of this study is to determine the sustainability of pelletised biomass wastes from agricultural industry as potential fuel for power generation in Sarawak. Correspondingly, this study investigates the suitability of pelletised biomass waste as fuel as well as examines the feasibility of establishing such undertaken in Sarawak. This study has found that Sarawak has immense electricity power generation from available agricultural biomass wastes which is estimated to be 5.73 GW in 2013. The pellets produced in this study are comparable to European Pellet Standard in which the pellets' calorific value exceeds 16.5 MJ/kg. The study has also identified and validated 10 relevant stakeholders, 7 biomass disposal methods, 5 sustainability aspects, 30 criteria, and 180 indicators which are relevant for biomass project in Sarawak, and constructed four decision making models programmes developed with Analytic Hierarchy Process (AHP) and Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) methods. From the two case studies conducted, it is found that pelletisation is the most sustainable option to dispose biomass waste from palm oil and sago industry. In the feasibility study of centralised pelletisation, it was found that pelletisation of biomass wastes as fuel for power generation is not only environmental friendly but also more economical as compared to sub bituminous coal fuel. Overall, it is concluded that utilisation of biomass wastes as fuel for power generation in Sarawak could partially support SCORE intensive energy need.

Keywords: Sustainability, Biomass Waste, Pellet, Power Generation, Multi-Attributes Decision Making, AHP, TOPSIS, Combined AHP and TOPSIS

Penggunaan Mampan Sisa Biomass Yang Dipelet Sebagai Bahan Api Untuk Penjanaan Tenaga di Sarawak

Abstrak

Koridor Tenaga Diperbaharui Sarawak (SCORE), yang dibentuk pada tahun 2008, bertujuan untuk mempercepatkan pertumbuhan ekonomi terutamanya di kawasan tengah Sarawak. SCORE dibangunkan kerana terdapat sumber asli yang banyak terutamanya tenaga hidro, arang batu, dan gas asli. Walaupun 1.35 juta hektar tanah di Sarawak dibangunkan untuk pertanian, potensi penjanaan kuasa dari sisa-sisa biomass industri pertanian tidak diambil kira sebagai salah satu sumber tenaga untuk SCORE. Oleh yang demikian, matlamat kajian ini adalah untuk mengenal pasti kelestarian pelet dari sisa-sisa biomass industri pertanian bagi tujuan penjanaan kuasa di Sarawak. Sehubungan dengan itu, kajian mengkaji potensi sisa-sisa biomass yang dipelet untuk penjanaan kuasa serta mengkaji kebolehlaksanaan tujuan tersebut di Sarawak. Kajian ini mendapati Sarawak mempunyai potensi penjanaan kuasa yang besar sebanyak 5.73GW dari sisa-sisa biomass yang tersedia pada tahun 2013. Pelet yang diperbuat dari sisa-sia biomass in adalah setara dengan Piawaian Pelet Eropah di mana nilai kalori pelet adalah lebih dari 16.5 MJ/kg. Kajian ini juga telah mengenalpasti dan mengesahkan 10 senarai pihak berkepentingan, 7 cara pelupusan biomass, serta 5 aspek, 30 kriteria, dan 180 penunjuk kelestarian yang bersesuaian untuk projek biomass di Sarawak, disamping membangunkan empat program membuat keputusan dengan menggunakan kaedah AHP dan TOPSIS. Dari dua kajian kes yang dijalankan, pempeletan sisa-sisa biomass dari industri kelapa sawit dan sagu adalah merupakan salah satu pilihan pelupusan yang lestari. Dalam kajian kebolehlaksanaan kilang pellet berpusat mendapati pempeletan sisa-sisa biomass bukan saja mesra alam sekitar malahan lebih menjimatkan berbanding dengan arang batu sub bitumen. Secara keseluruhanya, adalah disimpulkan bahawa penggunaan sisa-sisa biomass untuk penjanaan kuasa di Sarawak dapat menampung sebahagian daripada keperluan tenaga intensif SCORE.

Kata Kunci: Sustainabiliti, Sisa Biomass, Pelet, Penjanaan Kuasa, Pembuat Keputusan Pelbagai Atribut, AHP, TOPSIS, Gabungan AHP dan TOPSIS

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