Oil Palm Renewable Energy Businesses based on the Feed-in Tariff: Mapping Successful and Sustainable Business Models for Malaysia

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ABSTRACT

This research explores oil palm renewable energy businesses based on the Feed-in Tariff ("FiT") for biomass and biogas in Malaysia, from the perspective of Business Models. It has a particular focus on Business Models and the concept of Sustainability, particularly Renewable Energy Business Models for Sustainability. This thesis aims to investigate and model "Successful" and "Sustainable" FiT-based Oil Palm Renewable Energy Business Models in Malaysia to capture Economic, Environmental and Social value for a wide range of stakeholders, and increase the deployment of oil palm renewable energy in the country.

The research is conducted by adopting an Interpretivist Research Paradigm involving qualitative research using semi-structured interviews and focus-group discussions. A total of fifteen (15) semi-structured interviews were carried out, involving research participants selected using purposive sampling from stakeholder groups. Two (2) focus group discussions were held to gain feedback on the interview guide and then on the data findings, from the three (3) focus group members with experience and expertise in oil palm renewable energy in Malaysia.

This research has further contributed to the understanding of Renewable Energy Business Models, particularly Renewable Energy Business Models for Sustainability of oil palm renewable energy businesses based on the FiT in Malaysia. As this research has found, "Successful" and "Sustainable" FiT-based Oil Palm Renewable Energy Business Models can capture Economic, Environmental and Social value for a wide range of stakeholders and increase the deployment of oil palm renewable energy in Malaysia through:

- the introduction of an Energy Conservation Promotion Fund (ENCON Fund);
- the introduction of activities to promote awareness of oil palm renewable energy;
- the promotion of local technology and expertise;
- the promotion of Combined Heat and Power (CHP);
- the introduction of a location-specific bonus tariff for Sabah in East Malaysia;
- the development of a green grid;
- the promotion of bio-fertiliser as a value-added product;
- a One-stop Centre to coordinate the processing of all the project applications;
- grid interconnection based on simple, clear and transparent requirements;
- having at least 50% of the feedstock supply internally generated.

Although this research is specifically tailored to FiT-based oil palm renewable energy businesses in Malaysia, other types of FiT-based renewable energy businesses may also find this research useful to them for embedding sustainability and for overcoming at least to some degree the barriers facing their businesses, by following and replicating the research process.

By also investigating the issues and challenges confronting the FiT scheme in Malaysia for oil palm biomass and biogas, leading to conclusions and recommendations for the stakeholders including policy makers and renewable energy developers, this research has further contributed to the understanding and advancement of the FiT scheme in Malaysia. This will benefit not only the government and its regulatory agencies, and renewable energy developers in Malaysia but also key stakeholders in other palm oil producing nations wishing to embark on a similar FiT scheme.

CONTENTS

ABBREVIATIONS

a) CO2 Carbon dioxide

b) CHP Combined Heat and Power

c) DG Distributed generation

d) DL Distribution Licensee

e) EFB Oil Palm Empty Fruit Bunch

f) ENCON Energy Conservation Promotion Fund

g) FiT Feed-in Tariff

h) GHG Greenhouse Gas

i) IEA International Energy Agency

j) IEA-RETD International Energy Agency's Implementing Agreement for Renewable Energy Technology Deployment

k) IRENA International Renewable Energy Agency

l) KeTTHA Malaysian Ministry of Energy, Green Technology and Water

m) kWh Kilowatt - hour

n) POME Palm Oil Mill Effluent

o) RE Renewable Energy

p) REPPA Renewable Energy Power Purchase Agreement

q) TNB Tenaga Nasional Berhad

r) SEDA Sustainable Energy Development Authority of Malaysia

s) SESB Sabah Electricity Sdn. Bhd.

t) SREP Small Renewable Energy Programme

u) ST Energy Commission of Malaysia

v) Utility TNB or SESB

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DECLARATION

I hereby declare that no portion of this work has been submitted in support of an application for any other degree or qualification at this or any other university or institution of learning. In addition, I hereby confirm that, this thesis is solely my work and all work of others cited in this thesis have been acknowledged.

Signed:

CHAPTER 1.0

INTRODUCTION

1.1 INTRODUCTION

This chapter provides an overview of this study, starting with the aim of this research followed by an introduction of the key concepts in this research from the literature review. The significance and potential contributions of this research will then be discussed, leading to the formulation of the research objectives. Finally, the outline of this research thesis will be presented.

1.2 AIM OF THIS RESEARCH

Since the rise of e-commerce in the 1990s, "business models have become an increasingly popular concept in management theory and practice" (IEA-RETD, 2013, p. 24). With the growing significance of biomass, including palm oil wastes, as a job and wealth generator (Agensi Inovasi Malaysia, 2013) and as "the single most important resource to mitigate climate change" (IRENA, 2014a, p. 3), the concept of Business Models as "the approach for value creation" (IEA-RETD, 2013, p. 25) should also be extended and applied to the biomass renewable energy industry. Oil palm biomass are agricultural wastes or residues generated by the palm oil industry, which include Empty Fruit Bunches (EFB), Mesocarp Fibres, Palm Kernel Shells and Palm Oil Mill Effluent (POME), and can be utilised to generate renewable energy (Ali, et al., 2012).

Malaysian is currently the second largest producer of palm oil in the world, accounting for 39% of the world's palm oil production and 44% of the world's exports (MPOC, 2014), thereby generating huge amount of oil palm biomass. It already had the potential in 2005 to generate up to 2500 MW of renewable power for export to the grid (Chua, et al., 2011). To promote the deployment of renewable energy from renewable resources such as oil palm biomass, Malaysia launched the Feed-in Tariff (FiT) scheme which sets the price or tariff for every kilowatt-hour (kWh) of renewable power exported to the grid and sold to the utility company by an approved renewable energy producer. FiT payment is guaranteed through the Renewable Energy Power Purchase Agreement between the renewable energy producers and the utility companies (Chua, et al., 2011). However, the statistics on the FiT one year after its implementation show that 96% of the applications are from developers of Solar Photovoltaic installations (Muhammad-Sukki, et al., 2014) with only a small number of applications from oil palm biomass renewable energy developers. This is echoed by Adham, et al., (2014, p.257) who " find Photovoltaic has shown good progress while the developments of other RE sources are under-performed". Given the huge potential of oil palm biomass as a renewable energy resource for Malaysia, this very poor response is a serious problem that needs to be researched and addressed in order to develop the oil palm renewable energy businesses based on the FiT in Malaysia. In the wake of the recent ruling by the Malaysian Stock Exchange or "Bursa Malaysia" requiring every company listed on the Exchange to disclose their approach and performance in managing "Economic, Environmental and Social (EES)" Sustainability (Bursa Malaysia, 2015), sustainable business thinking is now gaining ground in Malaysia. Globally, businesses have also "begun to recognise the benefits of integrating sustainability" and as the "United Nations Global Compact – Accenture CEO Study" shows, "93% of the CEOs stated that they consider sustainability as important to the future success of their business" (Bursa Malaysia, 2015 a, p. 9). Hence, oil palm renewable energy businesses based on the FiT in Malaysia should develop "successfully" and also "sustainably". This leads to the aim of this research:

Aim of Research: *What are the "Successful" and "Sustainable" FiT-based Renewable Energy Business Models in Malaysia to capture Economic, Environmental and Social value for a wide range of stakeholders, leading to an increased deployment of oil palm renewable energy?*

1.3 CONCEPTS KEY TO THIS RESEARCH FROM THE LITERATURE REVIEW

The research will adopt the Business Model concept to investigate oil palm renewable energy businesses based on the Malaysian FiT. Richter (2013, pp. 1227-1228) describes the Business Model as "a valuable new tool for analysis and management in research and practice", and "a classifying device to build generic categories or blueprints to understand business phenomena" or to be copied, varied or innovated. Defining and mapping the Business Models of oil palm renewable energy businesses based on the FiT in Malaysia can "help to capture, visualize, understand, communicate and share the business logic" (Osterwalder, et al., 2005, p. 11). By "capturing and visualizing" the business logic and describing "the essential building blocks and their relationships", the Business Model concept "will improve planning, change and implementation" for sustainability (Ibid, p.15), as this research will later illustrate. Based on data findings from semi-structured interviews and focus group discussions with the relevant stakeholders, this research will innovate the FiT-based Business Models to offer a transition towards Renewable Energy Business Models for Sustainability (Richter, 2013).

However, "despite the increasing number of articles published on business models, the concept remains ill defined" (Roome & Louche, 2015, p. 4; see also Casadesus-Masanell & Ricart, 2011). This research will carry out a critical review of the current literature to establish the preferred concept and tool to model the oil palm renewable energy businesses based on the Malaysian FiT. It will establish that Osterwalder & Pigneur (2010, p.14) definition of Business Model - "*the rationale of how an organisation* *creates, delivers and captures value*"- should be adopted together with their "Business Model Canvas", a visual representation tool depicting the nine inter-connecting building blocks of a Business Model on a single page. Randles and Laasch (2015, p.1) have described this as "the nine basic elements of the acknowledged originator of the modern business model concept".

As mentioned earlier, the concept of Economic, Environmental and Social Sustainability is gaining ground in Malaysia and worldwide (Bursa Malaysia, 2015 a). In recent years, there has been a significant increase in the literature on new Business Models which integrate the concept of Sustainability. The Business Model concept is useful to researchers and practitioners as a tool to embed sustainability in businesses as it "offers a framework for system-level innovation for sustainability and provides the conceptual linkage with the activities of the firm" (Bocken, et al., 2015, p. 67). However, as with the definition of what is a Business Model, "an unequivocally supported definition of business models for sustainability is still missing" (Schaltegger, et al., 2015, p. 4). This research will critically review the different approaches to conceptualise Business Models for Sustainability or Sustainable Business Models in the current literature. From the literature review, a conceptual framework will then be developed to investigate and model Business Models for Sustainability for oil palm renewable energy businesses based on the Malaysian FiT. This framework will combine the normative principles of Stubbs and Cocklin (2008) and Boons and Ludeke-Freund (2013), the Value Mapping Tool of Bocken, et al. (2013) and the Triple Bottom Line Business Model Canvas of Osterwalder and Pigneur (2010, p. 285). This research will adopt the following definition of Business Models for Sustainability proposed by Schaltegger, et al. (2015, p.4):

> *"A business model for sustainability helps describing, analyzing, managing, and communicating (i) a company's sustainable value proposition to its customers, and all other stakeholders, (ii) how it creates and delivers this value, (iii) and how it captures economic value while maintaining or regenerating natural, social, and economic capital beyond its organizational boundaries."*

This research will also rely on the approach to Business Models for renewable energy adopted by the International Energy Agency's Implementing Agreement for Renewable Energy Technology Deployment (IEA-RETD). The IEA-RETD (2013, p.15) defines a Renewable Energy Business Model as "*a strategy to invest in renewable energy technologies, which creates value and leads to an increased penetration of renewable energy technologies*". And, a "successful" Business Model "*should address a wide range of barriers for an increased deployment of renewable energy technology*" (Ibid, p.41). As the IEA-RETD is a leading authority on renewable energies, their definition and approach should be incorporated into this investigation. Hence, in addition to it being "sustainable", this research will argue the need for Renewable Energy Business Models to be "successful" in order to overcome, at least to some degree, the barriers for the realisation of renewable energy.

Accordingly, the conceptual framework for sustainability will be extended to investigate barriers for renewable energy and identify strategies to address them, leading to a *Conceptual Framework to Investigate and Model "Sustainable" and "Successful" Renewable Energy Business Models for Malaysia*. This research will then elicit the views of key Malaysian renewable energy stakeholders, and the data gathered from them will be analysed, discussed and then incorporated into the Conceptual Framework to model and propose Sustainable and Successful FiT-based Oil Palm Renewable Energy Business Models for Malaysia, which can serve as a framework to guide and offer recommendations for Malaysian policy makers and renewable energy investors. This research will adopt Bocken, et al. (2013, p.489) multiple stakeholders which include "Academia, Customers, Investors and Shareholders, Employees, Suppliers and Partners, Environment, Community, Government, External Agencies, Media", but focuses only on "the relevant stakeholders" or "those with the highest level of influence or interest" (Bursa Malaysia, 2015 a, p. 23).

1.4 SIGNIFICANCE OF THIS RESEARCH AND POTENTIAL CONTRIBUTIONS

As stated earlier, Malaysia is the second largest producer of palm oil in the world after Indonesia, and already had the potential in 2005 to generate up to 2500 MW of renewable power from oil palm biomass (Chua, et al., 2011). According to Chin et al. (2013, p.725), if all the Palm Oil Mill Effluent or POME from the mills in Malaysia is treated in an anaerobic digester system, the energy potential from the methane biogas "is expected to be able to support about 700,000 households in Malaysia in 2011". Malaysia is focusing on 12 National Key Economic Areas (NKEA) "to boost the economy and achieve a high income status by 2020" (MPOB, 2014, p. 1), and one of the NKEA is Palm Oil, under which "eight core Entry Point Projects (EPPs) spanning the palm oil value chain" (Ibid, p.2) are being implemented. EPP No. 5 entitled "Build biogas facilities at all mills across Malaysia" is aimed at achieving "the installation of biogas facilities in all palm oil mills in Malaysia by 2020" (Ibid, p.2) to treat and utilise Palm Oil Mill Effluent (POME) in a sustainable manner. In recent years, the palm oil industry has drawn much negative attention over issues such as "deforestation, biodiversity loss, peat land destruction and social conflicts", and also "water pollution and greenhouse gas (CHG) emissions" (Embrandiri, et al., 2015, p. 219). Hence the sustainable management and utilisation of palm oil wastes such POME and Empty Fruit Bunches (EFB) for FiT-based power generation, as this research aims to promote, will "not only help in mitigating its negative impact but also will help in improving the economic status" (Ibid, p.227) of Malaysia.

The Malaysian Renewable Energy Policy and Action Plan 2010 aims to increase the use of indigenous renewable resources, such as the abundant supply of oil palm biomass, to contribute towards electricity supply security, fuel supply autonomy and protection of the environment. Pursuant to the Plan, the FiT scheme was launched in December 2011 and then revised on 1st of January 2014 to incentivise the deployment of grid-connected renewable energy (KeTTHA, 2014). The FiT scheme offers "new revenues for investors" in oil palm renewable energy businesses from "government incentives to renewable energy development" (IEA-RETD, 2013, p. 574). Hence, it can serve "as a stable basis for a business model" as it "guarantees access to a predictable and long-term revenue stream" (Ibid, p.67). This research investigates Business Models of oil palm renewable energy businesses based on the Malaysian FiT scheme, and aims to offer - *"Successful" and "Sustainable" FiT-based Renewable Energy Business Models in Malaysia to capture Economic, Environmental and Social value for a wide range of stakeholders, leading to an increased deployment of oil palm biomass renewable energy*. Umar et al. (2013, p.114) have evaluated the design of the FiT by focussing on 3 key challenges, namely oil palm biomass supply, bio-energy conversion technology and grid interconnection. The authors have concluded that the new policy scheme is not optimal as it is "only addressing a small fraction of the obstacles", there are certain unattractive terms that need to be reviewed, and that regular consultations need to be conducted by the authority to receive feedbacks about the scheme. The "Successful" and "Sustainable" Business Models offered at the conclusion of this research can guide and offer recommendations for Malaysian policy makers and renewable energy investors. The Models will serve as important frameworks for the government and investors "to identify, analyse, and manage" (Aslani & Mohaghar, 2013, p. 570) the huge biomass renewable energy potential in Malaysia as highlighted above. Thus, this research is significant as it will offer guidance to the industry and government to make informed and appropriate decisions pertaining to the FiT for oil palm biomass/biogas in Malaysia. This research will also include a comparative analysis of FiT policies in other jurisdictions to yield useful policy lessons for Malaysia (Umar, et al., 2014 a; Rahman, et al., 2016). In the course of this research, there will be regular interactions with the stakeholders - policy makers, power utilities, industry players and academics – to elicit their views and experiences as part of the primary data collection process. These interactions will provide mutual feedbacks which can help propel Malaysia's FiT scheme in the right direction (Umar, et al., 2013).

The significance of this research is further underscored by a working paper published by the International Renewable Energy Agency (IRENA) in September 2014, entitled "Global Bioenergy Supply and Demand Projections for the Year 2030" (IRENA, 2014a). It expects "biomass would be the single most important resource to mitigate climate change" as it could constitute 60% of the total final renewable energy use by the year 2030 with roughly 40% of the biomass originating from agricultural residues and wastes (Ibid, p.3). As the world is now grappling with the threat of climate change, this research is significant as it will conclude with recommendations to strengthen the oil palm renewable energy sector in Malaysia, leading to an increased deployment of renewable energy from biomass as an important resource to mitigate climate change. In the light of the warning, more bluntly than ever before, by the Intergovernmental Panel on Climate Change (IPCC) published on Sunday 2nd November 2014 in Copenhagen that "inaction" in reducing greenhouse gas emissions would cost the world to face "severe, pervasive and irreversible" damage and that "renewables will have to grow from their current 30% share to 80% of the power sector by 2050", this research is indeed being carried out at a very opportune moment (BBC, 2014). Given that Malaysia has pledged to voluntarily reduce CO_2 emissions intensity "by up to 40% based on 2005 levels" (Yatim, et al., 2016, p. 1) by the year 2020 (Bekhet & Sahid, 2016), this research will indeed augment Malaysia's effort to mitigate greenhouse gas (GHG) emissions.

This research is also important as it will offer a conceptual framework for Malaysian renewable energy businesses to embed Economic, Environmental and Social sustainability into their core, particularly, in the wake of the recent ruling by the Malaysian Stock Exchange or "Bursa Malaysia" requiring every Company listed on the Exchange to disclose their approach and performance in managing "Economic, Environmental and Social (EES)" Sustainability (Bursa Malaysia, 2015).

As Umar, et al. (2013) have pointed out, the FiT in Malaysia is still fairly new. Thus, it is not surprising that so far there is only a small amount of peer-reviewed literature on its performance, particularly on the FiT for oil palm biomass and biogas. Muhammad Sukki, et al. (2014) have reviewed the Malaysian FiT one(1) year after its implementation, focusing generally on renewable energy in Malaysia as a whole, and Umar, et al. (2014a) have explored some of the key barriers to the deployment of oil palm biomass renewable energy that remain unaddressed by the FiT scheme. A recent article by Wong, et al. (2015, p.43) discusses "the latest development of the FiT mechanism in Malaysia" and "its role in stimulating the growth in the renewable energy sector in Malaysia", but "with the special focus on solar energy sector". Apart from these and a few others, peer-reviewed literature available on the performance of the FiT for oil palm biomass and biogas in Malaysia appears to be quite limited. This research has the potential to contribute to the limited literature currently available on the FiT in Malaysia. By investigating the issues and challenges confronting the scheme, leading to conclusions and recommendations for the stakeholders including policy makers and renewable energy developers, this research can contribute to the understanding and advancement of the FiT for oil palm biomass/biogas in Malaysia.

This research also has the potential to contribute to the knowledge on Business Models for renewable energy, particularly Business Models based on the FiT. A search of the literature on Business Models reveals that the number of publications on Business Models for renewable energy is very limited. Apart from Wustenhagen and Boehnke (2006), APEC Energy Working Group (2009), Okkonen and Suhonen (2010), Aslani and Mohaghar (2013), Richter (2013), and IEA-RETD (2013), nothing significant has yet been found on Renewable Energy Business Models. Hardly anything has yet been found on Business Models based on the FiT for oil palm biomass/biogas. Hence, this research has the potential to offer a further contribution to the existing limited research on Renewable Energy Business Models, particularly Renewable Energy Business Models based on the FiT for oil palm biomass/biogas. It has the potential to contribute to knowledge that will benefit Malaysia as well as other major palm oil producing nations in the world. This research also has the potential to add to the discourse on Business

Models for Sustainability by offering a combination of multiple approaches, derived from a critical review of the current literature, as a Conceptual Framework for investigating and modelling Sustainable and Successful Renewable Energy Business Models based on the FiT for oil palm biomass/biogas in Malaysia. This Conceptual Framework can also potentially contribute to the knowledge on embedding sustainability in renewable energy businesses, particularly oil palm renewable energy businesses in Malaysia and other major palm oil producing countries.

1.5 RESEARCH OBJECTIVES

The aim or general question of this research as defined in section 1.2 is:

What are "Successful" and "Sustainable" FiT-based Renewable Energy Business Models in Malaysia to capture Economic, Environmental and Social value for a wide range of stakeholders, leading to an increased deployment of oil palm renewable energy?

From the discussions above, several sub-questions have emerged:

1. What are the issues and challenges confronting the renewable energy businesses based on the FiT for oil palm biomass/biogas in Malaysia?

2. How should the Business Models of renewable energy businesses be defined? What are the Business Models of renewable energy businesses based on the FiT for oil palm biomass/biogas in Malaysia?

3. What should be the conceptual characteristics of "Successful" and "Sustainable" Renewable Energy Business Models? What is the proposed Conceptual Framework for investigating and modelling "Successful" and "Sustainable" Renewable Energy Business Models based on the FiT for oil palm biomass/biogas in Malaysia?

4. How should the data be collected and analysed for investigating and modelling "Successful" and "Sustainable" Renewable Energy Business Models based on the FiT for oil palm biomass/biogas in Malaysia?

5. What are the findings from the investigation? What can be offered as "Successful" and "Sustainable" FiT-based Renewable Energy Business Models in Malaysia to capture Economic, Environmental and Social value for a wide range of stakeholders, leading to an increased deployment of oil palm renewable energy?

To address these research questions, 5 research objectives are adopted:

1) *To explore the literature to illustrate the background, issues and challenges of the FiT scheme, oil palm biomass and oil palm renewable energy in Malaysia;*

2) *To critically review the concepts of Business Models and Sustainability in the current literature to derive the Business Models of renewable energy businesses based on the FiT for oil palm biomass/biogas in Malaysia ("FiT-based Renewable Energy Business Models"), and develop a Conceptual Framework to investigate and model "Successful" and "Sustainable" FiT-based Renewable Energy Business Models for Malaysia;*

3) *To collect and analyse the data to investigate and model "Successful" and "Sustainable" FiT-based Renewable Energy Business Models for Malaysia;*

4) *To discuss the data findings pursuant to the Conceptual Framework to investigate "Successful" and "Sustainable" FiT-based Renewable Energy Business Models for Malaysia, and evaluate them with reference to the literature review; and*

5) *To conclude and model "Successful" and "Sustainable" FiT-based Renewable Energy Business Models for Malaysia with recommendations to the key stakeholders, and discuss the potential contributions of this research.*

1.7 THESIS OUTLINE

This thesis is organised into 7 chapters:

Chapter 1.0 i.e. this chapter provides an overview of this study, starting with the aim of this research followed by an introduction of the key concepts in this research from the literature review. The significance and potential contributions of this research are discussed, leading to the formulation of the research objectives. Finally, the outline of this research thesis is presented.

Chapter 2.0 describes the Feed-in Tariff ("FiT") scheme as a policy mechanism to promote the deployment of renewable energy, particularly from biomass and biogas. It will start with a discussion of the scheme as a policy instrument in the international context, followed by a detailed discussion of the scheme as is implemented in Malaysia. As this is a research investigating oil palm renewable energy businesses in Malaysia, this chapter will also explore the literature on oil palm biomass and oil palm renewable energy in Malaysia. This chapter addresses the first Research Objective.

Chapter 3.0 will critically review the current literature on Business Models, Renewable Energy Business Models and Business Models for Sustainability. It will then define and map the Business Models of renewable energy businesses based on the FiT for oil palm biomass/biogas in Malaysia. From a critical review of the current literature on "Successful" Renewable Energy Business Models and then on Business Models for Sustainability, this chapter will develop a Conceptual Framework, combining multiple conceptual approaches, to investigate and model "Successful" and "Sustainable"

Renewable Energy Business Models based on the FiT for oil palm biomass/biogas in Malaysia. This chapter will also discuss and identify the key stakeholders of the Malaysian Renewable Energy Business Models, whose views and experiences shall be consulted for this investigation. This chapter addresses the second Research Objective.

Chapter 4.0 will justify and establish the Methodology or Paradigm for this research. It will first discuss the ontological, epistemological and axiological aspects of this research, and establish the choice of particular Research Method to be adopted for this investigation. This chapter will then discuss the Research Design or framework to collect and analyse the data to investigate and model "Successful" and "Sustainable" FiT-based Renewable Energy Business Models for Malaysia. This chapter will illustrate the qualitative research method of using semi-structured interviews and focus group discussions, involving small samples or purposive sampling. It will describe how participants representing key stakeholder groups are identified and then invited to participate in the focus group discussions and semi-structured interviews to gather their views and experiences, as the primary data, for this investigation. Various measures to enhance data reliability and validity, including data and methodological triangulations, will also be discussed along with the emphasis on ethical considerations such as informed consent, voluntary participation, confidentiality and anonymity.

Chapter 5.0 will illustrate in detail the process of collecting, transcribing and analysing the data collected using the "template" style of thematic analysis on NVIVO 11, a Computer Aided Qualitative Data Analysis Software (CAQDAS). This chapter addresses the third Research Objective.

Chapter 6.0 will present the data findings and discuss them pursuant to the Conceptual Framework to *investigate* "Successful" and "Sustainable" FiT-based Renewable Energy Business Models for Malaysia. It will evaluate the findings with reference to the literature review. This chapter addresses the fourth Research Objective.

Chapter 7.0 will conclude the research and incorporate the findings into the Conceptual Framework to *model* "Successful" and "Sustainable" FiT-based Renewable Energy Business Models in Malaysia to capture Economic, Environmental and Social value for a wide range of stakeholders, leading to an increased deployment of oil palm renewable energy. This chapter will then offer recommendations to the key stakeholders, and discuss the potential contributions to knowledge and practice that this thesis will make. This chapter addresses the fifth and final Research Objective.

1.8 SUMMARY

In this chapter, the aim of this research has been defined together with an outline of the key concepts to be derived from the literature review. The significance and potential contribution of this research has been discussed, followed by the formulation of five (5) research objectives. As outlined earlier, this thesis is organised into seven (7) chapters. Chapter 2.0, which is next, will explore the literature to illustrate the background, issues and challenges of the FiT scheme and oil palm renewable energy in Malaysia.

CHAPTER 2.0

FEED-IN TARIFF AND OIL PALM RENEWABLE ENERGY

2.1 INTRODUCTION

This chapter describes the Feed-in Tariff ("FiT") scheme as a policy mechanism to promote the deployment of renewable energy, particularly from biomass. It will start with a discussion of the scheme as a policy instrument in the international context, followed then by a detailed discussion of the scheme as is implemented in Malaysia. As this is a study exploring oil palm renewable energy businesses based on the FiT in Malaysia, this chapter will also explore the literature on oil palm biomass and oil palm renewable energy in Malaysia.

Hence, this chapter addresses the first Research Objective:

To explore the literature to illustrate the background, issues and challenges of the FiT scheme, oil palm biomass and oil palm renewable energy in Malaysia.

2.2 THE FEED-IN TARIFF SCHEME

The Feed-in Tariff (FiT) scheme sets the price or tariff for every kilowatt-hour (kWh) of renewable power exported to the grid and sold to the utility company by an approved renewable energy producer. Payment is guaranteed through the Renewable Energy Power Purchase Agreement between the renewable energy producers and the utility companies (Chua, et al., 2011).

Umar, et al. (2014a) and Rahman, et al. (2016) have suggested that understanding how the FiT is implemented in the international context can yield some useful policy lessons for the scheme in Malaysia. Policies from other jurisdictions can contribute towards the advancement of the FiT scheme in Malaysia and serve as themes for the discussion and interviews with the research participants to elicit their views and experiences, as Chapter 5.0 will illustrate. This research will first examine the policy in Germany since the FiT scheme in Malaysia is closely modelled on the earlier version of Germany's FiT (The Star, 2011). Next, the FiT policy in the United Kingdom will be examined as this research is being undertaken at a UK-based institution. Subsequently, policy development and implementation in neighbouring Thailand (Green Prospect Asia, 2012), where the biomass sector is more advance than Malaysia, will be examined to have a clear perspective of the trend in the region. The International Energy Agency (IEA) and the International Renewable Energy Agency (IRENA) maintain a Joint Policies and Measures Database for Global Renewable Energy, providing information on renewable energy policies and measures of over 100 countries around the world (IEA, 2015). This Database will be utilised as a primary source of information on the policies and measures in Germany, the UK and Thailand.

Germany introduced the Electricity Feed-in Law in 1991, being a world leader in FiT (Rahman, et al., 2016) and the first country in the EU to have the FiT mechanism (IEA-Germany, 2013a). It has initially adopted *fixed* FiT or fixed price tariffs in contrast with Thailand using a *premium* FiT or premium price tariffs (CCAP, 2012). A fixed FiT "sets a constant price per unit of energy through the duration of a contract" (Ibid, p.1). In contrast, a premium FiT "sets a price equal to the spot-market electricity price plus an additional premium, known as an adder", which can either be a fixed adder or a variable adder (Ibid, p.2). In the case of Thailand, a fixed adder or premium is used. Thailand is the first country in the South East Asian region, which includes Malaysia, to offer the FiT or "adder" scheme, beginning in 2007 (IEA - Thailand, 2013a). The FiT was introduced much later in the UK and only in 2010 for renewable electricity from hydro, anaerobic digestion (biogas), wind and solar up to 5 MW.

2.2.1 GERMANY

The Electricity Feed-in Law of 1991 provided access to the grid for renewable electricity, and it obliged the power utilities to pay FiTs for the renewable electricity and then pass the cost to the electricity consumers (IEA-Germany, 2013a). The Renewable Energy Sources Act or "Erneuerbare-Energien-Gesetz" (EEG) 2000 superseded the 1991 Law, but maintained the underlying principles of priority grid connection and guaranteed power purchase by the utilities. Subsequently, the EEG 2004 replaced the EEG 2000. Key features of the EEG 2004 (IEA-Germany, 2013b) include giving priority to grid connection for electricity from renewable sources, obliging grid operators to purchase and transmit renewable electricity, making the renewable energy developers bear the costs of grid interconnection but grid operators must bear the costs of upgrading the grid, obliging grid operators to pay "a set of guaranteed rates" or fixed FiTs (Mabee, et al., 2012, p. 482), a guaranteed payment period, in general, of 20 years, differentiated tariffs for different renewable electricity technologies and for different sizes of installations, degression or reduction in the tariff for new biomass plants by 1.5% each year, and a bonus tariff in addition to the basic tariff for biomass plants using Combined Heat and Power (CHP) or fuel crops (Ibid; Rahman, et al., 2016).

The EEG 2009 (IEA-Germany, 2013c) further amended the law, followed by the introduction of the "Market Premium" under EEG 2012 (IEA-Germany, 2014 ; Rahman, et al., 2016). "Market Premium" allows renewable energy generators to sell their renewable electricity directly to the wholesale electricity market at market prices and claim a "market premium" on top of the wholesale market electricity price, instead of receiving the fixed FiT payment (Deutsche Bank AG, 2012). However, despite all the amendments, the basic principles of priority grid connection, guaranteed fixed tariffs, predetermined contract period and degression of rates remain unchanged (IEA-Germany, 2014). Priority grid connection and guaranteed purchase obligations are some of the key factors ensuring the success of Germany's FiT by obliging the power utilities “to purchase renewable based electricity and feed into their grids on a priority basis” (Rahman, et al., 2016, p. 3). Other success factors include ensuring “grid access without delay and bureaucratic hassles, which minimizes transaction costs” (Ibid) by “simplifying legal, technical and financial processes” (Ibid, p.6), and obliging system operators “to optimize, reinforce and expand the networks in order to accommodate the electricity from renewable resources without delay (Ibid, p.4).

The electricity supply industry in Malaysia is largely a “vertically integrated monopolistic transmission, distribution, and supply market” (Pacudan, 2013, p. 285) and currently there is no wholesale electricity market in Malaysia for renewable energy generators to market their electricity directly to retailers or suppliers. Germany’s “Market Premium” FiT is therefore inappropriate for Malaysia and will not be considered as a policy lesson for this research.

2.2.2 UNITED KINGDOM

Since 2002, the main support mechanism in the United Kingdom (UK) is the Renewables Obligation (RO) (IEA - UK, 2014d). The scheme expired on 31 March 2017, but generators accredited under the RO scheme will continue to receive support until the end of their RO duration of 20 years. The RO is a support mechanism that is quantity or quota-based as opposed to the FiT that is price-based, obliging UK electricity suppliers to source from renewable sources a specified proportion of their electricity supplied to consumers (DECC, 2014a). Originally, the RO was technology blind with one (1) Renewables Obligation Certificate (ROC) issued for each megawatt hour (MWh) of renewable electricity generated. “Banding” was later introduced to the RO in the form of multiple or fractional ROCs for different types of renewable generation. More support was offered to CHP than power-only schemes (DECC, 2008a). For example, the support for “Dedicated Biomass with CHP” is 1.9 ROC per MWh against 1.5 ROC per MWh for “Dedicated Biomass” in the period 2015/2016 (DECC, 2013).

FiT was only introduced in the UK in April 2010 (IEA - UK, 2014a) to support small-scale renewable electricity generation up to 5 MW. Eligible technologies include biogas from Anaerobic Digestion but excludes solid biomass, sewage gas and landfill gas (DECC, 2008b). “Generation tariffs” are payable for electricity whether used on-site or exported to the grid. However, there is an additional payment or “export tariff” for any power exported to the grid (Ibid). The generation and export tariff rates are linked to the Retail Price Index and are adjusted annually to increase or decrease with inflation (Ofgem, 2015). Tariff levels have been calculated to offer between 5-8% return on investment (IEA - UK, 2014a). No quota is specified for the FiT scheme, but the maximum capacity of an installation must not exceed 5 MW (RES LEGAL -UK, 2014a). The tariff payments are funded through the energy bills of the electricity consumer (GOV.UK, 2014b). Tariff support duration for anaerobic digestion (Biogas) is 20 years (IEA - UK, 2014a). The grid operator is “obliged to enter into a bilateral connection agreement without discriminating against certain plant operators”, but is “not obliged to give priority to renewable energy when connecting plants to the grid” (RES LEGAL - UK, 2014b).

FiT with Contract for Difference (CFD) was introduced in the UK starting in 2014. Until 2017, new project developers can choose as a once-off choice either RO or CFD (IEA - UK, 2013). CFD support is provided for biomass plants with CHP but not for electricity-only biomass power plants in line with the decision of the Department of Energy & Climate Change UK "not to support electricity-only dedicated biomass and in line with the requirements of Article 14(11) of the EU Energy Efficiency Directive (2012/27/EU) (DECC, 2014b, p. 155). The Department of Energy & Climate Change (DECC) actively promotes and supports the development of CHP schemes in the UK on their website under the section - Combined heat and power (DECC, 2015).

The UK has imposed Climate Change Levy (CCL) since 2001 (IEA - UK, 2014b) as an environmental tax on non-domestic energy users for their consumption of energy from non-renewable sources in order to encourage energy efficiency and reduce greenhouse gas emissions. "Electricity, gas and solid fuel are normally exempt from the main rates of CCL if the electricity is generated from renewable sources or they are supplied to or from certain combined heat and power (CHP) schemes" (GOV.UK, 2014a). This is followed by a Carbon Price Floor in 2013 as a tax on fossil fuels, namely gas, solid fuels and liquefied petroleum gas (LPG) used for power generation. Electricity from renewable sources such as biomass and biogas is exempted (RES LEGAL - UK, 2014c).

2.2.3 THAILAND

Thailand established the Energy Conservation Promotion Fund (ENCON Fund) in 1992, funded through a tax on all petroleum sold in the country, to provide financial incentives to promote energy conservation, energy efficiency and renewable energy (IEA - Thailand, 2013b). It collects "the revenue from a tax of 0.07 THB (0.002 USD) per litre on all petroleum products, with annually around 7 billion THB (200 million USD) of funds" (IEPD, 2016). The ENCON fund supports the efficient use of renewable technology to displace fossil fuel by providing full operational cost and interest subsidies for rural manufacturing and processing facilities utilising agro-industrial residues (biomass and biogas) to generate renewable energy. It has been successful in encouraging the deployment of biogas renewable technology in the rural agro-industrial sector energy (IEA - Thailand, 2013b). The fund provides technical and financial support to develop the Thai market for energy efficient or renewable energy equipment (Ibid). It also supports research and development by government agencies and academic institutions to develop new technologies or improve existing technologies, with emphasis on small-scale demo projects and dissemination of technical information (Ibid). The ENCON Fund has been disbursed through partial investment grants of 10 to 30% of the investments costs in installations including biogas and solar water heating (APEC, 2012, p. 38). Low-interest loans for investments in energy efficiency and renewable energy projects with a maximum interest rate of 4% and maximum loan period of 7 years are available with part of the funding coming from the ENCON Fund (Tongsopit & Greacen, 2012). In the past, the treatment of wastewater in Thailand has mostly utilised open lagoons without recovering the methane biogas (Jue, et al., 2012) as is still practised by majority of the palm oil mills in Malaysia. However, with the availability of financial support from the ENCON Fund, it is reported that in 2012 about 50% of the large-scale starch plants and most of the palm oil mills in Thailand have already been fitted with biogas plants (Ibid). The ENCON Fund is “critical in helping biogas developers overcome market barriers and establish sector technologies” (Ibid, p. 15), and hence it “has become a well-respected model and case-study” (Ibid, p.16).

Premium FiT or Adder was introduced in 2007 by offering renewable energy producers “feed-in premiums or adders on top of the regular electricity tariff” (IEA - Thailand, 2013a). Eligible renewable technologies include solar, wind, biomass, biogas, waste and hydro. The Adder is a premium to compensate for the greener renewable electricity. Tariffs differ by type of technology, installed capacity and locations. Special Adders or higher tariffs are paid for “Three Southernmost Provinces” and for “Diesel Replacement” in off-grid areas relying on diesel plants for electricity (Tongsopit & Greacen, 2013, p. 442). Special Adders for rural areas aim to promote the deployment of renewable electricity in these areas to displace the use of expensive diesel in electricity generation. The cost of the Adder is passed through to the electricity consumers as a surcharge on their monthly electricity bills (Ibid). There is no limit or quota but approval of the Adder for new renewable energy project is subject to an acceptable level of “pass-through cost” to electricity consumers. What is the unacceptable level of “pass-through cost” is not specified and thus there is no clear guideline as to “when to stop approving applications” (Ibid, p.440) . The support duration is seven (7) years for biogas and biomass renewable projects (Ibid).The approval criteria include “grid availability” and “readiness in terms of access to loans, land, and government’s permits”(Ibid). Other key features include streamlined grid interconnection procedures and standardized Power Purchase Agreements (Ibid). Complementing the Adder are various tax incentives – import duty reductions or exemptions on equipment; corporate income tax exemption of 100% up to 8 years and 50% exemption for another 5 years (Tongsopit & Greacen, 2012 , p. 34).

2.3 THE FEED-IN TARIFF SCHEME IN MALAYSIA

The promotion of renewable energy in Malaysia began in 2001 when the Government launched the Small Renewable Energy Program (SREP), which covered biomass, biogas, municipal waste, solar, mini-hydro and wind. SREP offered RM 0.21 per kWh for biomass and biogas renewable electricity up to a maximum capacity of 10 MW for the Renewable Energy Power Purchase Agreement (REPPA) period of 21 years (Chua, et al., 2011). Renewable energy was recognised as the fifth fuel of Malaysia in addition to oil, gas, coal and hydro under the Fifth Fuel Policy of the Eight Malaysian Plan (2001 – 2005) with Renewable Energy being targeted to contribute 5% of the nation’s total electricity demand by 2005 (Sulaiman, et al., 2011). However, SREP failed to stimulate the deployment of biomass renewable energy largely because of technical, economic and institutional barriers to its implementation (Sovacool & Drupady, 2011 ; Shafie, et al., 2012). To address the problem, the Malaysian Ministry of Energy, Green Technology and Water (KeTTHA) introduced the National Renewable Energy Policy and Action Plan (NREPAP) in 2010, and its main focus was the introduction of a FiT scheme in 2011. This new scheme was intended to guarantee access to the grid for all renewable energy producers, streamline the tariff application and approval procedures, and offer tariffs based on reasonable rates of return through the setting up of the Sustainable Energy Development Authority of Malaysia (SEDA) to administer the scheme (Sovacool & Drupady, 2011). The administration and management of the FiT by SEDA is provided for under the Renewable Energy Act 2011(Act 725), and SEDA is set up under the Sustainable Energy Development Authority Act 2011 (Act 726). NREPAP aims at increasing the use of indigenous renewable resources to contribute towards electricity supply security, fuel supply autonomy and protection of the environment. It targets to increase the share of renewable energy in the national energy mix from 1% in 2011 to 9% in 2020 and 24% in 2050.

The FiT scheme that was launched on 1st December 2011 initially covered only Peninsular Malaysia (or West Malaysia) and was funded by an additional charge of 1% to the electricity bills of consumers, but domestic electricity consumers of less than 300 kWh a month are exempted from the 1% additional contribution to the Renewable Energy Fund (Hashim & Ho, 2011; KeTTHA, 2014). The contribution to the Renewable Energy Fund was revised to 1.6% effective 1st January 2014 and was also levied for the first time on the State of Sabah and the Federal Territory of Labuan, both located in East Malaysia. (The State of Sarawak located in East Malaysia is currently the only state excluded from the scheme.) On 2nd of May 2014, Renewable Energy developers from Sabah and Labuan could participate in the FiT scheme for the first time (KeTTHA, 2014). Under the FiT scheme, the successful applicant or Feed-in Approval Holder (FiAH) for biomass or biogas will enter into a Renewable Energy Power Purchase Agreement (REPPA) with the power utility or Distribution Licensee (DL) to sell renewable electricity to the latter at the approved tariff fixed for the entire FiT duration of 16 years.

Currently, there are three (3) power utilities, majority owned by the government, operating three (3) independent grid systems in Malaysia. Tenaga Nasional Berhad (TNB) is the utility operating in Peninsular Malaysia (West Malaysia) whilst Sabah Electricity Sdn. Bhd (SESB) is the utility operating in Sabah and Labuan (East Malaysia). Syarikat SESCO Berhad (SESCO) is the operator in the state of Sarawak (the other state in East Malaysia). The three (3) utilities generate, transmit, distribute and supply electricity in their respective regions (Bekhet & Harun, 2016). The government ministry responsible for energy planning and policy development in Peninsular Malaysia, Sabah and Labuan is the Federal Ministry of Energy, Green Technology and Water (KeTTHA). The Federal Ministry is assisted by the Energy Commission, who regulates the energy industry and enforces the relevant laws and regulations in Peninsular Malaysia, Sabah and Labuan (Ibid). Neither does the Renewable Energy Act 2011, the Sustainable Energy Development Authority Act 2011 or the FiT scheme extend to the State of Sarawak. Hence, only two (2) power utilities or Distribution Licensees are involved in the FiT scheme - in Peninsular Malaysia, the Distribution Licensee is Tenaga Nasional Berhad (TNB) whilst the Distribution Licensee in Sabah and Labuan is Sabah Electricity Sdn. Bhd. (SESB).

With effect from 1st. January 2014, the revised FiT scheme offers a basic rate of RM 0.3085 per kWh for biomass plant with installed capacity up to 10 MW and an additional bonus rate of RM 0.01 per kWh for “the use of steam-based electricity generating systems with overall efficiency of above 20%”, as shown in Table 2.1 below. The FiT rates applicable to biogas plant are a basic rate of RM 0.3184 per kWh for installed capacity up to 4 MW and additional bonus rates, including RM 0.0199 per kWh for the “use of gas engine technology with electrical efficiency of above 40%” (see Table 2.1 below). The FiT scheme for biogas also offers an additional bonus of RM 0.05 for the “use of locally manufactured or assembled gas engine technology” (see Table 2.1). Prior to 2014, this bonus was offered at only RM0.01 (SEDA, 2015a). Umar et al. (2013) and Aghamohammadi, et al. (2016) have advocated the usage of more local technology to reduce the reliance on foreign technologies and hopefully to lower the technology costs. However, what constitutes “local assembly” is not clearly defined in the FiT scheme, and it remains to be seen whether this additional bonus for local assembly of RM0.05, increased from RM0.01 previously, can actually promote the development of the local gas engine technology in Malaysia and eventually lower the gas engine costs.

Table 2. 1 Amended Schedule for Biogas and Biomass effective 1st January 2014 (SEDA, 2014a)

Renewable Resource	Description	FiT rate (RM per kWh)	Degression Rate
Biogas	(a) Basic FiT rates having installed capacity of :		
	i. up to and including 4 MW	0.3184	0%
	ii. above 4 MW up to and including 10 MW	0.2985	0%
	iii. above 10 MW up to and including 30 MW	0.2786	0%
	(b) Bonus FiT rates having the following criteria (one or more) :		
	i. use of gas engine technology with electrical efficiency of above 40%	+0.0199	0%
	ii. use of locally manufactured or assembled gas engine technology	+0.05	0%
	iii. use of landfill ,sewage gas or agricultural waste including animal waste as fuel source	+0.0786	0%
Biomass	(a) Basic FiT rates having installed capacity of :		
	i. up to and including 10 MW	0.3085	0%
	ii. above 10 MW up to and including 20 MW	0.2886	0%
	iii. above 20 MW up to and including 30 MW	0.2687	0%
	(b) Bonus FiT rates having the following criteria (one or more) :		
	i. use of gasification technology	+0.0199	0%
	ii. use of steam-based electricity generating systems with overall efficiency of above 20%	+0.01	0%
	iii. use of locally manufactured or assembled boiler or gasifier.	+0.05	0%
	iv. use of solid waste as fuel source	+0.0982	0%

The Distribution Licensee collects the 1.6% surcharge from the electricity consumers and remits them to the Renewable Energy Fund. The Distribution Licensee pays the FiT rates to the Feed-in Approval Holders and then claims from the Renewable Energy Fund the difference between the FiT rate and electricity displaced cost plus an admin fee for administering the payment. The displaced cost is “the average cost to supply 1 kWh of electricity from non-renewable resources to the point of interconnection with the installation of Renewable Energy" (Wong, et al., 2015, p. 46). In other words, the FiT scheme bridges "the gap between the cost of fossil fuel and renewable sources" (Bekhet & Sahid, 2016, p. 1179). One design feature of the FiT is the annual tariff reduction or degression. When the tariffs for biomass and biogas were revised on 1st of January 2014, the degression was suspended with the rate reduced to nil (see above) (SEDA, 2015a). The support duration offered under the scheme remains at 16 years (SEDA, 2014a). There is an annual quota on the installed capacities available for biomass and biogas, based on the size of the renewable energy fund to ensure sufficient amount of funds to cover the FiT scheme (KeTTHA, 2011).

To "support the development of Green Technology", the Government of Malaysia has established the Green Technology Financing Scheme (GTFS), which is "a soft loan supported by the government", targeted at four (4) key sectors: "energy, water and waste management, building, transport" (Green Tech Malaysia, 2014). Biogas and biomass project developers are eligible to apply for this special financing up to RM 50 million per project for the loan tenure of up to 15 years, with the Malaysian Government guaranteeing 60% of the approved loan and subsidising 2% of the interest rate charged by participating financial institutions (Ibid; Yatim, et al., 2016 ; Bong, et al., 2016). Previously, Pioneer Status, Investment Tax Allowance (ITA) and Import Duty Exemption were offered until 31st December 2015 (SEDA, 2015b). Pioneer Status provided "exemption from income tax on 100% of statutory income for 10 years" to companies generating renewable energy (KeTTHA, 2009, p. 7). Investment Tax Allowance (ITA) was another incentive "in the form of a tax allowance of 100% on qualifying capital expenditure incurred within 5 years from the date the first qualifying capital expenditure is incurred", and companies generating renewable energy "can use this allowance to offset against 100% of their statutory income in the year of assessment", and "any unutilised allowance can be carried forward to subsequent years until the whole amount is fully utilised" (Ibid, p.6). . However, Investment Tax Allowance has now been extended beyond 31st December 2015 by allowing qualifying capital expenditure incurred from 25th October 2013 until the year of assessment 2020 to be "offset against 70% of the statutory income in the year of assessment" and "unutilized allowances can be carried forward until they are fully absorbed" (MIDA, 2016).

2.4 OIL PALM BIOMASS

Oil palm biomass are agricultural wastes or residues generated by the palm oil industry, which include Empty Fruit Bunches (EFB), Mesocarp Fibres, Palm Kernel Shells and Palm Oil Mill Effluent (POME), and can be utilised to generate renewable energy (Ali, et al., 2012). POME can be converted through the process of anaerobic digestion into methane biogas, which can then be combusted to generate electricity and heat (Hosseini & Wahid, 2013). Oil palm biomass is a strategic renewable energy resource that is abundantly available for heat and power generation in Malaysia to diversify its national energy mix, improve energy security and mitigate the emission of greenhouse gases (Sulaiman, et al., 2011; see also Foo, 2015). “By diversifying the supply options and reducing the dependency on conventional energy” (Sen & Ganguly, 2016, p. 4), oil palm biomass can help enhance energy security.

The International Renewable Energy Agency or IRENA is an intergovernmental organization with the European Union and over 100 states, including Malaysia, as its members. It is an important source of the latest information on biomass renewable energy and national policies to promote bioenergy deployment (IRENA, 2014b). In a working paper entitled “Global Bioenergy Supply and Demand Projections for the Year 2030”, IRENA expects that “biomass would be the single most important resource to mitigate climate change”, as it could constitute 60% of the total final renewable energy use by the year 2030 with roughly 40% of the biomass originating from agricultural residues and wastes (IRENA, 2014a, p. 3). As IRENA states, “there can be many advantages to using biomass instead of fossil fuels for power generation, including lower greenhouse gas (GHG) emissions, energy cost savings, improved security of supply, waste management/reduction opportunities and local economic development opportunities” (Ibid, p.4). According to Kumaran, et al. (2016, p.937), “approximately 50,000 jobs will emerge” in Malaysia from the construction, operation and maintenance of power plants related to renewable energy, which include oil palm biomass. Sen & Ganguly (2016, p.10) have also pointed out that “on average, renewable energy technologies create more jobs than fossil fuel technologies”.

2.4.1 PALM OIL MILLING

Mills typically use Palm Kernel Shells and Mesocarp Fibres as boiler fuel to generate steam (heat) and power for the operation of the mill, and “these two solid fuels alone are able to generate more than enough energy to meet the energy demands of a palm oil mill” with surplus energy left over (Yusoff, 2006, p. 90). Because of its high moisture content of more than 60%, fresh Empty Fruit Bunch (EFB) is a poor fuel unless it is “shredded and dehydrated to a moisture content below 50%” (Ibid, p.89). Hence, traditionally EFB is “either dumped or returned as mulch to the palm oil plantation” (Stichnothe & Schuchardt, 2011, p. 3977). The volume of solid biomass – EFB, Mesocarp Fibres, Palm Kernel Shells – is expected to increase to about 25 million dry tonnes by 2020 from an estimated 20 million dry tonnes in 2012, whilst the volume of wet biomass, POME, is expected to increase from 60 million tonnes in 2012 to around 70 to 110 million tonnes by 2020 (Agensi Inovasi Malaysia, 2013).

Traditionally POME is processed through the Ponding System involving open POME ponds and Chin et al. (2013, p.718) have reported that “more than 85% of the mills have adopted this method due to low operating cost”. However, these open POME ponds emit into the atmosphere about 5.5 to 9.0 kg of methane gas for every tonne of Fresh Fruit Bunch (FFB) processed in the oil mill (Stichnothe & Schuchardt, 2011). Alternatively, the methane gas can be captured by treating the POME “in a more efficient closed anaerobic digester” tank system (Chin, et al., 2013, p. 718). Kumaran, et al. (2016) has pointed out that if all the POME is treated anaerobically and the biogas generated is combusted using gas engines of 40% efficiency, it has the potential to generate around

553 MW of electricity in 2014. But, as Sharaai, et al. (2015) have reported, only 67 out of 439 palm oil mills in Malaysia have installed biogas plants as at 2014.

2.4.2 BIOMASS FEEDSTOCK

IRENA has pointed out that "unlike wind, solar and hydro, biomass electricity generation requires a feedstock that must be produced, collected, transported and stored" (IRENA, 2012, p. 27). It adds, "the only costs for the raw material are often the transport, handling and storage required to deliver the biomass wastes or residues to the power plant" (Ibid, p.26). IRENA stresses the importance of "the availability of a secure, long-term supply of an appropriate biomass feedstock at a competitive cost" to the viability of a biomass power plant, and highlights the fact that "feedstock costs can represent 40% to 50% of the total cost of electricity produced" (Ibid, p.27). IRENA notes that feedstock with a high moisture content poses a problem as the moisture "reduces the energy value of the feedstock", which in turn "increases transportation costs and the fuel cost on an energy basis, as more wet material is required to be transported and provide the equivalent net energy content for combustion" (Ibid, p.18). Another critical issue is "the low energy density of biomass feedstock", which "tends to limit the transport distance from a biomass power plant that it is economical to transport the feedstock". Because it is uneconomical to transport biomass feedstock over longer distances, "large quantities of low-cost feedstock are not available", thereby limiting "the scale of the biomass power plant" and hindering it from taking "advantage of economies of scale in the generating plant" (Ibid, p.27).

Seasonal supply fluctuation is another problem particularly in the case of agricultural residues (IRENA, 2014a). IRENA also notes that biomass feedstock prices are uncertain as many factors are involved, such as "the local supply chain", "competitive industrial uses (e.g. biochemical)", etc. (IRENA, 2012, p. 35), making it "difficult to negotiate long-term contracts that are designed to reduce price risk and guarantee security of feedstock supply" (Ibid, p.26). Hence, it recognises the fact that "many biomass power projects, particularly for CHP, are promoted by the industry which controls the process that produces the wastes and residues" (Ibid, p.26).

Chiew, et al. (2011) have highlighted the challenges of using oil palm EFB in Malaysia as an energy resource – (1) difficulty in transporting EFB due to its high moisture content and bulkiness; (2) problematic EFB supply chain including high cost due to transportation over long distances, lack of commitment from suppliers, unavoidable seasonal variation in the supply of EFB; (3) uncertainties in the EFB downstream market creating a wait and see situation that can reduce the availability of EFB for power generation and drive up the cost. Pre-treatment of EFB for efficient combustion by shredding and dehydrating it to achieve moisture content below 50% can render it useful as a green fuel source (Ibid).

In the case of wet biomass or POME, it can be treated anaerobically to produce biogas to generate grid-connected electricity, and internal steam and power for the mill (Hosseini & Wahid, 2013). The anaerobic process also produces a residue digestate that can be used as a bio-fertiliser (Ibid; Garcia-Nunez, et al., 2016; Kumaran, et al., 2016). According to Bong, et al. (2016, p.8), it is "rich in nutrient and can be used to fertilise crops". Ng, et al. (2016) have advocated the concept of waste recovery and regeneration (REGEN) system to convert the residual wastes including boiler ash into value-added products such as biofertiliser.

2.4.3 NATIONAL BIOMASS STRATEGY 2020

The National Biomass Strategy 2020 puts in place a "foundation for Malaysia to capitalise on its biomass by channelling it into higher value downstream uses" (Agensi Inovasi Malaysia, 2013, p. 7). The Strategy is developed by Agensi Inovasi Malaysia (AIM), a statutory body set up in 2010 as Malaysia's Innovation Agency. The Strategy aims to create "waste-to-wealth" from oil palm biomass through higher-value downstream uses such as pellets (bioenergy), bioethanol (biofuel) and biobased chemicals (Ibid, p.18; see also Yatim, et al., 2016). It emphasises that palletisation will enable palm oil millers to "immediately capitalise on available biomass" that can be shipped to Japan and Korea where there is an increasing demand for biomass pellets (Ibid, p.18). The Strategy also supports the conversion of biomass in the longer term into bioethanol and bio-based chemicals by stressing that "while these have only recently started to reach commercial scale in Malaysia, they also have the potential for significantly higher value creation (Ibid, p.5).

As pointed out, complementarity of the National Biomass Strategy 2020 and the FiT scheme is important, since "government policies that complement each other are more likely to be successful" (Sen & Ganguly, 2016, p. 10).

2.4.4 NATIONAL BIOGAS IMPLEMENTATION (EPP 5)

Malaysia is focusing on 12 National Key Economic Areas (NKEA) "to boost the economy and achieve a high income status by 2020" (MPOB, 2014, p. 1), and one of the NKEA is Palm Oil, under which "eight core Entry Point Projects (EPPs) spanning the palm oil value chain" (Ibid, p.2) are being implemented. EPP No. 5 entitled "Build biogas facilities at all mills across Malaysia" is aimed at achieving "the installation of biogas facilities in all palm oil mills in Malaysia by 2020" (Ibid, p.2). EPP 5 emphasises the importance of capturing biogas from POME to reduce "the carbon footprint" or Greenhouse Gas emissions so that oil palm products can gain "competitive market access" to "environmentally sensitive markets such as the European Union and the United States" (Ibid, p.3).

2.5 OIL PALM RENEWABLE ENERGY

As at 1st September 2016, the Cumulative Installed Capacity of Biomass Plants has reached only 68.40 MW (SEDA, 2016). The Cumulative Installed Capacity for Biogas (Landfill / Agricultural Waste) until September 2016 is only 18.88 MW. These achieved capacities are far off the 2015 targets set in the Tenth Malaysian Plan (2011 -2015), namely 330 MW of biomass renewable energy (including other solid wastes) and 100 MW of biogas renewable energy (landfill/agricultural waste/other biogas). Thus, Kumaran, et al. (2016, p.937) conclude that “the growth of biogas plant installation is still at the nascent stage in Malaysia”. Under the FiT, biomass is targeted to contribute 800 MW of grid connected electricity by the year 2020 (Umar, et al., 2013). This poses a critical question related to the aim of this investigation: Can the FiT scheme support such an ambitious goal?

Muhammad-Sukki, et al.(2014) have reviewed the impact of the FiT scheme on renewable energy as a whole in Malaysia one year after its implementation and concluded that the FiT application was dominated by solar photovoltaic and had fewer applications from other types of renewable energy including biomass and biogas. Umar, et al.(2013, p.114) have evaluated the design of the FiT in terms of overcoming the past defects or barriers of its predecessor, the Small Renewable Energy Programme (SREP), by focusing on three (3) main barriers, namely the availability of palm oil biomass supply, bio-energy conversion technology and grid interconnection. They have concluded that the new FiT policy scheme is not optimal as it is “ only addressing a small fraction of the obstacles”, there are certain unattractive terms that need to be reviewed, and that regular consultations need to be conducted by the authority to receive feedbacks about the scheme. In a subsequent article, Umar, et al. (2014b) have reported their quantitative research survey of the 417 palm oil mills in Malaysia carried out in May 2011. The survey involved e-mail questionnaires sent to 289 millers and postal questionnaires to the remaining 128 millers, to investigate their “views on their potential involvement in the renewable energy” businesses (Ibid, p.504). From the 85 survey questionnaires returned, the authors have made several quantitative findings on the key barriers to the deployment of biomass renewable energy from the perspective of palm oil millers in Malaysia. It is argued that the views of the palm oil millers are relevant to this research as they are the generators of the biomass resources and moreover, as stated earlier, they have the working experience in using oil palm biomass for heat and power generation in their mills.

Subsequently, guided by the work of Umar et al. (2014b), Aghamohammadi, et al. (2016) have investigated the sustainability of power generation from oil palm biomass in the State of Sarawak, East Malaysia by conducting a survey among the palm oil millers there. As stated in section 2.3, currently the FiT scheme does not extend to the State of Sarawak. However, it is argued that the study by Aghamohammadi, et al. (2016) can be relevant to this research, as the authors have identified and investigated several key factors that are critical to the sustainability of oil palm renewable energy businesses, and some of their findings are applicable not only to Sarawak but also Malaysia as a whole. Three (3) key sustainability factors for the Malaysian oil palm renewable energy businesses as identified by Umar et al. (2014b) and also Aghamohammadi, et al. (2016) are: “Sustainability of biomass supply chain”, “Sustainability of conversion technology” and “Sustainability of grid network system” (Aghamohammadi, et al., 2016, p. 5). These and other sustainability factors will now be examined closely in the following sub-sections.

2.5.1 SUSTAINABILITY OF BIOMASS SUPPLY CHAIN

Aghamohammadi, et al. (2016, p.7) have emphasised 'the continuous supply of palm biomass is one of the fundamental elements of sustainable power generation from palm biomass" and "uncertainties related to long-term biomass supply will expose the market to fluctuating prices". The survey findings of Umar et al. (2014b, p.499) show that 69.4% of the respondents were mills belonging to major plantation groups, who according to the authors, "hold full control" over their wastes, "thus offering flexibility to these main players to utilise the feedstock according to their business strategies". The survey findings show that 80% of the participants "utilised 40% of their biomass for animal feed, mulching, composting and soil conditioning purposes", which "in turn would limit new entries into biomass power generation, particularly the small producers who would confront supply constraints" (Ibid, p.499). Over 61% "claimed that fuel security and price inflation were amongst the main barriers that need to be removed" (Ibid, p.499). According to the authors, "limited boiler fuels such as EFB (empty fruit bunch), kernel shell and mesocarp fibre are likely to affect small developers who depend on third party supply, which is greatly exposed to market price fluctuation" (Ibid, p.499). Another major factor affecting biomass feedstock supply is "the seasonal nature and low cropping trend of oil palms" (Ibid, p.499), which Garcia-Nunez, et al. (2016) have also pointed out. On the willingness to purchase biomass wastes from other mills for electricity generation, "more than 90% expressed their unwillingness to do so" (Umar, et al., 2014b, p. 499). "Half of the respondents reported that the absence of a long term supply contract discouraged their active participation" in power generation (Ibid, p.499), consistent with the observation by Petinrin & Shaaban (2015, p.979) that "the fuel suppliers are not committed to having a long-term agreement with the renewable energy project developers". As pointed out, failure to secure long-term feedstock supply agreement may result in the financing of the project not being approved (Sharaai, et al., 2015 ;Yatim, et al., 2016; Kumaran, et al. ,2016).

Competing demand for biomass also affects the feedstock supply and cost, since the wastes can be "utilised for other economically viable co-products other than the energy, which can generate profit in a shorter period" (Kumaran, et al., 2016, p. 938). Other than using it as a dry fuel for heat and power generation, the uses and potential uses of EFB in Malaysia include pellets, palm fibres (long or short fibres), high value chemicals (Ng, et al., 2012). EFB can also be converted into pulp and paper and used to make medium density fibreboards (Sulaiman, et al., 2011). Briquetting, which is a "process of compacting loose material to form a homogeneous and densified product" (Ibid, p.3782) can convert EFB into oil palm briquettes that "can be used as fuel in producing steam, district heating and electricity generation for larger commercial scale" (Ibid, p.3783).

To avoid unnecessary transportation costs, "on-site generation" is suggested as a feasible option (Umar, et al., 2014b, p. 500). The conversion of existing palm oil mills into bio-refineries has been advocated since there is significant amount of biomass available at a single location and produced all year round (Garcia-Nunez, et al., 2016), and "the synergies that can be obtained with existing infrastructure in a palm oil mill could increase the potential to generate value-added new products at lower productions costs" including the production of biogas and bio-fertiliser, and electricity generation (Ibid, p.103). Chin, et al. (2013, p.724) have cited the challenge posed by the seasonal nature of palm oil milling and pointed out that “during the high crop season, the high loading rate may cause system failure to the biogas plant and cease methane production”. They add that “the instability of the biogas production will subsequently decrease the efficiency of the system” (Ibid, p.724).

2.5.2 SUSTAINABILITY OF RENEWABLE ENERGY TECHNOLOGY

The survey findings of Umar et al.(2014b, p.501) also indicate that 58% of the respondent mills were “less interested in embarking on a renewable energy venture and preferred to concentrate more on their traditional business” of producing palm oil. Having said that, if the venture can “increase their profit margins and minimise their operating costs”, about 66% of the respondent mills were interested “to convert to a modern technology” to achieve higher energy conversion efficiency from their biomass wastes that would enable them to generate surplus renewable energy for export to the grid (Ibid, p.501). The findings also show that almost 86% of the survey respondents “were utilising two-thirds of their biomass energy resources for self-consumption and only 8.3% were exporting a surplus to the grid”, which, according to the authors, could be attributed to the “inefficient conversion technology problem” in the oil mills (Ibid, p.502).Some respondents have “pointed out their lack of confidence to invest because of the poor record on implementation for previous biomass projects” (Ibid, p.502). The survey shows 61% of the respondents agreed that “high capital outlay” in the renewable energy technology is indeed a key challenge and 87% supported better incentives and an attractive interest rate for financing to encourage more renewable energy ventures (Ibid, p.503). As Petinrin & Shaaban (2015, p.979) have pointed out, high capital outlay “restrain efforts to promote the utilisation of renewable energy”. Thus, it has been suggested that the government should provide investment subsidies to help reduce the capital outlay as well as import duty exemptions or reductions to lower the cost of technology imports (Yatim, et al., 2016).

Chin, et al. (2013) and Kumaran, et al. (2016) have cited the high investment cost of building biogas plants with electricity generation system in palm oil mills compared to the conventional ponding treatment system. Biogas projects are also perceived as high-risk investments and one reason cited is the “lack of successful models in POME-biogas plant to persuade the palm oil mill operators” to invest (Chin, et al., 2013, p. 724). This concern over the high risk and high capital of biogas plants is echoed by Sharaai, et al. (2015, p.36), who note that millers “will definitely find it unattractive to make such an investment”. Another challenge cited is the lack of local expertise for operation and maintenance to ensure the stability of the biogas system (Ibid; Chin, et al., 2013; Kumaran, et al., 2016) in particular to cope with the seasonal fluctuation mentioned in section 2.5.1 above. Bong, et al. (2016, p.7) have cited “the inexperience and unfamiliarity in the anaerobic digestion process, its design and operation, maximisation of biogas yield” as some of the main challenges facing biogas renewable energy businesses in Malaysia. The authors note the lack of “skilful engineers and technicians” in Malaysia to operate and maintain biogas plants (Ibid, p.7). Hence, they have suggested “a need to improve technical know-how” through “trainings and workshops” on operation and maintenance (Ibid, p.7). It has also been suggested that “the government should collaborate with educational institutions to impart skill trainings and knowledge on anaerobic digesters and biogas power to develop local expertise” (Kumaran, et al., 2016, p. 938).

It is suggested by Chin, et al. (2013, p. 724) that the “government should provide special incentives and tax reduction” to “palm oil mills to assist them with the high capital investment of the biogas power generation plant”. Bong, et al. (2016, p.7) have suggested “more tax exemption on anaerobic digestion technology due to its high capital and operational cost”. On the financing of renewable technology, Borhanazad, et al. (2013, p.217) have highlighted "the lack of access to credit” for renewable energy investors. Similarly, Petinrin & Shaaban (2015, p.979) have cited the lack of confidence among financial institutions to finance renewable energy projects. Yatim, et al. (2016, p.9) have attributed the lack of confidence among financial institutions to their “lack of knowledge, experience and understanding of risks associated with renewable energy and green technologies”. Even with the Green Technology Financing Scheme (GTFS) as discussed in section 2.3, the participation of Malaysian financial institutions is still lacking, which Kumaran, et al. (2016) have attributed to the lack of awareness and experience. Hence, cooperation among the government, financial institutions and renewable energy investors is important to overcome “any misunderstanding and lack of communications related to renewable energy” (Sharaai, et al., 2015, p. 36). Sen & Ganguly (2016, p.9) have pointed out the need to build up adequate skills and capacities in “government ministries, financing institutions, regulatory agencies and utilities” as “inadequate skills and capacities could inhibit renewable energy development”.

Embrandiri, et al. (2015) also note that awareness of the potential of oil palm biomass as a renewable energy source is low. Petinrin & Shaaban (2015) have cited “lack of advanced technology for renewable energy generation and lack of awareness on the benefits of renewable energy resources” as a major challenge in Malaysia. Likewise, Yatim, et al. (2016, p.10) have cited “a considerable lack of awareness regarding sustainable technologies and the benefits” as a social challenge which needs to be addressed. A study investigating renewable energy technology acceptance in Peninsular Malaysia by Kardooni, et al. (2016, pp.6-7) finds that although “the majority of Malaysians are concerned about climate change”, “people feel that the use of renewable energy involve a high level of effort, and this has a negative effect on their attitude toward using renewable energy technology”. Several possible explanations are offered for this finding. Firstly, “limited capacity in renewable energy technology manufacturing and servicing, and a lack of skilled technicians for the installation and maintenance of technologies impede the introduction of renewable energy technologies in Malaysia” (Ibid, p.7). Secondly, there is lack of “public awareness of environmentally friendly practices and renewable energy products” (Ibid, p.7). Thirdly, the “lack of knowledge is also likely to be related to inadequate research and development” (Ibid, p.7). Hence, the study concludes that there is “a definite need for increasing the awareness of the public”

(Ibid, p.7) through suitable measures which include “introducing environmental and technology curriculum at all levels of school, improving environmental campaigns and the portrayal of green technology in mass media and social media, and introducing a one-stop centre/agency to disseminate information on green technology” (Ibid, p.5). The need to organise “seminars, talks and demonstrations” to increase “social awareness and acceptance towards green technology” is echoed by Bong, et al. (2016, p.9).

Aghamohammadi, et al. (2016, p.10) have advocated that “Malaysia should use foreign knowledge and technologies and start to increase the number of local technology manufacturers and skilled workers” to reduce the high cost of technology and maintenance. “Appropriate technological training and education” are required to create the work force “to meet the industry’s needs” (Bekhet & Sahid, 2016, p. 1180), as the “shortage of skilled manpower and expertise” is reported to impede the progress of the renewable energy industry in Malaysia (Yatim, et al., 2016, p. 10). Umar et al. (2013) and Aghamohammadi, et al. (2016) have advocated the usage of more local technology to reduce the reliance on foreign technologies and hopefully to lower the technology costs. Sharaai, et al. (2015, p.36) have cautioned that “the capital intensive initiative requiring huge costs to cover such imported technologies to the country is unsustainable”, and Kumaran, et al. (2016, p.938) note that the high import cost “demotivates the local biogas plant developers”. As stated in section 2.3, what constitutes “local assembly” in Malaysia’s FiT scheme is not clearly defined and it remains to be seen whether the additional bonus for local assembly of RM0.05, increased from RM0.01 previously, can actually promote the development of the local gas engine technology in Malaysia and eventually lower the gas engine costs.

2.5.3 SUSTAINABILITY OF GRID NETWORK SYSTEM

By referring to the map of the National Electricity Grid and oil palm plantations in Peninsular Malaysia, Kumaran, et al. (2016, p.937) note that “most of the oil palm processing mills are located far from the National Electricity Grid”, and “hence, the cost of grid connection overrides viability for return on investment”. The authors add that the distance between the interconnection point and the power plant “should be within 10km to minimise transmission power loss” and also to be “economically viable for investment” (Ibid, p.938). Likewise, Sharaai, et al. (2015, p.36) have highlighted “the lack of infrastructure for feed-in capability into power grids, gridlines availability issue and the long distance between the location of palm oil mills and power grids” as significant challenges, and suggested that the biogas industry players in Sabah should be given greater attention and funding. Bong, et al. (2016, p.7) have suggested that the government should construct “infrastructure to access to the national grid” so that renewable energy businesses can have access to the predictable and long-term revenue stream of the FiT scheme.

Thus, it is not surprising that the survey by Umar et al.(2014b) has revealed that hardly even 10% of the palm oil mill respondents are exporting a surplus power to the grid, which, as the authors explain, is also due to the lack of grid connections. The authors point out that “a major reason that deters the utility from extending the transmission lines from the main grid to the palm oil mills" is the "distance constraints" (Ibid, p.502). The cost of connecting to the grid is too expensive, and the survey findings show this is one of the key barriers to the deployment of grid-connected electricity from palm oil mills, causing "53% of respondents to resist investing in grid infrastructure" and 55% to state that they would participate "if the infrastructure cost was borne either by the government or the energy utility" (Ibid, p.502). The authors further note that this is "an uphill task" since "63% of the active palm oil plants are located more than 10km from the nearest grid connection point" (Ibid, p.502). Ahmed, et al. (2017) discuss how the connection costs are normally allocated and cited four (4) types cost allocation policies by referring to Figure 2.1 below.

The figure originally presented here cannot be made freely available via LJMU E-Theses Collection because of copyright. The figure was sourced at Ahmed, et al. (2017, p.1427).

Figure 2. 1 Connection costs allocation policies (Ibid, p.1427)

In "super shallow connection cost policy", renewable energy businesses do not bear any connection cost and all the interconnection costs are borne by the utilities (Ibid, p.1427). Under the "semi-shallow connection cost policy", the renewable energy developer bears a portion of the connection cost , which is determined by way of negotiation between the developer and the utility (Ibid, p.1427). In contrast, under the "shallow connection cost policy", renewable energy businesses are solely responsible for the connection costs up to the existing grid or transmission line (Ibid, p.1427). In the "deep shallow connection cost policy", renewable energy businesses "are solely responsible for network interconnection and network up-gradation cost" (Ibid, p.1427). The authors then conclude that these four (4) connection policies have great economic and financial impact on renewable energy businesses and, among these policies, the semi-shallow connection cost policy is sustainable and "is economically viable for renewable generators" (Ibid, p.1427).

It should be noted that “small scale technologies for harnessing renewable” including oil palm biomass are often “directly embedded within distribution network, or situated in proximity to the points of energy consumption”, in a “decentralised power generation system” or distributed generation (DG) system (Theo, et al., 2017, p. 533). In contrast, the conventional “centralised generation” system “involves large-scale power plants generating electricity utility in bulk to be injected into the transmission system” (Ibid, p. 532). A distributed power generation system comprising biomass and biogas power plants directly connected to the distribution network can have many technical advantages, including “elevating the voltage of electric power system and facilitating electricity transmission to remote areas”, and “ minimising power loss via deferment of massive transmission and distribution” (Ibid, p.533). Economic advantages include the “elimination of the need for costly investments on transmission and distribution expansion and upgrading” (Ibid, p.533). However, as Theo, et al. (2017) have highlighted, there exist various policy, institutional and socio-political barriers that hinder DG system connectivity with the power grid. They argued that “the existing electricity industry structure favours the centralised generation” by imposing “monopolising policies that rule out DG development”, which include “biased allocation of subsidies for centralised power station” and “bureaucratic complications for licensing application” (Ibid, p.536). Except for electricity generation, which has been deregulated to allow for the participation of private Independent Power Producers (IPP), the electricity supply industry in Malaysia is still largely regulated and remains “a single-buyer model with a competitive generation market but vertically integrated monopolistic transmission, distribution, and supply market in three geographic regions” (Pacudan, 2013, p. 285). Sen & Ganguly (2016, p.6) state that policies that protect the monopoly or near-monopoly transmission and distribution would make “the way of renewable energy very difficult”.

Theo, et al. (2017) add that “the institutional barrier could exist in the form of strict criterions for DG interconnection into power grid” (Ibid, p. 536). The “onerous requirements for small power producer set by utility” have been reported as some of the “common issues to implement renewable energy” in Malaysia (Borhanazad, et al., 2013, p. 217). At a workshop organised by IEA in collaboration with IRENA and FAO, one speaker has also highlighted the uncertain and difficult interconnection requirements, and request for special equipment by the power utility, as some of the interconnection difficulties faced by oil palm renewable energy businesses in Malaysia (Jamin, 2014).

Petinrin & Shaaban (2015, p.979) have described the “long negotiation periods” for the Renewable Energy Purchase Agreement (REPPA) to be concluded as another serious challenge, and the longer it takes, “the more expenses the development will incur” and if the “company does not have staying power, it will simply abandon” the initiative. Hence, it has been advocated that “clear and transparent grid interconnection rules are key for a fast uptake of the renewable energy market in Malaysia”, as the FiT participants are generally “not used to dealing with complex administrative and technical requirements” as the big independent power producers (Jacobs, 2010, p. 10). “Clarity of institutional roles” accompanied by “transparent and streamlined procedures can reduce transaction costs" (Sen & Ganguly, 2016, p. 9). It should be noted that success factors of Germany's FiT include ensuring "grid access without delay and bureaucratic hassles, which minimizes transaction costs" (Rahman, et al., 2016, p. 3) and obliging German system operators "to optimize, reinforce and expand the networks in order to accommodate the electricity from renewable resources without delay (Ibid, p.4).

2.5.4 SUSTAINABILITY OF THE FiT SCHEME FOR OIL PALM BIOMASS/BIOGAS

The Association of Water and Energy Research Malaysia (AWER) has been a vocal critic of the FiT scheme. In their open letter to the Prime Minister of Malaysia dated 16th July 2012, AWER alleged that the FiT lacks transparency, is "stealing from the poor and giving it to the rich", "does not guarantee a sustainable and continuous growth of RE industry" due to competing demand for biomass feedstock for non-energy related applications, and that SEDA should be shut down "due to its gross redundancy" (AWER, 2012). AWER cited the competition from the conversion of EFB fibres into packaging paper as a challenge. It alleged that the implementation of the FiT lacks transparency as it is widely alleged that the solar photovoltaic FiTs have been "monopolised" by certain parties. It added that the development and implementation of the FiT in Malaysia should have been carried out by the Energy Commission, and the setting up of SEDA specifically for this purpose is redundant and a waste of public resources for a small nation like Malaysia. According to Yatim, et al. (2016, p.9), there is some overlapping functions performed by SEDA and the Energy Commission and "this conflicting responsibility may cause confusion for stakeholders of the industry". Bong, et al. (2016, p.8) have also highlighted that "fragmented implementation" in the legal and regulatory framework has led to "overlapping function and unclear responsibilities".

As stated in section 2.3, the FiT is funded by an additional charge of 1.6% to the electricity bills of consumers effective 1st January 2014, but domestic electricity consumers of less than 300 kWh a month are exempted. Hence, "FiT is constrained by its limited fund" (Bekhet & Sahid, 2016, p. 1180). Since "the funding source for FiT is limited", annual quotas or caps are imposed on the installed capacities available under the scheme, which "limit the RE growth in Malaysia and constrain the grid connection of RE" (Chin, et al., 2013, p. 724). It has been contended that the capacity quota allocated to biomass and biogas is relatively low compared to solar (Jamin, 2014), and that the lower FiT rate for biogas is unsatisfactory compared to the higher FiT rate for solar (Kumaran, et al., 2016). A higher allocation of quota has been suggested for the State of Sabah in East Malaysia as new renewable plants are more urgently needed there to meet power shortages (Chin, et al., 2013, p. 724). As stated in section 2.2, Malaysia's FiT is modelled after Germany's EEG law and key features of the Malaysian FiT bear resemblance to the EEG Laws of 2004 and 2009. However, in its fixed FiT scheme, Germany had "chosen not to impose caps on the total amount of RE developed" and "this rate of growth and the total extent of RE deployment are left up to the market" (Couture, et al., 2010, p. 83). Furthermore, the German scheme, in general, offers a longer support duration of 20 years (Mabee, et al., 2012) in comparison to the duration of 16 years under Malaysian FiT for biomass and biogas. In the UK, no annual quota or cap is imposed on the biogas installed capacity, but the maximum capacity of an installation must not exceed 5 MW. As discussed in section 2.2.2, the UK's biogas tariff support duration is longer at 20 years, and "generation tariff" is payable even for electricity generated and used on-site. Electricity exported to the grid receives an additional payment or "export tariff".

It has also been suggested by Jacobs (2010, p.11) that the Malaysian policymaker can consider the time-differentiated tariffs by paying "a higher tariff in times of high demand (peak) and lower tariffs in times of low demand (off-peak)". Umar, et al. (2014 a, p.45) have suggested identifying "other alternatives to financing renewable technologies" including "a carbon tax for conventional power generation, transferring some of the conventional energy subsidy to promote the renewable market and imposing a levy for exporting fossil fuels". In return, the use of renewable energy "can offset the usage of fossil fuels" (Kumaran, et al., 2016, p. 936). Furthermore, "the government must ensure that a reasonable profit can be obtained through the FiT rates over a certain period of time" to ensure the success of the FiT scheme (Bong, et al., 2016, p. 9).

Another key challenge confronting the FiT scheme is that the policy is formulated at the federal level of government, but policy implementation "requires state and local authorities to issue land conversion approvals, planning permissions, and access to land use", which reportedly "tend to be lengthy" with "inconsistent" requirements (Yatim, et al., 2016). This has prompted the authors to call for state-level support "to provide transparency and to reduce costs, project delays and cancellations" (Ibid). Proper coordination among the wide array of institutions is "vital to ensure unfettered development" of renewable energy (Sen & Ganguly, 2016, p. 9). There is also "a lack of awareness among policy makers on the opportunities and benefits of renewable energy" due to the lack of "specialised" and "knowledgeable" decision makers (Kumaran, et al., 2016, p. 938).

2.5.5 ENVIRONMENTAL SUSTAINABILITY

Oil palm biomass is an agricultural residue and an "energy source that derives directly or indirectly from natural processes related to sunlight" and that "is constantly, naturally replenished " (IEA, 2011, p. 8). It is "sustainable" as long as "the rate of extraction of this energy source does not exceed the natural rate of replenishment" (Ibid, p.8). Using agricultural residues such as oil palm biomass as fuel would result "in a balanced carbon cycle because they grow/renew themselves annually" (IRENA, 2014a, p. 45). Hence, the deployment of agricultural residue such as oil palm biomass in the national energy portfolio could contribute significantly to the national and global effort to reduce GHG emissions. Hence, as stated earlier, IRENA expects "biomass would be the single most important resource to mitigate climate change" with roughly 40% of the biomass originating from agricultural residues and wastes (IRENA, 2014a, p. 3).

However, oil palm biomass is a by-product from oil palm cultivation and, in recent years, land clearing for oil palm cultivation has received widespread criticisms over issues of "biodiversity, destruction of old growth rainforest and air pollution" (Sulaiman, et al., 2011, p. 3779). Furthermore, "logging rain forests or peat blogs for oil palm plantation has a negative effect", which "results in an increase in CO2 emissions in the atmosphere" (IRENA, 2014a, p. 45). These claims of loss of biodiversity and increase in greenhouse gas emissions from oil palm cultivation have also been cited by Sharaai, et al. (2015). In this regard, there are genuine concerns on the environmental sustainability of oil palm, which needs to be addressed. The way palm oil is milled has been described earlier as an environmentally threatening process that requires special treatment. Each tonne of Crude Palm Oil (CPO) requires 5 to 7.5 tonnes of water and more than 50% of it ends up as POME (Wu, et al., 2009). According to Lam and Lee (2011, p.125), if POME is discharged without proper treatment, the potential damage in 2009 is estimated to "be equivalent to the waste generated by 75 million people which is nearly thrice the current population in Malaysia ". The authors note that "many palm oil mills are still unable to adhere to the wastewater discharge limits and thus resulting to a dramatic increase in the number of polluted rivers" (Ibid, p.125). Another polluting feature of POME is that traditionally, it is processed through anaerobic digestion systems involving open POME ponds that emit into the atmosphere about 5.5 to 9 kg of methane for every tonne of FFB processed in the oil mill (Stichnothe & Schuchardt, 2011). As discussed earlier in section 2.4.1, the methane gas can be captured in a more efficient closed anaerobic digester tank system, and then burnt as fuel in boilers, gas engines or gas turbines to generate steam and power to mitigate this greenhouse gas (GHG) emissions. Hosseini et. al. (2013, p.457) have cited the enormous potential of POME to produce methane biogas for power generation, but cautioned that "the global warming potential of methane is 21 times more than CO2".. If methane is not captured and escapes directly to the atmosphere, it can cause serious harm to the environment and is reported to have the "highest impact towards the environment (climate change category)" in Malaysia (Lam & Lee, 2011, p. 127). Another air quality concern cited is the unpleasant odour from the improper management of oil palm biomass, particularly POME (Kumaran, et al., 2016 ; Shukery, et al., 2016).

Hosseini et. al.(2013, p.455) have suggested " a combination of renewable and sustainable bioenergy strategy and wastewater treatment" should be adopted. Likewise, Lam and Lee (2011, p.126) support the treatment of POME using wastewater treatment technologies that can meet the standard discharge limits of Malaysian waterways, coupled with "simultaneous bio-energies recovery strategy" to harness methane for power generation that can reduce the "wastewater treatment cost by producing green energies as by-products that is also very beneficial towards environmental protection". Garcia-Nunez, et al. (2016, p.110) have advocated the conversion of palm oil mills into biorefineries to comply with environmental standards and also to optimise the use of the available oil palm biomass "to improve the economic, social and environmental performance of the industry". According to Shukery, et al. (2016, p.2121), "a sustainable and integrated bio-refinery concept for a palm oil mill" can generate higher value-added products such as bio-fertiliser and "also benefit the surrounding community" including "electricity generation for the community".

In most developing countries such as Malaysia, "there is usually no economic incentive to develop waste-free processes", and "a cleaner production is therefore limited unless it is subsidised, externalities are factored in, products are successfully designed for commercial reuse and, most importantly, the government takes the initiative in legislating for a sustainable industrial development" (Wu, et al., 2009, p. 50). Consequently, it is doubtful whether the objective of EPP 5 to achieve the installation of biogas facilities in all Malaysian palm oil mills by the year 2020 can be achieved. Kumaran, et al. (2016, p.938) have suggested that "a regulatory enforcement on the installation of anaerobic digesters in all waste treatment facilities" to mitigate greenhouse gas emission and reduce the carbon footprint by substituting biogas for fossil fuel.

2.5.6 COMBINED HEAT AND POWER (CHP)

As Umar et al. (2014b) have reported in their industry survey above, majority of the palm oil mills in Malaysia were built more than 10 years ago, A decade ago issues of environmental sustainability, renewable energy and energy efficiency were of minor importance, and milling wastes were considered to be more of a nuisance, rather than a renewable resource, such that the emphasis had always been more on getting rid of the wastes, which "was incinerated to be disposed of" with hardly any effort made " to optimise process steam consumption or boiler or turbine efficiency" (Sulaiman, et al., 2011, p. 3780). Sadly, till this day many mills are still operating "based on out-dated assumptions about the abundance of primary fuels", in the way Bristow (2012) has commented that the global electricity system has directed very little attention towards energy efficiency to generate the maximum possible amount of usable heat and power from the minimum possible amount of fuel. Husain et al. (2003, p.117) have aptly described it –

> "The palm oil industry is one of those rare industries where very little attempt is made to save energy. The energy balance in a typical palm oil mill is far from optimum and there is considerable scope for improvement. "

Chua et al. (2011, p.709) note that most of the existing biomass combustion systems in Malaysia utilise "low efficiency low-pressure boilers with combined heat and power efficiency of less than 40%". One approach to technology improvement is to upgrade "the commonly-used low pressure boilers to higher pressure cogeneration systems" (Umar, et al., 2014b, p. 501).

As IRENA has highlighted, biomass CHP systems have higher overall efficiencies and are economically very attractive with the sale or opportunity value of the heat produced, especially where the low-cost agricultural residues as feedstock and the process heat needs are located together (IRENA, 2012, p. 41). The IEA has identified several effective policy tools to support CHP – "A co-generation strategy at the national level, covering technology development, incentives where needed, grid interconnection, and outreach/awareness, among other initiatives, with a government department/agency to implement the strategy" (IEA, 2011, p. 27). IRENA has also advocated the adoption of "strategies to grow industrial CHP use" to increase the deployment of biomass renewable heat (IRENA, 2014a, p. 59). As discussed in section 2.2.2, the Department of Energy & Climate Change (DECC) actively promotes and supports the development of

CHP schemes in the UK (DECC, 2015) ,and various government incentives are available in the UK for CHP schemes (DECC, 2008a). There is also an “adder” or bonus tariff for CHP in Germany’s EEG law (Mabee, et al., 2012, p. 486).

However, the IEA notes that unlike renewable electricity, “heat cannot be transported efficiently over large distances” and thus, it must be produced close to where the heat or steam is needed (IEA, 2011, p. 10).

2.6 SUMMARY

This chapter has explored the literature to illustrate the background, issues and challenges of the FiT scheme and oil palm renewable energy in Malaysia. As discussed earlier, the Cumulative Installed Capacity of Biomass Plants as at 1st September 2016 has reached only 68.40 MW (SEDA, 2016). The Cumulative Installed Capacity for Biogas (Landfill / Agricultural Waste) until September 2016 is only 18.88 MW. These achieved capacities are already far off the 2015 targets set in the Tenth Malaysian Plan (2011 -2015), namely 330 MW of biomass renewable energy (including other solid wastes) and 100 MW of biogas renewable energy (landfill/agricultural waste/other biogas). Furthermore, under the FiT scheme, biomass is targeted to contribute 800 MW of grid connected electricity by the year 2020 (Umar, et al., 2013). Such a huge disparity between the achieved and targeted generation capacities poses a challenge that needs to be researched and addressed by investigating the issues and challenges confronting the FiT scheme, leading to conclusions and recommendations for the stakeholders including policy makers and renewable energy developers, as this research aims to do.

As the literature review in this chapter has highlighted, the FiT in Malaysia is still fairly new. Umar, et al. (2014a) have explored some of the key barriers to the deployment of oil palm biomass renewable energy that remain unaddressed by the FiT scheme. Petinrin & Shaaban (2015) have discussed the potential of renewable energy in Malaysia, the initiatives and incentives to promote them, and the challenges to their deployment, focusing on renewable energy in Malaysia as a whole - hydropower, biomass and solar energy, biofuel and biodiesel, and wind generation. Sharaai, et al. (2015) have discussed the challenges facing the conversion of palm oil mill effluent (POME) to biogas for power generation in Malaysia and suggested the appropriate measures to promote its development. Guided by the work of Umar, et al. (2014b), Aghamohammadi, et al. (2016) have investigated the sustainability of power generation from oil palm biomass in the State of Sarawak, East Malaysia by conducting a survey among the palm oil millers there. Apart from these, the body of knowledge available on the performance of the FiT in Malaysia for oil palm biomass and biogas appears to be rather limited, as this chapter has clearly illustrated. More research is clearly needed to expand this limited body of knowledge in order to strengthen and advance the FiT scheme in Malaysia, as this research aims to do.

From the literature review, this chapter has identified six (6) key sustainability factors for the Malaysian FiT- based oil palm renewable energy businesses, namely sustainability of biomass supply chain, sustainability of renewable energy technology, sustainability of grid network system, sustainability of the FiT scheme for oil palm biomass/biogas, environmental sustainability, and Combined Heat and Power (CHP). These sustainability factors are critical to the concept of "sustainability management" to be discussed in the next chapter, which is defined as "approaches dealing with social, environmental, and economic issues in an integrated manner to transform organizations in a way that they contribute to the sustainable development of the economy and society" (Schaltegger, et al., 2015, p. 2). As this research will later illustrate, in order to "sustainably" and "successfully" manage FiT-based oil palm renewable energy businesses in Malaysia, the key sustainability factors as highlighted in this chapter will need to be addressed.

As the next chapter will illustrate, some of the information presented in this chapter will constitute the details to construct the building blocks or components of the Renewable Energy Business Models based on the FiT scheme. The key sustainability factors emerging from this chapter will later form part of the themes for the semi-structured interviews and focus group discussions with the relevant research participants. The literature review in this chapter will also serve as references in the discussion of the data findings from the semi-structured interviews and focus group discussions.

CHAPTER 3.0

BUSINESS MODELS

3.1 INTRODUCTION

In general, a Business Model “describes how a business creates value” and is now “an important new unit of analysis, highly relevant to both management theory and practice” (Wustenhagen & Boehnke, 2006, p. 255). Richter (2013, pp.1227-1228) describes the Business Model as “a valuable new tool for analysis and management in research and practice”, and “a classifying device to build generic categories or blueprints to understand business phenomena” or to be copied, varied or innovated. The concept “offers a framework for system-level innovation for sustainability and provides the conceptual linkage with the activities of the firm” (Bocken, et al., 2015, p. 67).

The utility of Business Models can best be summed up as follows (Osterwalder, et al., 2005): First, “Business models help to capture, visualize, understand, communicate and share the business logic” (Ibid, p.11). “Visual representation” of a business model helps in understanding “the relationship between the different elements of a business model”, and in communicating and sharing “this understanding with other stakeholders” (Ibid, p.11) and hence, it can improve decision making (Ibid, p.16). Second, “the business model concept can contribute in analyzing the business logic” as “a new unit of analysis” (Ibid, p.14). Capturing the business logic through a Business Model makes it “easier to identify the relevant measures to follow to improve management”. Third, by describing “the essential building blocks and their relationships”, the Business Model concept helps “managers to design a sustainable business model” (Ibid, p.15). The Business Model approach of “capturing and visualizing” the business logic “will improve planning, change and implementation” as depicted below:

The figure originally presented here cannot be made freely available via LJMU E-Theses Collection because of copyright.

The figure was sourced at Osterwalder, et al. (2005, p. 15).

Figure 3. 1 Business Models to aid planning, change and implementation
Source: *(Osterwalder, et al., 2005, p. 15)*

Fourth, “A formal and modular business model approach can foster innovation” (Ibid, p.16).

As discussed in Chapter 1.0, this research adopts the Business Model concept to investigate renewable energy businesses based on the FiT for oil palm biomass and biogas in Malaysia. Defining and mapping the Business Models of oil palm renewable energy businesses based on the FiT in Malaysia can “help to capture, visualize, understand, communicate and share the business logic”. A map or “visual representation” of the FiT-based Business Models can help in understanding “the relationship between the different elements” of the Business Models, and in communicating and sharing this understanding, which can improve decision making for the stakeholders including project developers, investors and policy makers. By “capturing and visualizing” the business logic and describing “the essential building blocks and their relationships”, the Business Model concept “will improve planning, change and implementation” for sustainability, as this research will later illustrate. Based on the findings from the semi-structured interviews and focus group discussions with the relevant stakeholders, this research will innovate the FiT-based Business Models to offer a transition towards Renewable Energy Business Models for Sustainability (Richter, 2013).

Hence this section will address the second Research Objective:

To critically review the concepts of Business Models and Sustainability in the current literature to derive the Business Models of renewable energy businesses based on the FiT for oil palm biomass/biogas in Malaysia (“FiT-based Renewable Energy Business Models”), and develop a Conceptual Framework to investigate and model “Successful” and “Sustainable” FiT-based Renewable Energy Business Models for Malaysia

3.2 BUSINESS MODELS

The definition of what is a Business Model has been extensively discussed in the literature but till today the concept is still ill defined. Although “everyone agrees that executives must know how business models work if their organizations are to thrive, yet there continues to be little agreement on an operating definition” (Casadesus-Masanell & Ricart, 2011). Similarly, Roome and Louche (2015, p.4) have pointed out that “despite the increasing number of articles published on business models, the concept remains ill defined”.

3.2.1 WHAT IS A BUSINESS MODEL?

In a recent article published in the Harvard Business Review, Ovans (2015) has outlined the development of the Business Model definition over the last 15 years, starting with Lewis (1999), followed by Magretta (2002), Johnson, et al. (2008), Osterwalder & Pigneur (2010) and Casadesus-Masanell & Ricart (2011). Lewis (1999, p.289) describes Business Model as “one of those terms of art that were central to the Internet boom: it glorified all manner of half-baked plans” and “all it really meant was how you planned to make money”. Magretta (2002) refers to Business Models as “stories that explain how enterprises work” and “a good business model answers” – “Who is the customer? And what does the customer value?"; "How do we make money in this business?"; "What is the underlying economic logic that explains how we can deliver value to customers at an appropriate cost?" (Ovans, 2015). According to Johnson, et al. (2008), a successful Business Model "can be broken down into four elements" as depicted below:

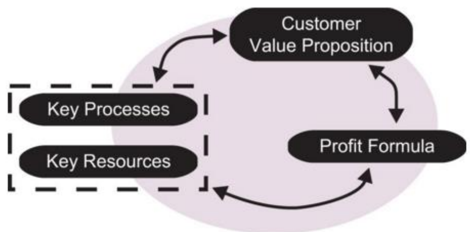


Figure 3. 2 Johnson's Business Model comprising 4 interrelated elements
Source: *(Johnson, 2014)*

The 4 interrelated elements of Johnson's model are – (1) Customer Value Proposition (Ibid, pp.7-8): "What are you aspiring to do for customers"? What is the "job-to-be-done"?;(2) Profit Formula (Ibid, p.9): "A blueprint detailing how the company will create value", comprising the Revenue Model, Cost Structure, Resource Velocity; (3) Key Resources (Ibid, pp.9-10): Key resources are the "combination of people, technology, equipment, funding and so forth which is required to deliver the value proposition to the customer"; and (4) Key Processes (Ibid, pp.10-11) : Key processes "are the recurring tasks which must be performed consistently in order to make delivering the customer value proposition repeatable".

Osterwalder & Pigneur (2010, p.14) define the Business Model as "the rationale of how an organisation creates, delivers and captures value". Their Business Model is represented as nine inter-connecting building blocks on a single page, as shown in the "Business Model Canvas" below.

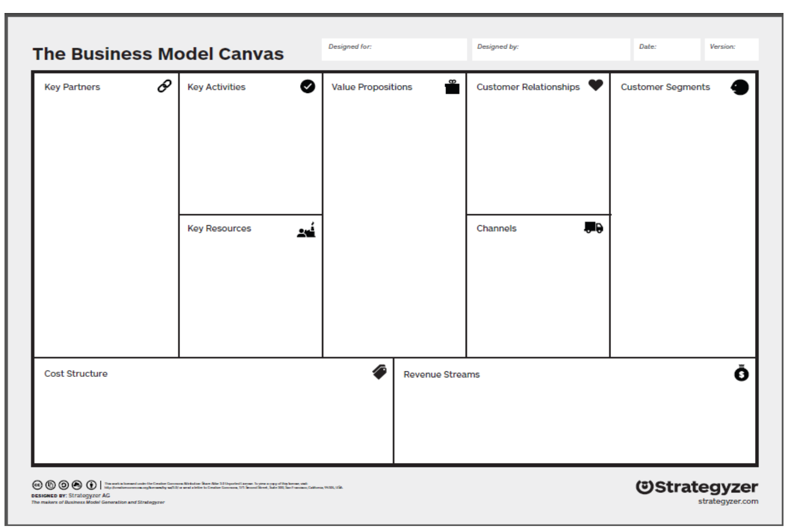


Figure 3. 3 Osterwalder's Business Model Canvas of 9 building blocks
Source: *(Strategyzer AG, 2015)*

The nine building blocks or components of the Osterwalder's Business Model are - (1) Customer Segments (Osterwalder & Pigneur, 2010, p. 41): "For whom are we creating value?" "Who are our most important customers?"; (2) Value Propositions (Ibid, pp.43-44): "What value do we deliver to the customer?" "Which one of our customer's problems are we helping to solve?" "Which customer needs are we satisfying?"; (3) Channels (Ibid, pp.47-48): "Through which Channels do our Customer Segments want to be reached?" "How are we reaching them now?" "How are our Channels integrated" "Which ones work best?" "Which ones are most cost-efficient?"; (4) Customer Relationships (Ibid, p.49): "What type of relationship does each of our Customer Segments expect us to establish and maintain with them?" "Which ones have we established" "How costly are they" "How are they integrated with the rest of our business model?"; (5) Revenue Streams (Ibid, p.51): "For what value are our customers really willing to pay?" "For what do they currently pay?" "How are they currently paying?"; (6) Key Resources (Ibid, pp.55-56): "What Key Resources do our Value Propositions require?" "Our Distribution Channels?" "Customer Relationships?" "Revenue Streams?"; (7) Key Activities (Ibid, pp.57-58): "What Key Activities do our Value Propositions require?" "Our Distribution Channels?" "Customer Relationships?" "Revenue Streams?"; (8) Key Partnerships (Ibid, pp.59-60): "Who are our Key Partners?" "Who are our key suppliers?" "Which Key Resources are we acquiring from partners?" "Which Key Activities do partners perform?"; and (9) Cost Structure (Ibid, pp.61-62): "What are the most important costs inherent in our business model?" "Which Key Resources are most expensive?" "Which Key Activities are most expensive?"

Casadesus-Masanell & Ricart (2011) approach the Business Model as a model consisting of "a set of managerial choices and the consequences of those choices". The authors refer to Business Models as "the logic of the company- how it operates and creates and captures value for stakeholders". Although the definition has developed considerably over the years, sadly, there is still no consensus on "What is a Business Model, Really?" (Casadesus-Masanell & Ricart, 2011). Roome & Louche (2015, p.4) point out that "despite this ambiguity, four core characteristics of business models emerge from the literature", namely "*value proposition*, referring to the value embedded in the product/service offered by the firm; *value network*, referring to the relationships with the network including customers, suppliers, and other actors; *value capture*, referring to costs and revenue streams; and *value creation and delivery*, referring to the key activities, resources, channels, technology, and patterns that create value and the way value is then (re)distributed."

3.2.2 OSTERWALDERS'S BUSINESS MODEL CANVAS

From a search of the recent literature on Business Models, Osterwalder's nine-part model appears as one of the most cited, advocated or adopted models. Upward and Jones (2015, p.4) note that Osterwalder's ontology of business models, developed through the dissertation research by Osterwalder (2004), “shows 2,873 citations in Google Scholar (2015) and has generated more impact than most other dissertations”, and “the widely known business model canvas (BMC), derived from the ontology, has become a de facto reference standard” with “over 1 million books sold” and “5 million downloads of the canvas template”. Randles and Laasch (2015, p.1) have termed the Osterwalder (2004) ontology of Business Models with its Business Model Canvas as the “acknowledged originator of the modern business model concept”.

This research argues that Osterwalder’s Business Model Canvas is the framework suited for this investigation of the FiT in Malaysia for oil palm biomass and biogas from a Business Model perspective. Firstly, it has been successfully applied in numerous studies related to renewable energies, as is the case with this investigation (APEC Energy Working Group, 2009; Okkonen & Suhonen, 2010; Sommer, 2011; Henriksen, et al., 2012; Beltramello, et al., 2013; Richter, 2013). Secondly, it enables a detailed discussion of business model elements including their characteristics and interrelationships in greater depth (Sommer, 2011) , and can provide more information and therefore have the potential to serve more needs to the stakeholders (Lambert, 2012). Thirdly, it is a popular (Bocken, et al., 2013) and practical tool (Muehlhausen, 2013) to construct maps of a business model, in this instance, the FiT Business Model, and to clarify the processes underlying them (Chesbrough, 2010). As Henriksen, et al. (2012) have pointed out, it was developed and published through open source collaboration with an international group of 470 practitioners. Hence, it should be the preferred modelling tool for the purpose of carrying out this investigation on the Business Models based on the FiT for oil palm renewable energy in Malaysia. Fourthly, it can be combined with other models to provide a well-suited basis to conceptualise business models as a unit of analysis (Sommer, 2011). Its components have been integrated with other business model components in numerous Business Model literature (Henriksen, et al.,2012; Lambert, 2012; Afuah, 2014), thereby offering the flexibility of integration with other Business Models for the purpose of this research. Finally, it is a helpful tool for Business Model Innovation or change to experiment with and adopt new business models (Chesbrough, 2010). Sommer (2011) uses it as a tool for “Managing Green Business Model Transformations” and Henriksen, et al. (2012) use it for “Green Business Model Innovation”.

3.3 RENEWABLE ENERGY BUSINESS MODELS

The International Energy Agency’s Implementing Agreement for Renewable Energy Technology Deployment (IEA-RETD) has commissioned a study on Business Models for “the deployment of renewable energy technologies and energy efficiency measures in the built environment” (IEA-RETD, 2013, p. 3). The IEA-RETD “brings together the experience and best practices of some of the world’s leading countries in renewable energy with the expertise of renowned consulting firms and academia”, whose member countries include Germany and the United Kingdom (Ibid, pp.3-4). Although the study by the IEA-RETD focuses only on Business Models for the deployment of renewable energy technologies in the built environment, their approach is still highly relevant to this investigation on Business Models of renewable energy businesses based on the FiT scheme. The IEA-RETD (2013, p.15) defines a Renewable Energy Business Model as:

> "*A strategy to invest in renewable energy technologies, which creates value and leads to an increased penetration of renewable energy technologies*".

This definition refers to policy instruments for "an increased penetration of renewable energy technologies" that create "value" for the renewable energy developers. One such instrument is the FiT scheme, which offers "new revenues for investors" from the "government incentives to renewable energy development" (Ibid, p.574). The FiT scheme can serve "as a stable basis for a business model" as it "guarantees access to a predictable and long-term revenue stream" (Ibid, p.67). As the IEA-RETD describes it, Business Models based on the FiT scheme fall under the category of "business models based on new and innovative revenue models" (Ibid, p.40). Hence, Business Models of renewable energy businesses based on the FiT scheme in Malaysia are in fact Renewable Energy Business Models based on new and innovative revenue schemes.

According to Aslani and Mohaghar (2013, p. 570), Renewable Energy Business Models "provide qualitative indicators to evaluate potential of the industry and companies to create economic value" in the renewable energy industry. Identifying, analyzing and understanding key features and aspects of Renewable Energy Business Models "can promote commercialization and diffusion of related technologies in this industry", and help "managers, investors and policy makers to study different aspects of business in the Renewable Energy industry" (Ibid, p.570). The IEA-RETD (2013, p.15) has emphasised the "increased penetration of renewable energy technologies" as an important feature of Renewable Energy Business Models. Thus, it is argued that in addition to value creation for the industry, Renewable Energy Business Models should also serve as a tool for policy makers to "promote commercialization and diffusion" of renewable energy technologies. As the study has pointed out, the strength of Renewable Energy Business Models based on the FiT scheme is that "it has a predictable and stable long-term cash flow from a credit-worthy counterpart" (IEA-RETD, 2013, p. 69) for the duration of the FiT. Investors can also combine "the use of a feed-in scheme with other available support mechanisms such as soft loans or fiscal incentives to improve financing conditions" (Ibid, p.69). These are some of the strengths of the FiT scheme for oil palm biomass/biogas in Malaysia as a policy instrument to increase the deployment of oil palm renewable energy, which are outlined in Chapter 2.0. However, as highlighted in the same chapter, there are still many issues and challenges confronting the FiT scheme in Malaysia for oil palm biomass/biogas.

The preceding section has established Osterwalder's Business Model Canvas as the framework well-suited for this investigation, particularly as the Canvas has been successfully applied in numerous studies relating to renewable energies (APEC Energy

Working Group, 2009 ; Okkonen & Suhonen, 2010; Sommer, 2011; Henriksen, et al., 2012; Beltramello, et al., 2013; Richter, 2013). Osterwalder's Business Model is defined as "the rationale of how an organisation creates, delivers and captures value" (Osterwalder & Pigneur, 2010, p. 14), and this research argues that this is indeed compatible with the Renewable Energy Business Model regarded by the IEA-RETD as strategies to create, deliver and capture value from investing in renewable energy technologies. Accordingly, the Business Model Canvas will be adopted in this investigation "to construct maps" of the Renewable Energy Business Models based on the FiT for oil palm renewable energy and "to clarify the processes underlying them" (Chesbrough, 2010).

3.4 MALAYSIAN RENEWABLE ENERGY BUSINESS MODELS

As stated above, this research adopts the Business Model Canvas to construct maps of the Renewable Energy Business Models based on the FiT for oil palm renewable energy in Malaysia, and to clarify the processes underlying them. The mapping process is aimed at discovering and describing (Afuah, 2014) the Business Models based on the FiT for oil palm renewable energy in Malaysia by using the nine interconnecting building blocks or components of Osterwalder's Business Model as discussed in section 3.2. As Afuah (2014, p.43) has aptly described, "it is the process of painting a portrait of the business model". The task here is "to detail what is going on within each of the building blocks of the model" (Ibid, p.44), and "the process should not leave out something that should be in the model but make sure that items that should not be there are not" (Ibid, p.45).

3.4.1 BIOMASS RENEWABLE ENERGY BUSINESS MODELS

The nine building blocks or components and their questions are listed below. Based on the information from the literature review in Chapter 2.0, the questions are answered to detail what is going on within each of the building blocks in order to construct the Renewable Energy Business Models based on the FiT for oil palm biomass, which is visually represented by the Business Model Canvas in Figure 3.4.

(1) CUSTOMER SEGMENTS - "For whom are we creating value?" "Who are our most important customers?":
The Distribution Licensee, namely SESB or TNB, as stated in Section 2.3.

(2) VALUE PROPOSITIONS - "What value do we deliver to the customer?" "Which one of our customer's problems are we helping to solve?" "Which customer needs are we satisfying?":
Renewable Electricity generated, exported to the grid and sold to the Distribution Licensee, as stated in section 2.3.

(3) CHANNELS - "Through which Channels do our Customer Segments want to be reached?" "How are we reaching them now?" "How are our Channels integrated" "Which ones work best?" "Which ones are most cost-efficient?":
The Grid infrastructure, as stated in section 2.5.3.

(4) CUSTOMER RELATIONSHIPS - "What type of relationship does each of our Customer Segments expect us to establish and maintain with them?" "Which ones have we

established" "How costly are they" "How are they integrated with the rest of our business model?":
The Renewable Energy Power Purchase Agreement (REPPA) between the Feed-in Approval Holder (renewable energy developer) and the Distribution Licensee for 16 years, as stated in section 2.3.

(5) REVENUE STREAMS - "For what value are our customers really willing to pay?" "For what do they currently pay?" "How are they currently paying?":
Payment of the FiT basic rate, and the FiT bonus rate for efficiency above 20%, as stated in section 2.3, are direct revenue streams. Indirect revenue streams which complement the FiT scheme include the Green Technology Financing Scheme subsidy of 2% on the interest costs, Investment Tax Allowance allowing qualifying capital expenditure incurred from 25th October 2013 until the year of assessment 2020 to be offset against 70% of the statutory income in the year of assessment , all as described in section 2.3.

(6) KEY RESOURCES - "What Key Resources do our Value Propositions require?" "Our Distribution Channels?" "Customer Relationships?" "Revenue Streams?":
Feedstock, namely Empty Fruit Bunches (EFB), Mesocarp Fibres and Palm Kernel Shells. Secure and long-term supply of Feedstock is essential as discussed in section 2.4.2, as well as operation technology and expertise as highlighted in section 2.5.

(7) KEY ACTIVITIES - "What Key Activities do our Value Propositions require?" "Our Distribution Channels?" "Customer Relationships?" "Revenue Streams?":
Grid interconnection as discussed in section 2.5.3; Transport, handling and storage of Feedstock, and Pre-treatment of Feedstock as described in section 2.4.2; and Feedstock combustion and power generation discussed in section 2.5.6.

(8) KEY PARTNERSHIPS - "Who are our Key Partners?" "Who are our key suppliers?" "Which Key Resources are we acquiring from partners?" "Which Key Activities do partners perform?":
Distribution Licensees – TNB and SESB, and Government Ministries and Agencies – KeTTHA and SEDA, as discussed in section 2.3. Also the feedstock suppliers – Palm Oil Mills in section 2.4.1.

(9) COST STRUCTURE - "What are the most important costs inherent in our business model?" "Which Key Resources are most expensive?" "Which Key Activities are most expensive?"
Grid connection costs in section 2.5.3, Financing costs as discussed in section 2.5.2, Feedstock and Transportation costs in section 2.4.2 , and Operational Costs as discussed in sections 2.4.2 and 2.5.6.

Key Partners	Key Activities	Value Propositions	Customer Relationships	Customer Segments
Distribution Licensees – TNB and SESB Government Ministries and Agencies – KeTTHA and SEDA Feedstock suppliers – Palm Oil Mills	Grid interconnection Transport, handling, storage of Feedstock Pre-treatment of Feedstock Feedstock combustion and power generation	Renewable Electricity generated, exported to the grid and sold to the utility company	Renewable Energy Power Purchase Agreement (REPPA) between the Feed-in Approval Holder (renewable energy developer) and the Distribution Licensee (power utility) for 16 years	Distribution Licensee –SESB or TNB
	Key Resources Feedstock – Empty Fruit Bunches (EFB), Mesocarp Fibres, Palm Kernel Shells Secure and long-term supply of Feedstock Operation technology and expertise		**Channels** Grid infrastructure	

Financial Cost Structure	Financial Revenue Streams
Grid connection costs Financing costs Feedstock costs Transportation of feedstock Operational costs	FiT basic rate FiT bonus rate for efficiency above 20% Green Technology Financing Scheme's subsidy of 2% on the interest costs Investment Tax Allowance allowing qualifying capital expenditure incurred from 25th October 2013 until the year of assessment 2020 to be offset against 70% of the statutory income in the year of assessment

Figure 3. 4 Biomass Renewable Energy Business Models

3.4.2 BIOGAS RENEWABLE ENERGY BUSINESS MODELS

The nine building blocks of the Renewable Energy Business Models based on the FiT for oil palm biogas, and their component questions are listed below. Based on the information from the literature review in Chapter 2.0, the questions in each block are answered to detail what is going on within each of the building blocks in order to construct the Biogas Renewable Energy Business Models represented by the Business Model Canvas in Figure 3.5.

(1) CUSTOMER SEGMENTS - "For whom are we creating value?" "Who are our most important customers?":
The Distribution Licensee, namely SESB or TNB, as stated in Section 2.3.

(2) VALUE PROPOSITIONS - “What value do we deliver to the customer?” “Which one of our customer’s problems are we helping to solve?” “Which customer needs are we satisfying?”:
Renewable Electricity generated, exported to the grid and sold to the Distribution Licensee, as stated in section 2.3.

(3) CHANNELS - “Through which Channels do our Customer Segments want to be reached?” “How are we reaching them now?” “How are our Channels integrated” “Which ones work best?” “Which ones are most cost-efficient?”:
The Grid infrastructure, as stated in section 2.5.3.

(4) CUSTOMER RELATIONSHIPS - “What type of relationship does each of our Customer Segments expect us to establish and maintain with them?” “Which ones have we established” “How costly are they” “How are they integrated with the rest of our business model?”:
The Renewable Energy Power Purchase Agreement (REPPA) between the Feed-in Approval Holder (renewable energy developer) and the Distribution Licensee (power utility) for 16 years, as stated in section 2.3.

(5) REVENUE STREAMS - “For what value are our customers really willing to pay?” “For what do they currently pay?” “How are they currently paying?”:
Payment of the FiT basic rate, and the FiT rate for locally assembled technology, as stated in section 2.3, are direct revenue streams. Indirect revenue streams which complement the FiT scheme include the Green Technology Financing Scheme subsidy of 2% on the interest costs, Investment Tax Allowance allowing qualifying capital expenditure incurred from 25th October 2013 until the year of assessment 2020 to be offset against 70% of the statutory income in the year of assessment, all as described in section 2.3.

(6) KEY RESOURCES - “What Key Resources do our Value Propositions require?” “Our Distribution Channels?” “Customer Relationships?” “Revenue Streams?”:
Feedstock, namely Palm Oil Mill Effluent (POME) as highlighted in section 2.4.2, as well as operation technology and expertise as mentioned in section 2.5.2.

(7) KEY ACTIVITIES - “What Key Activities do our Value Propositions require?” “Our Distribution Channels?” “Customer Relationships?” “Revenue Streams?”:
Grid interconnection as discussed in section 2.5.3; and Anaerobic digestion process and power generation discussed in section 2.5.5.

(8) KEY PARTNERSHIPS - “Who are our Key Partners?” “Who are our key suppliers?” “Which Key Resources are we acquiring from partners?” “Which Key Activities do partners perform?”:

Distribution Licensees – TNB and SESB, and Government Ministries and Agencies – KeTTHA and SEDA, as discussed in section 2.3. Also POME suppliers – Palm Oil Mills in section 2.4.1.

(9) COST STRUCTURE - “What are the most important costs inherent in our business model?” “Which Key Resources are most expensive?” “Which Key Activities are most expensive?”
Grid connection costs in section 2.5.3, Financing costs as discussed in section 2.5.2 and Operational costs in section 2.5.2.

<table>
<tr>
<td rowspan="2">Key Partners

Distribution Licensees – TNB and SESB

Government Ministries and Agencies – KeTTHA and SEDA

POME supplier – Palm Oil Mill</td>
<td>Key Activities

Anaerobic digestion process and power generation

Grid interconnection</td>
<td rowspan="2" colspan="2">Value Propositions

Renewable Electricity generated, exported to the grid and sold to the utility company</td>
<td>Customer Relationships
Renewable Energy Power Purchase Agreement (REPPA) between the Feed-in Approval Holder (renewable energy developer) and the Distribution Licensee (power utility) for 16 years</td>
<td rowspan="2">Customer Segments
Distribution Licensee –SESB or TNB</td>
</tr>
<tr>
<td>Key Resources

Feedstock – Palm Oil Mill Effluent (POME)

Operation technology and expertise</td>
<td>Channels

Grid infrastructure</td>
</tr>
<tr>
<td colspan="3">Financial Cost Structure

Grid connection costs

Operational costs

Financing costs</td>
<td colspan="3">Financial Revenue Streams

FiT Basic rate

FiT rate for locally assembled technology

Green Technology Financing Scheme’s subsidy of 2% on the interest costs

Investment Tax Allowance allowing qualifying capital expenditure incurred from 25th October 2013 until the year of assessment 2020 to be offset against 70% of the statutory income in the year of assessment</td>
</tr>
</table>

Figure 3. 5 Biogas Renewable Energy Business Models

3.5 BUSINESS MODELS FOR SUSTAINABILITY

The IEA-RETD notes that “research on business models generally focus on the strategy at a company level”. However, in their study, they have broadened “the definition of a business model to also include strategies of non-corporate actors" (IEA-RETD, 2013, p. 25). This research concurs that this approach should be adopted particularly in the case of FiT-based Business Models as the "the government is also a part of stakeholders that participates" in the scheme "as regulator and financial incentives provider" (Aslani & Mohaghar, 2013, p. 573), apart from investors and managers. Bocken, et al. (2014, p. 44) have highlighted that "a business model does not only have a company focus, but involves a wider set of stakeholders". They add that the model extends "beyond the entity of the firm, its customers and shareholders" (Ibid, p.44), consistent with Zott, et al. (2011, p. 1031) who wrote, "it outlines the essential details of a firm's value proposition for its various stakeholders as well as the activity system the firm uses to create and deliver value to its customers". As Section 3.5 below will illustrate, the Business Model Canvas focuses mainly on the customer and is "poorly suited for assisting a firm in generating wider sustainability across the full stakeholder network – including suppliers, local communities, and the wider society and the environment" and thus, "expert facilitation would be required to adapt the tool to different" contexts (Bocken, et al., 2013, p. 485). This research concurs with Bocken, et al.(2013, p.482) on the "need for economic, social and environmental sustainability" and argues that Renewable Energy Business Models must also be "sustainable" in order to capture not only economic value but also social and environmental value for a wide range of stakeholders. Thus, next section will discuss the concept of Business Models in the context of Sustainability based on current literature.

3.5.1 THE CONCEPT OF SUSTAINABILITY

Although "the literature is rife with attempts to define sustainability" (Stubbs & Cocklin, 2008, p. 104), "there is no consensus on this definition and a variety of sustainability worldviews are presented" (Ibid, p.105). This is echoed by Aghamohammadi, et al. (2016, p.2) who describe it as a vague concept but add that, however, most of the interpretations of sustainability do revolve around the "three components of sustainability namely, economy, environment and society". The World Commission on Environment and Development (WCED, 1987) refers to sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". This has led to concepts such "sustainability management" which is defined as "approaches dealing with social, environmental, and economic issues in an integrated manner to transform organizations in a way that they contribute to the sustainable development of the economy and society" (Schaltegger, et al., 2015, p. 2). Upward and Jones (2015, p.7) adopt the term "flourishing" by defining a "strongly sustainable firm" as "one that creates positive environmental, social, and economic value thorughout its value network, thereby sustaining the possibility that human and other life can flourish on this planet forever".

Noting that "stakeholders are increasingly interested in understanding the approach and performance of corporations in managing the economic, environmental and social" risks and opportunities, the Malaysian Stock Exchange or "Bursa Malaysia" has recently amended the Listing Requirements, requiring every Company listed on the Stock Exchange to disclose its "management of material economic, environmental and social risks and opportunities in its annual report" (Bursa Malaysia, 2015). In conjunction with these amendments, the Malaysian Stock Exchange has issued a "Sustainability Reporting Guide" to help listed Companies "on embedding sustainability in their organisations and reporting on it" (Ibid). Whilst acknowledging the above definition of sustainability by the WCED as "the most widely used definition globally" (Bursa Malaysia, 2015 a), the Guide views sustainability in the context of Economic, Environmental and Social (EES). Economic refers to: "*An organisation's impact on the economic conditions of its stakeholders and on economic systems at local, national, and global levels. Note: These may include the organisation's procurement practices, or community investment*" (Ibid, p.8). Environmental refers to: "*An organisation's impact on living and non-living natural systems, including land, air, water and ecosystems. Note: These may include the organisation's usage of energy and water, discharge of emissions, or loss of biodiversity, etc*." (Ibid, p.8). Social describes: "*The impacts an organisation has on the social systems within which it operates. Note: These may include the organisation's relationships with communities, employees, consumers, etc*." (Ibid, p.8). It highlights that the key benefits of integrating and reporting sustainability for businesses include, among others : "*Maintaining a licence to operate*" – a "social licence" rather than a "legal or regulatory" one, referring to the "implicit community-approval of an organisation's business operations", as communities are likely to be more supportive of businesses that integrate and report sustainability (Ibid, p.12); "*Securing capital*" - As investors are increasingly looking at an organisation's management of EES in addition to its financial performance, "improving sustainability performance and disclosures may provide organisations increased access to capital, locally and globally" (Ibid, p.13); "*Improving productivity and cost optimisation*" – Sustainability efforts can "enhance employee and supplier productivity" and lead to "cost efficiencies" (Ibid, p.13). The Guide cites the sustainability effort of a Malaysian plantation conglomerate to reduce Greenhouse Gas Emissions by capturing methane from POME, which "resulted in cost reductions and investment revenue generation" from using the methane to power its palm oil mills and selling the excess electricity generated to the grid (Ibid, p.14); and "*Enhancing brand value and reputation*" – "Stakeholders respond positively to organisations that conduct themselves in a sustainable and ethical manner", thereby enhancing brand value and reputation (Ibid, p.14).

The Sustainability Reporting Guide by the Malaysian Stock Exchange defines a stakeholder as "essentially an individual or a group that has an effect on, or is affected by the organisation and its activities" (Ibid, p.23). It is important to first identify who are the relevant stakeholders as it is not practical to engage with all the stakeholders. According to the Guide, "the relevant stakeholders are those with the highest level of influence or interest" (Ibid, p.23). This research concurs with Bursa Malaysia and argues that Economic, Environmental and Social sustainability is critical to the Malaysian FiT-based oil palm renewable energy businesses. First, it can help maintain "*a licence to operate*" or "implicit community-approval" to fund the FiT scheme, as the public is likely to be more supportive. Second, investors are increasingly looking at the management of Economic, Environmental and Social sustainability in addition to financial performance. Hence, improving sustainability performance and disclosures may provide increased access to capital, locally and globally for these businesses, particularly since lack of financing poses one of the greatest challenges as stated in section 2.5.2. Third, sustainability efforts can increase productivity and lead to cost efficiencies, which can result in cost reductions and revenue generation. Fourth, stakeholders respond positively to organisations that conduct themselves in a sustainable and ethical manner, thereby enhancing brand value and reputation of palm oil producers who are linked to the sustainable oil palm renewable energy businesses.

3.5.2 NORMATIVE REQUIREMENTS FOR SUSTAINABILITY

Embedding sustainability into the core of Business Models is strongly supported by an increasing body of literature (Stubbs & Cocklin, 2008; Boons & Ludeke-Freund, 2013;Bocken, et al., 2013;Bocken, et al., 2014;Schaltegger, et al., 2015;Upward & Jones, 2015;Abdelkafi & Tauscher, 2015;Gauthier & Gilomen, 2015;Roome & Louche, 2015), so much so that the journal, Organization & Environment, has dedicated a complete issue in 2015 to "*Business Models for Sustainability: Entrepreneurship, Innovations and Transformation*". Stubbs and Cocklin (2008) are probably the first few researchers to trigger this discourse linking Business Models and sustainability through their research entitled "*Conceptualizing a Sustainability Business Model*" (Upward & Jones, 2015; Schaltegger, et al., 2015). They conclude that "the characteristics and components of a sustainable business model" (Stubbs & Cocklin, 2008, p. 123) include: (1) Expressing the "purpose, vision and/or mission in terms of social, environmental, and economic outcomes" (Ibid, p.121); (2) Using "a triple bottom line approach in measuring performance" such as the reporting of "social and environmental indicators" together with "the financial indicators in an annual report" (Ibid, p.122); (3) Considering "the needs of all stakeholders" and acknowledging that "the organization's success is inextricably linked to the success of its stakeholders, including local communities, suppliers, partners, employees, and customers" (Ibid, p.122); (4) Acknowledging "nature as a stakeholder" and promoting "environmental stewardship" by using renewable resources, minimising waste and pollution, repairing any environmental damage caused and endeavouring to make "the whole supply chain sustainable – to do no harm to the environment" (Ibid, p122); (5) Adopting "the systems perspective as well as the firm-level perspective" by developing "internal structural and cultural capabilities to achieve firm-level sustainability" and collaborating "with key stakeholders to achieve sustainability for the system that the organization is part of" , which "requires changes in legislation and regulation", and "collaborative partnerships among stakeholders" (Ibid, p.122). The authors support "modifying the taxation system" to "encourage organizations to invest in infrastructure to support recycling, clean energy, clean transportation, and closed-loop systems (to avoid the environmental taxes)" (Ibid, p.117). Also important is a "community engagement strategy" to retain and reinvest capital in local communities (Ibid, p.117). In essence, it "revealed a set of normative principles of organizational development that together form an "ideal type" of sustainability oriented business model" (Schaltegger, et al., 2015, p. 1).

Subsequently, various studies have emerged on how to "understand, develop, and analyze" Business Models for Sustainability or Sustainability Business Models (Abdelkafi & Tauscher, 2015, p. 2). Boons and Ludeke-Freund (2013, p.15) describe Stubbs and Cocklin's Sustainable Business Model as "an expression of organizational and cultural changes in business practices and attitudes that integrate need and aspirations of sustainable development". It is argued that Stubbs and Cocklin's Model based on organisational and cultural changes in business practices and attitudes is insufficient as a foundation for Sustainable Business Models based on the FiT for oil palm biomass/biogas in Malaysia (Upward & Jones, 2015), although their proposed organisational and cultural changes can aid in the conceptualisation process as normative requirements for some of the constituting elements of the proposed Sustainable FiT-based Business Models.

Boons and Ludeke-Freund (2013, p.9) observe that "current literature does not offer a general conceptual definition of sustainable business models" (see also Abdelkafi & Tauscher, 2015; Roome & Louche, 2015; Upward & Jones, 2015 ; "an unequivocally supported definition of business models for sustainability is still missing" : Schaltegger, et al., 2015, p. 4). Schaltegger, et al. (2015, p.4), which is co-authored by Ludeke-Freund, describe Boons and Ludeke-Freund (2013) model of sustainability as a framework of *"basic normative requirements for each of the constituting elements of business models: The value proposition must provide both ecological or social and economic value through offering products and services, the business infrastructure must be rooted in principles of sustainable supply chain management, the customer interface must enable close relationships with customers and other stakeholders to be able to take responsibility for production and consumption systems (instead of simply "selling stuff"), and the financial model should distribute economic costs and benefits equitably among actors involved.*" This research argues that the set of "basic normative requirements" by Boons and Ludeke-Freund (2013) is, by itself, insufficient as a tool to conceptualise FiT-based Business Models for Sustainability although it can aid in the conceptualisation process as normative requirements for some of the constituting elements, similar to the normative principles of Stubbs and Cocklin (2008).

3.5.3 VALUE-BELIEFS-NORMS (VBN) THEORY

Abdelkafi and Tauscher (2015, p.2) approach Business Models for Sustainability by incorporating "sustainability as an integral part of the company's value proposition and value creation logic", and "as such, Business Models for Sustainability provide value to the customer and to the natural environment and/or our society". The authors note that although so far no study has offered "sufficient answers to the question what a sustainable business model might be", there is general agreement among researchers on "the creation of customer and social value and on the integration of social, environmental, and business activities" (Ibid, p.3). The authors conceptualise their

Business Model for Sustainability "from environmental cognition, a research area, which studies the behavior of individuals and organizations in favour or against the environment" (Ibid, p.10). By relying on the "values-beliefs-norms (VBN) theory" which "emerged from social psychology", the authors focus "on the cognition and behavior of entrepreneurs and managers as the individuals who develop the Business Model for Sustainability, and of customers as the individuals who are served by the Business Model" (Ibid, p.10). Their "system dynamics-based representation" (Ibid, p.12) of Business Models for Sustainability is reproduced below:

The figure originally presented here cannot be made freely available via LJMU E-Theses Collection because of copyright.

The figure was sourced at Abdelkafi and Tauscher (2015, p.12).

Figure 3. 6 System dynamics-based Business Models for Sustainability
Source: (Abdelkafi & Tauscher, 2015)

In their model, “environmental value proposition” is “the value proposition provided to stakeholders concerned about the environment” and is integrated to the model to conceptualise the Business Models for Sustainability (Ibid, p.8). The environment is represented by the “ecological capital” as “a monetary equivalent of the natural environment”. As the firm engages in value creation by consuming resources (see Arrow 1), “pollution and waste” is generated which decreases the ecological capital (see Arrow 2). As illustrated (Arrow 3), “the level of ecological capital and the changes of this level have an influence on the beliefs of the decision makers”. The environmental risk perceived by the decision maker transforms to his “personal norms” or “self-expectations regarding prosocial behaviour”, which “have an impact on the behaviour of the decision maker” (Arrows 4 and 5). This then “initiates a transformation to Business Model for Sustainability”. The decision maker “can influence the environment indirectly through the business model, in particular the value created (Arrow 13), change in customer value proposition (Arrow 14), change in value creation capacity (Arrow 15), and change in environmental value proposition (Arrow 16)”. As depicted, “a change in the environmental value proposition either increases (Arrow 17) or decreases (Arrow 18) the ecological capital” or the monetary equivalent of the natural environment. Hence their research conceptualizes a link between Business Models for Sustainability and “the decision maker’s cognitive representation of the natural environment”: “change in sustainability -related beliefs and norms of the decision maker” triggered by the natural environment “leads to a changing behavior”, and “the changed behavior can result in changes in the firm’s business model”, which then “feeds back to the environment” (Ibid, p.17).

As stated earlier, Abdelkafi and Tauscher’s Business Models for Sustainability rely on the “values-beliefs-norms (VBN) theory” which emerged from social psychology and focus on the cognition and behavior of individuals. This thesis investigates the FiT in Malaysia for oil palm biomass/biogas from a Business Model perspective, by focusing on the issues and challenges facing the FiT-based Business Models from the perspective of its stakeholders and offering Sustainable FiT-based Business Models for Malaysia. Value-beliefs-norms (VBN) theory related to social psychology is beyond the scope of this thesis and hence the model conceptualised by Abdelkafi and Tauscher has limited relevance to this research. As Bocken, et al. (2013, p.485) have suggested, maps that are “complicated and time-consuming” may not be suitable for business modelling and “using perspectives on value from economics, psychology, sociology and ecology” may be too complex.

3.5.4 STRONGLY SUSTAINABLE BUSINESS MODEL ONTOLOGY

Upward and Jones (2015, p.18) have contended that, although "the Business Model Canvas has shown to be quite powerful as a tool for formulating profit-normative business models", it "may leave their users exposed to material risks and missed opportunities due to overlooking the inherent ecological, social, and economic entailments of all business models". Based on their findings from a transdisciplinary review of the literature on "business models, industrial ecology, strategic management, ecological economics, environmental sociology, and positive psychology" (Ibid, p.6), Upward and Jones have formulated "a comprehensive ontology" or "framework of strongly sustainable business model (SSBM) propositions and principles" (Ibid, p.6), which extends "Osterwalder profit-oriented ontology for business models" (Ibid, p.1). As pointed out, "the core concepts and functions" of Osterwalder's Business Model Ontology "remain, albeit generalized, extended or overloaded" (Ibid, p.13). The formative propositions of the Strongly Sustainable Business Model Ontology are: (1) A strongly sustainable firm is defined as "one that creates positive environmental, social, and economic value throughout its value network, thereby sustaining the possibility that human and other life can flourish on this planet forever" (Ibid, p.7); (2) The definition of value is revised from the narrow definition of value "as a source of individual or organizational enrichment, measured uniquely in monetary units, to a wider and "socially responsive understanding of value", "measured in aesthetic, psychological, physiological, utilitarian, and/or monetary terms" (Ibid, p.8-9); (3) The definition of a Business Model is reconceptualised: "the business model is reformulated as a systemic model of necessary and sufficient concepts" that "explicitly consider the relationship of a business with the natural environment, society, and economy in which the business is situated and interconnected and on which the business is ultimately dependent, and with all the individuals involved in that business" (Ibid, pp.9-10); (4) The definition of profit is reconceptualised and replaced with "tri-profit" as "a new inclusive conceptual metric", "calculated as the conceptual net sum of the costs (harms) and revenues (benefits) arising as a result of a firm's activities in each of the environmental, social , and economic contexts in a given time period" measured using "monetary units, and nonfinancial metrics, in various units of measure" (Ibid, p.10). From the ontology of the Strongly Sustainable Business Model, "a visual practitioner tool (canvas)" (Ibid, p.21) has been derived as presented below:

The figure originally presented here cannot be made freely available via LJMU E-Theses Collection because of copyright.

The figure was sourced at Jones and Upward (2014).

Figure 3. 7 Strongly Sustainable Business Model Canvas
Source: (Jones & Upward, 2014)

As depicted above, the Strongly Sustainable Business Model Canvas shows the boundary of the organisation – "Your Organization" and 3 contexts for the organisation: (1) "Environment (Physical, Chemical and Biological)"; (2) "Society (Social, Technological); and (3) "Financial Economy (Monetary)". The Canvas highlights 4 perspectives important to a Business Model (Jones & Upward, 2014, p. 4): (1) "Product, Learning and Development – what the organization does now and in the future"; (2) "Stakeholder – who the organization does it for, to and with"; (3) "Process – how, where and with what does the organization do it"; and (4) "Measurement – how does the organization define and measure its success". Based on these 4 perspectives, Upward and Jones (2015, p.10) define a Business Model as " a description of the logic for an organization's existence: who it does it for, to and with; what it does now and in the future; how, where and with what does it do it; and how it defines and measures its success". The Canvas has 18 blocks and, similar to Osterwalder's Business Model

Canvas, each has its own set of questions to be answered to help construct the Strongly Sustainable Business Model.

This research acknowledges the Strongly Sustainable Business Model Canvas based on 3 contexts and 4 perspectives, comprising 18 building blocks, as a comprehensive tool but argues against adopting it for this investigation, as the apparent complexity of this tool makes it difficult to understand and use (cf. "apparent simplicity" of the Value Mapping Tool "ensuring ease of understanding and use": Bocken, et al., 2013, p.495). It should be noted that what all these different Business Models for Sustainability discussed so far have in common is that they seek to extend the value creation toward social and environmental values, which "distinguish the discourse on business models for sustainability from their conventional antecedents" based on "one-dimensional profit maximization, without considering the consequences for the wider social and ecological contexts" (Schaltegger, et al., 2015, p. 3). This research will argue and illustrate below that the value creation of profit-oriented tool such as Osterwalder's Business Model Canvas can still be extended towards social and environmental values by using a less complex approach that is easier to use and understand. Furthermore, as the inventor of the tool himself has acknowledged, the Strongly Sustainable Business Model Canvas is still "currently being further developed and tested" (Upward, 2015).

3.5.6 VALUE MAPPING TOOL

According to Bocken, et al. (2013, p. 484), "sustainable business models seek to go beyond delivering economic value and include a consideration of other forms of value for a broader range of stakeholders". Business model innovation for sustainability can "radically improve sustainable performance to create greater environmental and social value while delivering economic sustainability" (Ibid, p.483). The scholars add that the business modelling process for embedding sustainability or "sustainable business modelling" "offers a more holistic perspective that incorporates all three dimensions of sustainability (i.e. social, environmental and economic)" (Ibid, p.483). The authors have developed a "value mapping tool" to support the sustainable business modelling process, as shown below:

The figure originally presented here cannot be made freely available via LJMU E-Theses Collection because of copyright. The figure was sourced at Bocken, et al. (2013).

Figure 3. 8 Value Mapping Tool
Source: (Bocken, et al., 2013)

This tool helps users to (1) “understand the positive and negative aspects of the value proposition” in a “network of stakeholders involved in creation, delivery and receipt of value”; (2) “identify conflicting values (i.e. where one stakeholder benefit creates a negative for another stakeholder)”; and (3) “identify opportunities” for business model transformation “to reduce negative outcomes and improve the overall outcome for the stakeholders” – “especially for society and environment” (Ibid, p.489). One important aspect of this tool is that it “seeks to expand the range of stakeholders or recipients of value” to include “the environment and society” (Ibid, p.489). It “adopts a multiple stakeholder view of value, a network rather than firm centric perspective” (Ibid, p. 482). There are 4 stakeholder segments (Ibid, pp.490 – 491): (1) Environment – explore the environmental benefits and negative impacts; (2) Society – includes government, community and employees to explore the societal benefits and negative impacts; (3) Customers – explore the perceived and actual benefits and negative impacts.; and (4) Network actors – includes “the focal firm, investors, suppliers, partners, distribution channels, and in some cases also media, academia”. The tool explores by “starting at the centre of the circle and working outwards: from purpose and value proposition, to value destroyed and missed, through to exploring new opportunities for value creation” (Ibid, p.492). The first ring “Purpose” explores the purpose of the business by probing “Why is the business here in the first place? What is the primary reason for the existence of the business (this should not be primarily financial)?” (Bocken, 2013). The second ring “Value Captured” explores the “current Value Proposition” by probing “What value is created for the different types of stakeholders? What positive value is created and what negative value do all the stakeholders mitigate?" (Ibid). The third ring "Value Missed, Destroyed or Wasted" explores the "negative outcomes, or value inadequately captured by current model", by probing "What is the value destroyed or missed or negative outcomes for any of the stakeholders? Is the business missing an opportunity to capture value, or squandering value in its existing operations? Are assets, capacity and capabilities under-utilised?" (Ibid). The fourth ring "Value Opportunities" explores "new opportunities for additional value creation and capture through new activities and relationships" by focusing "on turning the negatives to positives" and by probing "What new positive value might the network create for its stakeholders through introduction of activities and collaborations? (Ibid). Bocken, et al. (2015, p.77) suggest that "the business model canvas by Osterwalder" can then be used as a follow-up tool "to map the business model elements that need to be changed (e.g. value proposition, activities and partnerships) as a result of the new business model idea" generated by the Value Mapping Tool.

This research concurs with Bocken, et al. (2013, p.495) that the "apparent simplicity of the tool is an important strength ensuring ease of understanding and use", and it is applicable from exploring new Business Models, assisting in transforming existing Business Models, to "use in public sector and non-government organisations" (Ibid, p.495), including serving as "a framework for macro-level analysis of industry" for policy makers (Ibid, p.493). This research adopts the Value Mapping Tool as "it provides a simple and visually engaging format" (Bocken, et al., 2015, p. 70) to "assist in the design of sustainable business models, by considering different forms of value exchanges for a range of stakeholders as part of the business model" (Ibid, p.67).

3.5.7 TRIPLE BOTTOM LINE BUSINESS MODEL CANVAS

As mentioned above, Osterwalder's Business Model Canvas is based on profit maximization without considering the consequences for the wider social and environmental contexts. "The focal point of the business model canvas is the value proposition for the customer, and limited stakeholders (i.e. those in the supply chain such as partners and suppliers) are considered" whilst "stakeholders such as 'society" and "environment" are excluded from the canvas" (Bocken, et al., 2015, p. 69). Acknowledging the need to "embed sustainability in the business by considering environmental and social value" (Bocken, et al., 2013, p. 488), Osterwalder and Pigneur (2010, p.285) have extended their Business Model Canvas to accommodate "triple bottom line" or "the practice of accounting for environmental and social, as well as financial, costs". This Triple Bottom Line Business Model Canvas has 2 additional building blocks, namely "The Social and Environmental Costs of a Business Model (i.e. its negative impact)" and "The Social and Environmental Benefits of a Business Model (i.e. its positive impact)" (Ibid, p.286), as depicted below:

<table>
<tr><td rowspan="2">Key Partners</td><td>Key Activities</td><td rowspan="2" colspan="2">Value Propositions</td><td>Customer Relationships</td><td rowspan="2">Customer Segments</td></tr>
<tr><td>Key Resources</td><td>Channels</td></tr>
<tr><td colspan="3">Financial Cost Structure</td><td colspan="3">Financial Revenue Streams</td></tr>
<tr><td colspan="3">Social and Environmental Costs</td><td colspan="3">Social and Environmental Benefits</td></tr>
</table>

Figure 3. 9 Triple Bottom Line Business Model Canvas of 11 Building Blocks
Source: (Osterwalder & Pigneur, 2010)

A Triple Bottom Line Business Model Canvas seeks to maximise Financial Revenue and minimise Financial Costs, whilst minimising Social and Environmental Costs and maximising Social and Environmental Benefits (Ibid, p.287). Hence, this research will also adopt the Triple Bottom Line Business Model Canvas to complement the Value Mapping Tool of Bocken, et al. (2013), to investigate and model Sustainable FiT-based Business Models for oil palm biomass and biogas in Malaysia.

With all the different approaches to conceptualise Business Models for Sustainability as discussed above, it is apparent that "an unequivocally supported definition of business models for sustainability is still missing" (Schaltegger, et al., 2015, p. 4). This research concurs with Schaltegger, et al. (2015, p.4) who have proposed the following definition "based on the present literature":

> *"A business model for sustainability helps describing, analyzing, managing, and communicating (i) a company's sustainable value proposition to its customers, and all other stakeholders, (ii) how it creates and delivers this value, (iii) and how it captures economic value while maintaining or regenerating natural, social, and economic capital beyond its organizational boundaries."*

As pointed out, this definition combines the "conceptual characteristics of business models" of Osterwalder, et al. (2005) with "the need to integrate multiple stakeholders and their diverse value conceptions" (SustainableBusinessModel.org, 2016).

3.6 CONCEPTUAL FRAMEWORK FOR BUSINESS MODEL INNOVATIONS

Gauthier and Gilomen (2015, p.16) have identified 4 broad categories of business model transformations for sustainability: (1) "Business model as usual" with no changes in the Business Model components ;(2) "Business model adjustment" with marginal changes in the Business Model components; (3) “Business model innovation” with substantial changes in the Business Model components; and (4) “Business model redesign” with radical changes in the Business Model components. This research aims to investigate and propose substantial changes to the Business Models of the renewable energy businesses based on the FiT for oil palm biomass/biogas in Malaysia. Hence, it will adopt the “business model innovation” approach to offer a transition towards Sustainable FiT-based Business Models.

Roome and Louche (2015) have also focused on the process of transformation leading to the development of Business Models for Sustainability. The authors note “in the case of business models for sustainable development, it is also necessary to take account of the question of value destruction” (Ibid, p.3). According to them, “a business model that contributes to sustainable development might realistically be expected to mitigate the destruction of value in and on society and its environment”, and “knowing what value is being destroyed and taking steps to reduce or mitigate those impacts is as important to a business model for sustainability as the creation of value for the firm and society” (Ibid, p.3). They use “the main four elements found in the literature on business models” namely “value proposition, value network, value capture, and value creation and delivery” and “add a fifth element to this framework – value destruction” (Ibid, p.13). The authors argue by citing Stubbs and Cocklin (2008) that “definitions of sustainable development, which consider companies as actors in connection and interrelation with other actors in economic and social systems, rather than independent entities, necessitate a broader understanding of ‘value’ than usual” (Ibid, p.3). Hence, Business Models for Sustainability “must be designed so as to allow the firm to envision and capture the notion of value for the company itself and for society”, which “involves engagement with a wider set of actors and necessitates a broader value network perspective” (Ibid, p.3). According to Bocken, et al. (2014, p. 44), innovations for sustainability involve:

> “*Innovations that create significant positive and/or significantly reduced negative impacts for the environment and/or society, through changes in the way the organisation and its value-network create, deliver value and capture value (i.e. create economic value) or change their value propositions*”

From the preceding literature review, this research will now develop a framework for innovating both the Biomass and Biogas Renewable Energy Business Models mapped out in section 3.4, to transform them into Business Models for Sustainability. This framework combines the normative requirements of Stubbs & Cocklin (2008) and Boons and Ludeke-Freund (2013), the Value Mapping Tool of Bocken, et al. (2013) and the Triple Bottom Line Business Model Canvas of Osterwalder & Pigneur (2010, p. 285), as represented in Figure 3.10 below. This framework will guide the later part of this research to investigate, model and recommend Sustainable Business Models for renewable energy businesses based on the FiT for oil palm biomass and biogas in Malaysia. By combining Osterwalder’s Business Model concept with Bocken’s Value Mapping Tool in order to capture not only economic value but also social and environmental value for a wide range of stakeholders, this framework will lead to the development of a Business Model for Sustainability that "*helps describing, analyzing, managing, and communicating (i) a company's sustainable value proposition to its customers, and all other stakeholders, (ii) how it creates and delivers this value, (iii) and how it captures economic value while maintaining or regenerating natural, social, and economic capital beyond its organizational boundaries* " (Schaltegger, et al., 2015, p. 4).

As discussed earlier in section 3.3, the IEA-RETD (2013, p.15), as a leading authority on renewable energies, has emphasised the "increased penetration of renewable energy technologies" as an important feature of Renewable Energy Business Models. In addition to value creation, Renewable Energy Business Models should also serve as a tool for policy makers to promote commercialization and diffusion of renewable energy technologies. According to the IEA-RETD (2013, p.36), "successful" Renewable Energy Business Models represent strategies in which the deployment of renewable energy is structured such that the "barriers for realisation of renewable energy are – at least to some degree – overcome". The IEA-RETD (2013) has also investigated and analysed the relevant Renewable Energy Business Models, leading to conclusions and finally recommendations for the stakeholders including policy makers and investors. This research concurs with the IEA-RETD that "successful" Renewable Energy Business Models based on the FiT for oil palm biomass/biogas in Malaysia should – at least to some degree – overcome the barriers which inhibit value creation and hinder an increased deployment of oil palm renewable energy. In other words, "successful" Renewable Energy Business Models based on the FiT should – at least to some degree – increase the deployment of oil palm renewable energy in Malaysia. As stated earlier, the IEA-RETD is a leading authority on renewable energies, and hence, their Renewable Energy Business Model's definition and approach should be incorporated into this investigation. Therefore, the Renewable Energy Business Model innovations in this research should be extended to include innovations that lead to an increased penetration of renewable energy technologies such that the "*barriers for realisation of renewable energy are – at least to some degree – overcome*" (IEA-RETD, 2013, p. 36), in addition to innovations for sustainability "*that create significant positive and/or significantly reduced negative impacts for the environment and/or society, through changes in the way the organisation and its value-network create, deliver value and capture value (i.e. create economic value) or change their value propositions*" (Bocken, et al., 2014, p. 44).

This research will investigate, model and recommend Malaysian Renewable Energy Business Models that capture not only economic value but also social and environmental value for a wide range of stakeholders, and overcome at least to some degree barriers for realisation of renewable energy, leading to an increased deployment of oil palm renewable energy in Malaysia. The conceptual framework of this research for innovations toward sustainability and innovations leading to an increased deployment of oil palm renewable energy in Malaysia is presented below:

<table>
<tr><th colspan="4">A Conceptual Framework to Investigate and Model “Sustainable” and “Successful”
Renewable Energy Business Models for Malaysia</th></tr>
<tr><td colspan="3">“A business model for sustainability helps describing, analyzing, managing, and communicating (i) a company’s sustainable value proposition to its customers, and all other stakeholders, (ii) how it creates and delivers this value, (iii) and how it captures economic value while maintaining or regenerating natural, social, and economic capital beyond its organizational boundaries” (Schaltegger, et al., 2015, p. 4).</td><td rowspan="2">“Successful business models represent situations in which the financing and implementation of renewable energy technology” are “organised in a way that barriers for the realisation of renewable energy are – at least to some degree -overcome” (IEA-RETD, 2013, p. 36).</td></tr>
<tr><th>Stubbs and Cocklin (2008), and
Boons and Ludeke-Freund (2013)</th><th>Value Mapping Tool of
Bocken, et al. (2013)</th><th>Triple Bottom Line Canvas of
Osterwalder and Pigneur (2010)</th></tr>
<tr><td rowspan="2">(1) Expressing the “purpose, vision and/or mission in terms of social, environmental, and economic outcomes”.
(2) Reporting of “social and environmental indicators” together with “the financial indicators in an annual report”.
(3) Considering “the needs of all stakeholders”. Acknowledging “nature as a stakeholder”.
(4) Adopting “the systems perspective as well as the firm-level perspective” of sustainability, which “requires changes in legislation and regulation”. “Community engagement strategy” to retain and reinvest capital in local communities.
(5) The value proposition must provide both ecological or social and economic value through offering products and services.
(6) The business infrastructure must be rooted in principles of sustainable supply chain management.
(7) The customer interface must enable close relationships with customers and other stakeholders to be able to take responsibility for production and consumption systems.
(8) The financial model should distribute economic costs and benefits equitably among actors involved.</td><td rowspan="2">Purpose
“Why is the business here in the first place? What is the product or service offered by the company or business unit? What is the primary reason for the existence of the business (this should not be primarily financial)?”

Value Captured
“What value is created for the different types of stakeholders? What positive value is created and what negative value do all the stakeholders mitigate?”

Value Missed, Destroyed or Wasted
“What is the value destroyed or missed or negative outcomes for any of the stakeholders? Is the business missing an opportunity to capture value, or squandering value in its existing operations? Are assets, capacity and capabilities under-utilised?”

Value Opportunities
“What new positive value might the network create for its stakeholders through introduction of activities and collaborations?</td><td rowspan="2">Value Propositions?

Key Partners?

Key Activities?

Key Resources?

Customer Segments?

Customer Relationships?

Channels?

Financial Revenue Streams?

Financial Cost Structure?

Social and Environmental Benefits?

Social and Environmental Costs?</td><th>IEA-RETD (2013)</th></tr>
<tr><td>What are the barriers for realisation of oil palm renewable energy in Malaysia?

What are the potential strategies to overcome- at least to some degree- the barriers for realisation of oil palm renewable energy in Malaysia?

What are the recommendations for the stakeholders including policy makers and investors?</td></tr>
</table>

Figure 3. 10 A Conceptual Framework to model Sustainable Renewable Energy Business Models

3.7 MALAYSIAN RENEWABLE ENERGY BUSINESS MODEL STAKEHOLDERS

As discussed earlier in Section 3.5, a Business Model does not only have a company focus, but involves a wider set of stakeholders (Bocken, et al., 2014). The model extends beyond the entity of the firm, its customers and shareholders. In a "Peer Review on Low Carbon Energy Policies in Malaysia" endorsed by the APEC Energy Working Group (APEC, 2014), the groups identified and consulted as key renewable energy stakeholders in Malaysia are 1)Ministries and Government Agencies including the Ministry of Energy, Green Technology and Water (KeTTHA), Sustainable Energy Development Authority (SEDA) and the Energy Commission; 2) Distribution Licensee - Tenaga Nasional Berhad (TNB); and 3) Renewable Energy Developers. These are also the key stakeholders of the Malaysian Renewable Energy Business Models for Biomass and Biogas, as illustrated in Figures 3.4 and 3.5 respectively. As highlighted in Section 3.5, the Government Ministries and Agencies are important stakeholders as they participate in the FiT scheme as regulator and financial incentives provider.

Aslani & Mohaghar (2013, p. 573) have defined the "Stakeholder Side" of Renewable Energy Business Models to include the "government, suppliers, investors, local population, non-profit organizations, researchers, and users/customers". Their view is consistent with Bocken, et al. (2013, p.489) who have adopted a multiple stakeholder perspective to include "Academia, Customers, Investors and Shareholders, Employees, Suppliers and Partners, Environment, Community, Government, External Agencies, Media". As discussed in section 3.5.1 above, the Sustainability Reporting Guide of the Malaysian Stock Exchange defines a stakeholder as "essentially an individual or a group that has an effect on, or is affected by the organisation and its activities" (Bursa Malaysia, 2015 a, p. 23). According to the Sustainability Guide, it is important to first identify who are the relevant stakeholders as it is not practical to engage with all the stakeholders, and "the relevant stakeholders are those with the highest level of influence or interest" (Ibid, p.23).

This research adopts the multiple stakeholder perspective of Bocken, et al. (2013), which include "Academia, Customers, Investors and Shareholders, Partners, Environment, Community, Government, External Agencies", but focuses only on "the relevant stakeholders" or "those with the highest level of influence or interest". Hence, the key renewable energy stakeholders in Malaysia, as identified above, will be consulted as the "relevant stakeholders": (1) "Government" and "External Agencies" - the Ministry of Energy, Green Technology and Water (KeTTHA) and the Sustainable Energy Development Authority (SEDA); (2) "Customers" – the Distribution Licensee i.e. Tenaga Nasional Berhad (TNB) or Sabah Electricity Sdn. Bhd. (SESB); and (3) "Investors and Shareholders" – the Renewable Energy Developers. This approach is consistent with the major stakeholders identified by the IEA-RETD (2013, p.68), namely "the institution that makes the payment available (government, network operator) and the recipient". The stakeholders "Environment" and "Community (Society)" will not be consulted directly but environmental and societal views will be sought from the other relevant stakeholders as well as the literature. Academics ("Academia") who have researched on power generation from oil palm biomass in Malaysia are "relevant stakeholders", as are the Project Consultants ("Partners") who design and commission the Malaysian Biomass and Biogas Power Plants.

Section 5.2.2 will further discuss the stakeholders to be consulted for the purpose of this investigation, namely: 1) Academics; 2) Distribution Licensee – TNB and SESB; 3) Renewable Energy Developers; 4) Project Consultants; and 5) KeTTHA and SEDA. These stakeholders should be targeted as they are the (1) People involved in the oil palm biomass and biogas FiT policy design, reform and implementation; (2) People who are affected by the issues and challenges facing the deployment of renewable energy from oil palm biomass/biogas; and (3) People who may be affected by the recommendations made in this investigation (Majchrzak & Markus, 2014). As Petinrin & Shaaban (2015, p.980) have stated, "the prospect and vision of renewable energy is tremendously bright in Malaysia if all the stakeholders cooperate and collaborate synergistically to make the vision a reality". However, the stakeholders in the Malaysian renewable energy industry "appear to be less organized and under-represented" except for the stakeholders in the solar photovoltaic industry, and there appears to be no association representing the "collective views, interests and concerns" of the stakeholders in the Malaysian oil palm renewable energy industry (Yatim, et al., 2016, p. 9).

3.8 SUMMARY

This chapter has shown that the Business Model approach can be used in this research, to study, advance and embed sustainability in Malaysian oil palm renewable energy businesses. However, as the literature search in this chapter has revealed, the number of publications on Business Models for renewable energy is still very limited. Apart from Wustenhagen and Boehnke (2006), APEC Energy Working Group (2009), Okkonen and Suhonen (2010), Aslani and Mohaghar (2013), Richter (2013), and IEA-RETD (2013), nothing significant has yet been found on Renewable Energy Business Models. In fact, there is hardly anything yet on Renewable Energy Business Models based on the FiT for oil palm biomass and biogas in Malaysia or anywhere else.

From the literature review, this chapter has established the Business Model Canvas (Osterwalder & Pigneur, 2010) as a tool well-suited for this research to investigate and map the Business Models of renewable energy businesses based on the FiT for oil palm biomass/biogas in Malaysia. The information derived from the literature review in chapter 2.0 has provided the details to map the building blocks or components of the existing Renewable Energy Business Models based on the FiT scheme. Later, in line with the "business model innovation" approach (Gauthier & Gilomen, 2015, p. 16), this research will investigate and then propose substantial changes to innovate these FiT-based

Renewable Energy Business Models to offer a transition towards Renewable Energy Business Models for Sustainability (Richter, 2013).

This chapter has argued that Economic, Environmental and Social sustainability is critical to the Malaysian oil palm renewable energy businesses based on the FiT, as sustainability efforts can increase productivity and lead to cost efficiencies, provide increased access to capital, locally and globally, and enhance brand value and reputation of palm oil producers who are linked to the sustainable oil palm renewable energy businesses. As the discussion in this chapter has shown, the concept of sustainability has gained significant momentum over the recent years, with an increasing body of literature emerging on Business Models for Sustainability.

However, as the literature search in this chapter has revealed, an unequivocally supported approach to conceptualise Business Models for Sustainability is still missing. From a critical review of the current literature on Business Models for Sustainability, this chapter has justified the adoption of a combination of multiple conceptualisation approaches to investigate and offer a transition towards Sustainable Business Models. It has combined in section 3.6 the normative requirements of Stubbs & Cocklin (2008) and Boons and Ludeke-Freund (2013), the Value Mapping Tool of Bocken, et al. (2013) and the Triple Bottom Line Business Model Canvas of Osterwalder & Pigneur (2010, p. 285) to develop a Conceptual Framework to investigate and model “Sustainable” Renewable Energy Business Models based on the FiT for oil palm biomass and biogas in Malaysia. This chapter has argued that the System dynamics-based Business Models for Sustainability (Abdelkafi & Tauscher, 2015) relying on the values-beliefs-norms (VBN) theory, and the Strongly Sustainable Business Model Canvas (Jones & Upward, 2014) are not practical for business modelling due to their complexity.

Based on the IEA-RETD (2013, p.36) approach to “successful business models”, this chapter has argued the need for Renewable Energy Business Models to be “successful” as well as “sustainable” to overcome, at least to some degree, the barriers for the realisation of renewable energy. Hence, the proposed Conceptual Framework was extended to investigate the barriers, and identify the potential strategies to address them in order to stimulate an increased deployment of oil palm renewable energy in Malaysia. This has resulted in a Conceptual Framework for investigating and modelling “Successful” and “Sustainable” FiT-based Oil Palm Renewable Energy Business Models that can capture Economic, Environmental and Social value for a wide range of stakeholders, leading to an increased deployment of oil palm renewable energy in Malaysia.

As this research will later illustrate, the Conceptual Framework can aid in embedding sustainability in FiT-based oil palm renewable energy businesses and in overcoming at least to some degree the barriers facing them. It can offer innovation and transition towards “Sustainable” and “Successful” FiT-based Renewable Energy Business Models for Malaysian stakeholders to guide them on how to manage FiT-based oil palm renewable energy businesses “sustainably” and “successfully”.

The next chapter will discuss the Research Methodology and Design. It will discuss how this research will explore the views of key Malaysian renewable energy stakeholders pursuant to the Conceptual Framework to Investigate and Model “Sustainable” and “Successful” Renewable Energy Business Models for Malaysia.

CHAPTER 4.0

RESEARCH METHODOLOGY AND DESIGN

4.1 INTRODUCTION

In any social science research such as this, it is fundamental to first address the issue of Research Paradigms, defined as “the basic belief system or worldview that guides the investigator, not only in choices of method but in ontologically and epistemologically fundamental ways” (Guba & Lincoln, 1994, p. 105). Ontology refers to “what is the form and nature of reality” (Ibid, p.108). Epistemology concerns “what constitutes acceptable knowledge “ (Saunders, et al., 2009, p. 112). Methods are defined as “the techniques or procedures we use to collect and analyse data” (King & Horrocks, 2010, p. 14). This chapter will first justify and establish the Paradigm for this research. Following from this, the Methodology will be developed, and the Research Design will then be formulated with a detailed description of all its elements - (a) Data Collection Procedures; (b) Population and sampling procedures; (c) Data analysis procedures; (d) Procedures to address credibility of research findings; and (e) Ethical considerations (Marshall & Rossman, 2011).

4.2 ONTOLOGY, EPISTEMOLOGY AND AXIOLOGY

The dominant paradigms underlying research in social science include positivism and interpretivism (Hennink, et al., 2011). Positivism adopts the ontological position “that reality consists of facts and that researchers can observe and measure reality in an objective way with no influence of the researcher on the process of data collection” (Ibid, p.37). It adopts the epistemological assumption that “only observable phenomena can provide credible data, facts” (Saunders, et al., 2009, p. 119), and “that the end product of such research can be law-like generalisations similar to those produced by the physical and natural scientists” (Ibid, p.113). Positivist “researchers formulate a hypothesis from theoretical concepts or statistical models, then operationalize and test the hypothesis by collecting empirical data and then evaluating whether the evidence supports the hypothesis” (Hennink, et al., 2011, p. 37). Positivism forms the foundation for quantitative research (Ibid, p.36), which “is concerned with measurement, precisely and accurately capturing aspects of the social world that are then expressed in numbers – percentages, probability values, variance ratios, etc.” (King & Horrocks, 2010, p. 15).

The aim of this research is to investigate oil palm renewable energy businesses based on the FiT for oil palm biomass/biogas in Malaysia from a Business Model perspective, and offer Successful and Sustainable Renewable Energy Business Models for Malaysia. As the researcher is academically trained in economics, business, accounting and law instead of “ physical and natural sciences” , and is also an entrepreneur who is the major shareholder and director of an Australian public listed company as well as two Malaysian public listed companies that are involved in oil palm renewable energy, it is the firm belief of the researcher that the social world of renewable energy businesses and government policies is far too complex and “that rich insights into this complex world are lost if such complexity is reduced entirely to a series of law-like generalisations” similar to those produced by the physical and natural scientists (Saunders, et al., 2009, p. 116). The researcher believes that reality is socially constructed and meanings are assigned through social interaction, and thus, it is necessary “to study the details of the situation to understand the reality or perhaps a reality working behind them” (Ibid, p.111). Accordingly, for this research, the “research philosophy is likely to be nearer to that of the interpretivist” (Ibid, p.116), which adopts the ontological position “that people’s perceptions and experiences of reality are subjective; therefore, there can be multiple perspectives on reality, rather than a single truth as proposed in positivisms” (Hennink, et al., 2011, p. 38). The interpretivist “paradigm recognizes that reality is socially constructed as people’s experiences occur within social, cultural, historical or personal contexts” (Ibid, pp. 37-38).

This research philosophy is often referred to as “constructionism, or social constructionism”, which views “reality as being socially constructed” (Saunders, et al., 2009, p. 111). Under this research philosophy, “it is necessary to explore the subjective meanings motivating the actions of social actors in order for the researcher to be able to understand these actions” (Ibid,p.111). Social actors, such as the key Malaysian oil palm renewable energy stakeholders that this research plans to study, “may place many different interpretations on the situations in which they find themselves” (Ibid, p.111). So individual stakeholders will view different situations in different ways as a result of their own view of the world, and “these different interpretations are likely to affect their actions and the nature of their social interaction with others” (Ibid, p.111). Their actions “may be seen by others as being meaningful in the context of these socially constructed interpretations and meanings” (Ibid, p.111). Therefore, in the case of these key renewable energy stakeholders, it is necessary “to seek to understand the subjective reality” of these stakeholders “in order to be able to make sense of and understand their motives, actions and intentions in a way that is meaningful” (Ibid, p.111). This research seeks to ask the key Malaysian oil palm renewable energy stakeholders their views in relation to the questions in the Conceptual Framework to Investigate and Model “Sustainable” and “Successful” Renewable Energy Business Models for Malaysia as discussed in section 3.6, and recognises that they will have their own understanding and views that are constructed from their own personal experiences.

Following the adoption of this “subjectivist” ontology, the epistemological approach or “what constitutes acceptable knowledge” in this research would involve “studying the subjective meanings” that key Malaysian oil palm renewable energy stakeholders “attach to their experiences” (Hennink, et al., 2011, p. 37). This interpretivist approach to knowledge generation is generally described as “*idiographic,* which literally means describing aspects of the social world by offering a detailed account of specific social settings, processes or relationships” (King & Horrocks, 2010, p. 19). The focus for research is “to uncover how people feel about the world and make sense of their lives from their particular vantage points” (Ibid, p.19). Therefore, actually conversing with the key renewable energy stakeholders “enables them to share their experiences and understandings” and thus, as discussed in the next paragraph, “qualitative interviewing fits” (Ibid, p.19). According to Saunders, et al. (2009, p.116), “an interpretivist perspective is highly appropriate in the case of business and management research” such as the present research on FiT-based oil palm renewable energy businesses in Malaysia, since “not only are business situations complex, they are also unique”. Qualitative research approaches are generally founded on interpretivism (King & Horrocks, 2010). “Qualitative researchers study things in their natural settings, attempting to make sense of or interpret phenomenon in terms of the meanings people bring to them. Qualitative research involves the studied use and collection of a variety of empirical materials that describe routine and problematic moments and meanings in individual’s lives” (Denzin & Lincoln, 2011, pp. 3-4). Through qualitative research, the people or “participants” in this research will be “discussing and telling their story in an interview or a focus group discussion. Due to the in-depth nature of qualitative research, few study participants are needed, as the purpose is to achieve depth of information (rather than breadth) by mining each participant deeply for their experience on the research topic” (Hennink, et al., 2011, pp. 39-40). The primary data generated through these interviews and focus group discussions are “textual”, and the data analysis that follows will be interpretative as the researcher will “seek to interpret the meanings that participants themselves give to their views and experiences” (Ibid, p. 40). As Saunders, et al. (2009, p.116) have stated, the challenge here is “to enter the social world” of the participants and “understand their world from their point of view”.

However, it should be noted that researchers can still “maintain some positivist elements, such as being highly systematised and concerned with quantification and causal factors, while at the same time incorporating interpretivist concerns around subjectivity and meaning” (King & Horrocks, 2010, p. 27). Hence, as King & Horrocks (2010, p. 27) have pointed out, “a modified version of positivism – ‘post-positivism’ – does exist”. As stated above, positivism forms the foundation for quantitative research (Hennink, et al., 2011) whilst qualitative research approaches are generally founded on interpretivism (King & Horrocks, 2010). Saunders, et al. (2009, p. 124) note that “deduction owes more to positivism and induction to interpretivism”. In the deductive approach, the researcher will “develop a theory and hypothesis (or hypotheses) and design a research strategy to test the hypothesis”, whereas in the inductive approach, the researcher will “collect data and develop theory” as a result of the data analysis (Ibid, p.124). “Mixed methods, both qualitative and quantitative, are possible, and possibly highly appropriate, within one study” (Saunders, et al., 2009, p. 109) , and it is “perfectly possible to combine deduction and induction within the same piece of research” (Ibid, p.127), particularly under a post-positivism paradigm.

The Conceptual Framework derived from the literature review of Business Models in chapter 3.0 does not seek to “formulate a hypothesis from theoretical concepts or statistical models, then operationalize and test the hypothesis by collecting empirical data, and then evaluating whether the evidence supports the hypothesis” (Hennink, et al., 2011, p. 37). Instead, it poses a number of open-ended questions to the key stakeholders, namely what are the Purpose, Value Captured, Value Missed, Destroyed or Wasted, and Value Opportunities of FiT-based oil palm renewable energy businesses in Malaysia, as well as the Barriers, Potential Strategies and Recommendations. Through conversing with the key stakeholders in semi-structured interviews and focus group discussions, these questions are answered and the answers are probed, which then constitute the data to be collected and analysed to develop the theory of "Successful" and "Sustainable" FiT-based Oil Palm Renewable Energy Business Models, in line with an inductive research approach (Saunders, et al., 2009). In other words, it is not the choice or preference of the researcher, but rather the Conceptual Framework derived from the Literature Review that drives the inductive research approach in this research. As Saunders, et al. (2009, p.155) have pointed out, "it is vital to have a clear research question and objectives for your study and ensure that the methods you use will enable you to meet them". Using a deductive approach or mixed methods combining inductive and deductive approaches would not enable the researcher to properly elicit the views of key stakeholders pursuant to the Conceptual Framework, in order to meet the aim of this research.

As stated earlier in section 2.5, the Cumulative Installed Capacity of Biomass Plants as at 1st September 2016 has reached only 68.40 MW (SEDA, 2016). The Cumulative Installed Capacity for Biogas (Landfill / Agricultural Waste) until September 2016 is only 18.88 MW. Hence, the number of renewable energy developers as the relevant stakeholders that are available as potential research participants is relatively small. With the inductive approach, "the study of a small sample of subjects might be more appropriate than a large number as with the deductive approach" (Saunders, et al., 2009, p. 126). Due to the small sample of subjects in this research, it would be almost impossible to gather enough data by using questionnaires under a deductive approach or mixed methods combining inductive and deductive approaches. According to Saunders, et al. (2009, p. 126), the researcher needs to adapt the "research design to cater for constraints", which "may be practical, involving, say, limited access to data".

Furthermore, in the course of this research, the researcher has found that government officials and utility executives in Malaysia are quite reluctant to comment on the weaknesses of their policies and practices, unless they can rest assured about the anonymity and confidentiality of their discussion. Through personal interaction during the interviews, the researcher has managed to "allay, wherever possible, the interviewee's uncertainties about providing information", and provide assurances about the anonymity and confidentiality of the discussion to increase the researcher's "trustworthiness" (Ibid, p.331). Without personal interaction and assurances, some of these research participants may have been unwilling to express their views even on an anonymous basis, if they were to be asked using questionnaires under a deductive approach or mixed methods combining both inductive and deductive approaches. Quantitative research or mixed methods is therefore highly inappropriate as it cannot cater for this constraint.

In summary, the adoption of an interpretivist stance has influenced this research in the following manner: Firstly, in the literature review, the researcher uses literature to inform the research by "looking for engaging topics, unanswered questions" and "problems that need investigation", instead of looking for "concepts and themes others have introduced" in prior literature to formulate a hypothesis to be tested and evaluated (Rubin & Rubin, 2012, p. 17). Secondly, axiology refers to "the role that our own values play in all stages of the research process" (Saunders, et al., 2009, p. 116). "Interpretivism highlights the inherent subjectivity of humans, both as study participants and researchers" (Hennink, et al., 2011, p. 38), and acknowledges that researchers "are active participants in the research; their personalities, their knowledge, their curiosity, and their sensitivity all impact the quality of the work" (Rubin & Rubin, 2012, p. 17). Hence, the researcher is "part of what is being researched" and thus, this research is "value bound" instead of "value free" (Saunders, et al., 2009, p. 119). Choosing this business research topic on oil palm renewable energy businesses rather than another has been influenced by the personal and entrepreneurial values of the researcher. In this respect, the researcher is academically trained in economics, business, accounting and law, and is also an entrepreneur who is the major shareholder and director of an Australian public listed company as well as two Malaysian public listed companies that are involved in oil palm renewable energy. As stated above, these personal and entrepreneurial values have influenced the interpretivist approach of this research, by adopting the view that the social world of renewable energy businesses and government policies is far too complex and that rich insights into this complex world are lost if such complexity is reduced entirely to a series of law-like generalisations, similar to those produced by the physical and natural scientists, under the paradigm of positivism. The importance of personal interaction in the business world has also axiologically influenced the researcher to "value personal interaction" through interviews and focus group discussions with the key renewable energy stakeholders "more highly than their views expressed through an anonymous questionnaire" (Ibid, p.116).Finally, the characteristics of this research as stated above - "gaining an understanding of the meanings humans attach to events", "the collection of qualitative data", "a realisation that the researcher is part of the research process", "less concern with the need to generalise" – are consistent with the inductive research approach, in which data is collected and then theory is developed as a result of the data analysis (Saunders, et al., 2009, p. 127).

4.3 RESEARCH PARADIGM

From the ontological, epistemological and axiological discussions above, the Research Paradigm of this study can be summarised as follows (Saunders, et al., 2009, p. 119):

Paradigm	Interpretivism
Ontology	Multiple realities, “socially constructed, subjective”
Epistemology	“Subjective meanings and social phenomena”. Interpret phenomenon in terms of the meanings people bring to them. “Focus upon the details of situation, a reality behind these details”
Axiology	“Research is value bound, the researcher is part of what is being researched”
Data collection technique	Qualitative research using interviews and focus-group discussions, “small samples”
Research approach	Induction: Building theory

Data collection to “explore” the situations and issues in this study involves focus group discussion and semi-structured interviews (Saunders, et al., 2009, p. 598). The focus group comprises three (3) “individuals representative of the population whose ideas are of interest” (Ibid, p.30). A first or Pilot focus group discussion is facilitated to “encourage the group to come to a conclusion” (Ibid, p.30) on the appropriate semi-structured interview questions to be posed to the interview participants. After the data is collected and analysed, a second and final focus group discussion is facilitated to “encourage the group to come to a conclusion” on the data findings (Ibid, p.30). The semi-structured interviews are conducted to look “for rich and detailed information, not for yes-or-no, agree–or–disagree responses” without giving “the interviewee specific answer categories” (Ibid, p.29). “The questions are open ended, meaning that the interviewee can respond any way he or she chooses, elaborating upon answers, disagreeing with the question, or raising new issues” (Ibid, p.29). Answers are probed and follow-up questions are asked to “obtain greater detail from the participants” (Ibid, p.329). Probing the answers is intended to get the “interviewees to explain, or build on, their responses” (Ibid, p.323), which is consistent with the interpretivist epistemology of studying the subjective meanings that stakeholders attach to their experiences with oil palm renewable energy businesses based on the FiT in Malaysia. Probing, as it is intended, “will add significance and depth to the data” and “may also lead the discussion into areas” not previously considered but relevant to the research objectives (Ibid, p. 324). The interviews start by “demonstrating interest in the interviewee by asking about her or his role” (Ibid, p.331) to verify the job position, qualification and experience in order to exclude those who do not fall within the sampling criteria. The themes for the focus group discussion and semi-structured interviews are identified beforehand from the literature review (Ibid). To promote validity and reliability in this research, as shall be further discussed, these themes are provided to the participants before the focus group discussion and the interviews to enable them to consider the information being requested and allowing them the opportunity to assemble the supporting documents (Ibid).

King & Horrocks (2010, p.37) have pointed out that qualitative research “does not normally use sampling strategies aimed at producing statistical representativeness” of the total population, but rather the key criterion is “diversity” by recruiting interview participants “who represent a variety of positions in relation to my research topic, of a kind that might be expected to throw light on meaningful differences in experience”. Using what is referred to as “purposive” sampling, stakeholders “who represent a variety of positions” were targeted (Ibid, p.37). As Kumar (2011, p.227) has pointed out, “the primary consideration in purposive sampling is your judgement as to who can provide the best information to achieve the objectives of your study”. Hence, it is also referred to as “judgemental sampling” (Ibid, p.227).

As noted earlier, this research seeks to interpret the meanings that interview participants themselves give to their experiences with oil palm renewable energy businesses based on the FiT in Malaysia. To achieve this, the thematic approach to data analysis is adopted, as is “normally associated with experience-focused methodologies” (King & Horrocks, 2010, p. 150). NVIVO 11, a Computer Aided Qualitative Data Analysis Software (CAQDAS), is used to aid the analysis of the interviews to look for themes, defined as “recurrent and distinctive features of participants’ accounts, characterising particular perceptions and/or experiences, which the researcher sees as relevant to the research” (Ibid, p.157). In this research, the template style of thematic analysis was used, which involves the construction of a template comprising “top-level themes” and their “sub-themes” (Ibid, p.174). The analysis is preceded by the researcher defining “some themes in advance of the analysis process – referred to as a priori themes” that the researcher has identified from the literature review (Ibid, p.176). The interviews are transcribed, and the transcripts are read and analysed to “highlight relevant material” and code them (Ibid, p.160). Codes are essentially issues, topics, ideas, opinions, etc. on the research topic that are discussed by the interviewees (Hennink et al., 2011, p.239). According to King (2014a), an “initial template” is normally developed “after initial coding of a sub-set of the data, for example, after reading through and coding the first three of 15 transcripts in a study”.

Where the coded issues, topics, ideas or opinions “do not fit well with any of the themes on the initial template, the template is revised, perhaps by adding a theme or redefining an existing one” (King & Horrocks, 2010, p.174). Moving from one transcript to the next, the researcher continues “applying, revising and then reapplying the template” and its themes and sub-themes, until “it is clear and thorough enough to serve as a basis for building an account of the findings” (Ibid, p.174). The researcher continues on coding on the transcripts until “the point of saturation, that is, when no more new issues are identified in the data” (Hennink et al., 2011, p.240). In the template, aspects of the data “that provide the richest insights into the topic” of the research would “generally be coded in greater depth (i.e. to more levels)" through "a more detailed and deeper set of sub-themes" (King & Horrocks, 2010, p.174). In other words, there are more "hierarchical coding levels" on a theme that needs to be further elaborated. In reporting the findings of the analysis, the researcher intends to "describe and discuss each of the overarching themes in turn, referring to examples from the data and using direct quotes" to show how the findings "have cast light upon the topic at hand" (Ibid, p.173). "It is not necessary to refer to every constituent code within each theme" but rather the focus should be "on those that most strongly illustrate what the theme is covering, and which most effectively address" the research objectives (Ibid, p.173).

4.4 EXPLORATORY RESEARCH DESIGN

The Research Design for this study is "exploratory" in nature as the aim here is to find out "what is happening; to seek new insights; to ask questions and to assess phenomena in a new light" (Saunders, et al., 2009, p. 139) in order to investigate and model Successful and Sustainable FiT-based Renewable Energy Business Models for Malaysia. As Richter (2013, p. 1229) has suggested, an "exploratory qualitative research strategy" is appropriate since "research on business models in the energy sector is still at an early stage". The Research Design comprises: (a) Data Collection Methods; (b) Population and sampling strategies; (c) Data analysis procedures; (d) Procedures to address credibility of research findings; and (e) Ethical considerations (Marshall & Rossman, 2011).

4.4.1 DATA COLLECTION METHODS

By using focus group discussions and semi-structured interviews, this research seeks to elicit the views of key stakeholders pursuant to the Conceptual Framework to Investigate and Model "Sustainable" and "Successful" FiT-based Renewable Energy Business Models for Malaysia, as outlined in section 3.6. The focus group consists of three (3) individuals representative of the population whose ideas are of interest, namely an international energy consultant based in Malaysia (for reason of anonymity, is referred to as Expert 1), a retired Engineer and former Malaysian policy maker (Expert 2) previously involved in renewable energy policy development, and a practising Malaysian engineering consultant (Expert 3) who supervised the design and commissioning of a number of biomass and biogas power plants including the first oil palm biomass power plant in Malaysia and the world. The Pilot focus group discussion was facilitated in January 2016 to allow the group to come to a conclusion on the appropriate semi-structured interview questions to be posed to the interview participants based on the research objectives. Further into the research, a second and final focus group discussion was held in April 2017 to allow the group to come to a conclusion on the data findings. As justified in section 4.4.2, a total of fifteen (15) interviews were carried out. The main themes of investigation of this research , as encapsulated in the Conceptual Framework in section 3.6, were provided beforehand to the focus group and interview participants, via the Participant Information Letters approved by LJMU's Research Ethics Committee (REC reference number:15/LBS/004 dated 29th January 2015), to enable them to consider the information being requested and allowing them the opportunity to assemble the supporting documents.

According to Saunders, et al. (2009, p.329), the researcher should begin with a set of interview “themes that reflect the variables being studied, or at least one or more general questions” related to the research topic, and then use these themes to design the interview guide. Interview themes may be derived from the literature or discussions with research participants, or a combination of these approaches (Ibid). In this research, the interview themes are derived from the literature reviewed in chapters 2.0 and 3.0, and the discussions with the focus group members as illustrated below. The main themes from the literature reviewed in chapters 2.0 and 3.0 have been incorporated into the Conceptual Framework to Investigate and Model “Sustainable” and “Successful” Renewable Energy Business Models for Malaysia, as set out in section 3.6.

King & Horrocks (2010, p. 43) stress that “flexibility is a key requirement of qualitative interviewing”, and “qualitative interviews use an interview guide that outlines the main topics the researcher would like to cover, but is flexible regarding the phrasing of questions and the order in which they are asked, and allows the participant to lead the interaction”. This research aims to interview the research participants to seek their views in relation to the questionnaire in the Conceptual Framework, recognising that they as research participants will have their own understanding and views that are constructed from their own personal experiences, as discussed in section 4.2. Saunders, et al. (2009, p.329) have pointed out that the interview guide should “lists topics that you intend to cover in the interview along with initial question and probes that may be used to follow up initial responses and obtain greater detail from the participants”. Hence, in designing the interview guide, this research has included the questionnaire in the Conceptual Framework as the initial questions, namely the Purpose, Value Captured, Value Missed, Destroyed or Wasted, and Value Opportunities of FiT-based oil palm renewable energy businesses in Malaysia, as well as the Barriers, Potential Strategies and Recommendations.

As highlighted in section 4.3, these initial questions are open ended, meaning that the interviewee can respond any way he or she chooses, elaborating upon answers, disagreeing with the question, or raising new issues. Answers are probed and follow-up questions are asked to obtain greater detail from the participants. Probing the answers is intended to get the interviewees to explain, or build on, their responses, which is consistent with the interpretivist epistemology of studying the subjective meanings that stakeholders attach to their experiences with oil palm renewable energy businesses based on the FiT in Malaysia. The interview guide in this research has also incorporated the probes to follow up initial responses and obtain greater detail from the participants. These probes are based on the themes derived from the literature reviewed in chapter 2.0, mainly related to the six (6) key sustainability factors for the Malaysian FiT- based oil palm renewable energy businesses, namely sustainability of biomass supply chain, sustainability of renewable energy technology, sustainability of grid network system, sustainability of the FiT scheme for oil palm biomass/biogas, environmental sustainability, and Combined Heat and Power (CHP).

Following the development of the interview guide, the Pilot focus group discussion was then held in January 2016 to review the Proposed Interview Guide for the semi-structured interviews. The rationale for each question and probe in the Proposed Interview Guide was explained. The meeting suggested that the researcher should also ask:

> *What people think about the overall policy framework especially framework for biomass and biogas, and also how they find the current status of implementation in the country.*

The meeting also noted:

> *Interesting to look at issue about decentralised versus centralised generation using renewable energy or biomass in particular, currently the focus of policy is to use biomass at the place it originates to have decentralised power plant more than looking at using biomass in centralised plant, as in Europe where biomass would be used to a very large extent in centralised power plant for substituting coal by co-firing biomass with coal or in pure biomass plant supplying heat and power to the city and town. This has not really been addressed in Malaysia and interesting to hear views on using biomass in large scale biomass power plant and what kind of issues they foresee in doing so.*

In the discussion, it was also noted that it would be interesting to know the views of participants on whether the National Biomass Strategy may create unrealistic price expectation on the part of feedstock supplier, thereby exacerbating the challenge of feedstock security facing biomass project owners. The meeting espoused the view that Biomass FiT should only be offered to project developers who can secure at least 50 to 60% of their feedstock internally through their own mills or a joint venture with other oil mills. The meeting also rephrased the impact of methane gas from POME:

> *On methane from POME being 21 times more lethal to the environment than CO2; probably change that to say that it has a global warming potential which is 21 times higher or more than CO 2. Actually it is 25 times ; there was a revision done by the Intergovermental Panel on Climate Change.*

On Combined Heat and Power (CHP), the meeting resolved that participants should still be queried on their views regarding CHP although one focus group member commented:

> *Without an oil mill or consumer to use the heat, no reason to have CHP and so do not agree that biomass plant must be CHP for Malaysia. Don't believe SEDA or Government should impose CHP as a condition for biomass Feed-in Tariff. Plants like Kina and Seguntur are producing only electricity without an oil mill to use the steam, so should not be penalised for this.*

On the policy lessons from other countries, particularly the UK off-grid FiT, it was noted that in Malaysia most biogas plants are affiliated with palm oil mills and there might not be enough on-site or off-grid power demand, as most palm oil mills already have surplus power even without the biogas plants. It was felt that the Interview Guide questions might probably be difficult for some participants if they do not really understand and know about the policies in other countries. Thus, the questions should be preceded by a description of the relevant policy as is implemented in Thailand or the UK. The adoption of Thailand's ENCON Fund was supported by the focus group members:

> *There should be an ENCON type of fund to replace the Renewable Energy Fund as a bigger fund and it can be applied to energy efficiency as well. In fact, from the calculations, only need to tax RM0.01 per litre of fuel and especially with falling oil prices now, it is easier to implement and can be referred to as a Green Technology Fund.*

The meeting suggested that it might be relevant to ask the participants*:*

> *Whether the FiT as is implemented in Malaysia as a flat rate is the best system or should it be a system based on various tariff periods - peak period, medium or low period , meaning that the plant that is producing renewable energy whether biogas or biomass will have an incentive to produce the power when it is most needed by the grid system; for instance in the the peak period they will be paid more than the off-peak period.*

It was pointed out that some of the fiscal incentives in the form of tax exemptions were no longer being offered after 2015 ,and furthermore sales tax has been abolished and replaced by GST with effect from 1st April 2015. It could be quite relevant to ask whether these incentives should be continued in the future after 2015. With regard to the Green Technology Financing Scheme (GTFS), it was pointed out that GTFS has its own limitations, as it does not secure the project financing but only provides a subsidy of 2% of the interest cost by the Government. Furthermore, a borrower with a good track record might end up getting a better rate of financing than GTFS. The meeting viewed the Fiscal Incentives as being fair and generous. It would also be interesting to find out from the participants:

> *Whether the Malaysian policy and incentives have a reach and a plan that is clear enough for the renewable energy project developers to act on so that they can be given sufficient time to actually develop their project and know what kind of incentives they will be entitled to*

The consensus reached was that the Interview Guide was quite good and comprehensive, covering the important issues relating to this research. Following the Pilot discussion, the researcher revised and updated the Interview Guide as shown in Appendix A, incorporating all the changes discussed during the Pilot meeting as highlighted using underlined text. The application of this Interview Guide varied from interview to interview as the "organisational context" differed from one interview to another, requiring some questions to be omitted in some interviews or additional questions to be raised “given the nature of events within particular organisations” (Saunders, et al., 2009, p. 320).

Interviews were conducted from January 2016 to February 2017. To enhance the validity and reliability of this research as discussed in section 4.4.4 below, all participants were provided with the relevant research themes prior to their interviews to enable them to consider the issues and prepare in advance (Saunders, et al., 2009). Each interview lasted less than an hour. Most interviews were conducted at the quiet corner of hotel cafeterias in Kuala Lumpur, where it was not too noisy to reduce the quality of the audio recordings. The interview setting was casual and the locations chosen were convenient and comfortable to the participants (Ibid). For interviewees based outside Kuala Lumpur, the interviews were held in hotel cafeterias convenient to them, close to their home. The interviews were recorded with the consent of the interviewees, and then transcribed and analysed.

4.4.2 POPULATION AND SAMPLING STRATEGIES

Using purposive sampling as described earlier, stakeholders who represent a variety of positions were targeted and they included: (1) People involved in the oil palm biomass/ biogas FiT policy design, reform and implementation; (2) People who are affected by the issues and challenges facing the deployment of oil palm renewable energy; and (3) People who may be affected by the recommendations made in this investigation (Majchrzak & Markus, 2014). The sample also included academics and researchers who are knowledgeable about the issues and challenges as well as the latest development, by virtue of their research work on the subject matter, as they are also part of the “Stakeholder Side” of the Renewable Energy Business Models as discussed in section 3.7 above. As pointed out earlier, the primary consideration in purposive sampling or judgemental sampling is to judge who can provide the best information to achieve the research objectives. In exercising that judgement, the members best positioned to provide the best information to achieve the objectives of this study are people who meet the following criteria in terms of their position, qualification and experience:

Table 4. 1 Sampling Criteria

Key Stakeholder Group		**CRITERIA**		
		Position	**Qualification**	**Experience**
1	**Consultant Engineering Firm**	Senior Partner, Consultant or Director.	Qualified Professional Engineer.	At least 10 years of experience in designing and supervising oil palm bioenergy plants.

2	**Government Agencies**	Section Head or Chief.	N/A	Relevant experience in Feed-in Tariff policy design or implementation.
3	**Power Utilities**	General Manager or Chief Engineer.	Engineering Qualification.	Relevant experience in handling and overseeing grid interconnection for renewable energy projects.
4	**Biomass/biogas Plants**	CEO, COO or General or Senior Manager.	Qualified Plant Engineer.	At least 10 years of experience in palm oil milling or power generation with relevant experience in oil palm renewable energy.
5	**Researchers and academics**	University Researcher or Lecturer.	PhD.	Written at least one article on biomass/biogas – based power generation from palm oil wastes in Malaysia and publish it in a reputable peer-reviewed journal

The background and job descriptions of the prospective participants were carefully checked beforehand to ensure that they fall within the sampling inclusion criteria. Through the Participant Information Letters, the participants were informed and well-aware beforehand of the sampling inclusion criteria and that anyone falling outside the criteria were excluded. Again in the opening question of the interview, as stated in Appendix A, participants were asked to describe what their roles are, and their responses enabled further verification of their job position, qualification and experience in order to exclude those who did not fall within the criteria. Through the good relationship that the researcher has developed with some of the interviewees over the years from his involvement in the industry, some of them had from the outset indicated their willingness to participate in this research. One interviewee, who is an Associate Professor at the Malaysian campus of an established UK University, was introduced by a member of the focus group. As for other participants , their contact and job details were sourced from publicly available information before approaching them directly, or indirectly through a third party.

As stated in section 4.2, due to the in-depth nature of qualitative research, few study participants were needed as the purpose is to achieve depth of information (rather than breadth) by mining each participant deeply for their experience on the research topic. Accordingly, the participants were limited to three (3) members from each of the stakeholder groups identified in section 3.7, namely: (a) Three (3) senior Consultant Engineers/ technology providers; (b) Three (3) senior government officials involved in the FiT; (c) Three (3) senior executives of the Distribution Licensees i.e. the Power Utilities; (d) Three (3) senior managers of Biomass/Biogas plants; and (e) Three (3) researchers and academics.

4.4.3 DATA ANALYSIS PROCEDURES

Each interview was recorded with the consent of the participants using a digital voice recorder, as stated in the Participant Information Letter, and then transcribed. As noted earlier, this research seeks to interpret the meanings that interview participants themselves give to their experiences with FiT-based oil palm renewable energy businesses in Malaysia. To achieve this, the thematic approach to data analysis was adopted. NVIVO 11, a Computer Aided Qualitative Data Analysis Software (CAQDAS), was used to aid the analysis of the interview transcripts to develop themes - recurrent and distinctive features of participants' accounts, characterising particular perceptions and/or experiences, which the researcher sees as relevant to the research. The template style of thematic analysis was used, involving the construction of a template comprising top-level themes and their sub-themes.

In line with the template style of thematic analysis, the first step was to identify the *a priori* nodes, encompassing all the themes and sub-themes from the literature review (King & Horrocks, 2010, p. 176). Issues, topics, ideas and opinions from the Pilot focus group discussion, notably "Time-differentiated tariff system" and "Centralised biomass power generation", were also included. The *a priori* nodes were created on NVIVO 11, as shown in Figure 4.1, in a "hierarchical" structure, "using broad themes encompassing successively narrower, more specific ones" (King, 2014a), such as "Value opportunities" being a broad theme encompassing "ENCON type fund", "Location-specific bonus tariff", "Off-grid Feed-in Tariff", "Rural Electrification" and Time-differentiated tariff system" as the narrower and more specific themes. The *a priori* nodes below were subsequently "modified or dispensed with if they did not prove to be useful or appropriate to the actual data examined" (Ibid).

Nodes

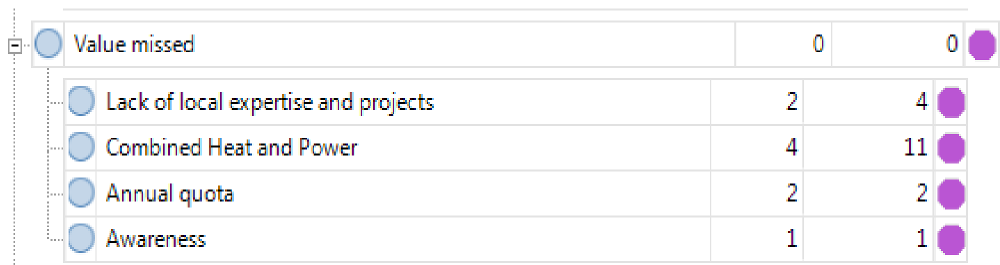
Name

- Purpose of FiT
- Value captured
  - Methane emission reduction incentive
  - Rural electrification
- Value destroyed
  - High investment & operational costs
  - Connection costs
  - Grid infrastructure and distance
  - Transportation of feedstock
- Value missed
  - Lack of grid infrastructure
  - Lack of successful local projects
  - Lack of local operation expertise
  - Combined Heat and Power
- Value opportunities
  - ENCON type fund
  - Location-specific bonus tariff
  - Off-grid Feed-in Tariff
  - Time-differentiated tariff system
  - Centralised biomass power generation
  - Anaerobic digestate as bio-fertiliser
- Barriers
  - Implementation status
  - Sustainable Energy Development Authority (SEDA)
  - Competing demand for feedstock
    - Pellets and briquettes
    - National Biomass Strategy
  - Supply security
  - Interconnection procedures
- Potential Strategies and Recommendations for stakeholders
  - Feedstock ownership and control
  - Incentives
    - Green Technology Financing Scheme
    - Fiscal incentives
      - Pioneer Status
      - Investment tax allowance

Figure 4. 1 *A Priori* Nodes

Three (3) pilot interviews were conducted on 4th February 2016, 11th February 2016 and 2nd March 2016 respectively. The three (3) transcripts were then imported to NVIVO 11 together with the transcript of the Pilot focus-group discussion. In reading through the transcripts one by one, any segment that appeared "to tell the researcher something of relevance to the research" was marked, and "where such segments correspond to a priori themes", they were coded to the respective nodes on NVIVO 11 (King, 2014a). If the segments were not "encompassed" by one of the *a priori* nodes, then an existing node was modified or a new node was created (King, 2014b). After completing the pilot data analysis of reading and coding the three (3) interview and one (1) focus group transcripts, the following changes were made to the *a priori* nodes:

- Academic 1 pointed out that the quota on installed capacities was restrictive and there was lack of awareness on the biomass FiT. Consultant 1 also expressed the same view on the quota system. It was considered useful for the coding of future transcripts to create two (2) new child nodes for these sub-themes – "Annual quota" and "Awareness" under the "Value missed" node as shown below, consistent also with the literature review findings.



Value missed	0	0
Lack of local expertise and projects	2	4
Combined Heat and Power	4	11
Annual quota	2	2
Awareness	1	1

Figure 4. 2 Addition of Child Nodes – "Annual Quota" and "Awareness"

- Academic 1 talked about his experience in Indonesia:

  It's unlike actually compared to Indonesia. Indonesia actually, when I went to Indonesia to do my project, they actually feed; they bring the substation into your site because they need more power. …………in Indonesia, they are very, very interesting model, framework or shape. It's as long as you want to build a palm oil mill; first thing is they'll ask you how much power you can produce to supply to the society. They will treat palm oil mill as a power plant……………. lack of power in general in the entire Indonesia. So as any opportunity they can get power, they will want it.

  As these segments relate to policy lessons from Indonesia that is not specifically encompassed by any of the *a priori* nodes, a new child node "Other International lessons" was created under the "Value opportunities" node, as shown below:

Value opportunities	0	0
ENCON type fund	4	5
Location-specific bonus tariff	3	3
Off-grid Feed-in Tariff	4	4
Other International lessons	1	3
Time-differentiated tariff system	3	3
Centralised biomass power generation	3	5
Anaerobic digestate as bio-fertiliser	3	4

Figure 4. 3 Addition of Child Node – “Other International lessons”

- King (2014b) advises grouping the themes identified in the selected transcripts into a smaller number of higher-order codes which describe broader themes in the data, and states that there can be as many levels of coding as found useful to distinguish, but too many levels may make the template less clear than it should be. It is therefore advisable to reorganise the *a priori* nodes – “Barriers” – as there are too many levels that make the template less clear than it should be. Accordingly, the nodes were reorganised as shown below. “National Biomass Strategy” was moved to a higher level child node given that it was coded seven (7) times from four (4) different sources. “Pellets and briquettes”, being coded seven (7) times from three (3) different sources was also elevated to supersede the node “Competing demand for feedstock”.

Barriers	0	0
Implementation status	3	7
Sustainable Energy Development Authority (SEDA)	3	7
National Biomass Strategy	4	7
Pellets and briquettes	3	7

Figure 4. 4 Elevation of the nodes – “National Biomass Strategy” and “Pellets and briquettes”

The nodes “Connection costs” and “Grid infrastructure and distance” are identical themes as one participant, Consultant 1, has put it:

> *Grid interconnection issue is that basically you can connect as far as you want. It’s just a question of upgrading your wiring, getting it fat and fatter, that’s it. So it’s just money.*

Accordingly, the two nodes have been merged into a single node – “Grid connection costs.”

Value destroyed	0	0
Grid connection costs	3	12
Transportation of feedstock	2	3

Figure 4. 5 Merger into a single node – “Grid connection costs”

The node "Interconnection procedures" was amended to "Interconnection difficulties " to better reflect the challenges and difficulties discussed by the participants concerning the requirements for grid connection imposed by the utilities.

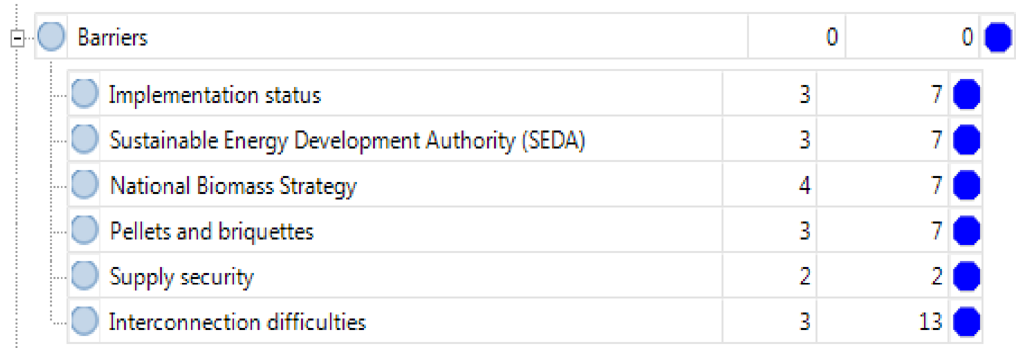


Figure 4. 6 "Interconnection procedures" renamed as "Interconnection difficulties"

To further reduce the number of nodes so as to make the template clearer, "Lack of successful local projects" and "Lack of local operation expertise" were merged into a single node – "Lack of local expertise and projects", as the two (2) themes are quite identical.

Figure 4. 7 Merger into a single node – "Lack of local expertise and projects"

"Pioneer Status" and "Investment tax allowance" were subsumed into their parent node – "Fiscal Incentives", as these themes were discussed collectively by the participants instead of discussing them individually.

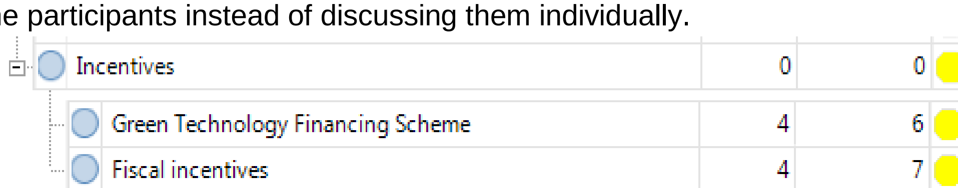


Figure 4. 8 Incorporation of child nodes into the parent node – "Fiscal incentives"

The nodes that emerged from this pilot data analysis constituted the "initial template", as King (2014a) has suggested.

Nodes

Name	Sources	References
Purpose of FiT	0	0
Value captured	0	0
Methane emission reduction incentive	4	14
Rural Electrification	4	6
Value destroyed	0	0
Grid connection costs	3	12
Transportation of feedstock	2	3
Value missed	0	0
Lack of local expertise and projects	2	4
Combined Heat and Power	4	11
Annual quota	2	2
Awareness	1	1
Value opportunities	0	0
ENCON type fund	4	5
Location-specific bonus tariff	3	3
Off-grid Feed-in Tariff	4	4
Other International lessons	1	3
Time-differentiated tariff system	3	3
Centralised biomass power generation	3	5
Anaerobic digestate as bio-fertiliser	3	4
Barriers	0	0
Implementation status	3	7
Sustainable Energy Development Authority (SEDA)	3	7
National Biomass Strategy	4	7
Pellets and briquettes	3	7
Supply security	2	2
Interconnection difficulties	3	13
Potential strategies and recommendations for stakeholders	0	0
Feedstock ownership and control	4	7
Incentives	0	0
Green Technology Financing Scheme	4	6
Fiscal incentives	4	7

Figure 4. 9 Initial Template

This initial template was then applied to the whole data set and modified in the light of careful consideration of each transcript (King, 2014a). Where the coded issues, topics, ideas or opinions did not fit well with any of the themes on the initial template, the template was revised by adding a theme or redefining an existing one. Moving from one transcript to the next on NVIVO 11, the researcher continued applying, revising and then reapplying the template and its themes and sub-themes, until the point of saturation where no newer issues were identified in the data, and it was clear and thorough enough to serve as a basis for building an account of the findings. This final template then serves as the basis for the researcher's interpretation or illumination of the data set and the writing up of the findings.

In the next two chapters, the findings of the analysis are reported by describing and discussing each of the overarching themes in turn, referring to examples from the data and using direct quotes to show how the findings have cast light upon the topic at hand. Not every constituent code within each theme is illustrated but only those that most strongly illustrate what the theme is covering and which most effectively address the research objectives.

4.4.4 PROCEDURES TO ADDRESS CREDIBILITY OF RESEARCH FINDINGS

Saunders, et al. (2009, p. 156) point out that "attention has to be paid to two particular emphases on research design: reliability and validity" of research findings. According to them, "reliability is concerned with whether alternative researchers would reveal similar information" (Ibid, p.326), and validity "refers to the extent to which the researcher gains access to their participants' knowledge and experience, and is able to infer a meaning that the participant intended from the language that was used by this person" (Ibid, p.327). This research adopts the data quality measures suggested by Saunders, et al. (2009) to promote reliability and validity – (a) A methodological account is provided in this thesis i.e. the "research design, the reasons undermining the choice of strategy and methods, and the data obtained", in order to promote reliability so that other researchers can refer to them to understand the research processes and findings "to enable them to reanalyse the data" (Ibid, p.328); (b) Utilising, during interviews, the knowledge gained from the literature review to demonstrate the researcher's "credibility", and to "assess the accuracy of responses and encourage the interviewee to offer a more detailed account of the topic under discussion" (Ibid, p.328); (c) Supplying the relevant research themes to the participants before the interview, as stated in the Participant Information Letter, to "promote validity and reliability by enabling the interviewee to consider the information being requested and allowing them the opportunity to assemble supporting" documents (Ibid, p.328); (d) Choosing an interview location convenient and comfortable to the participants, where "outside noise will not reduce the quality" of the recordings, and wearing clothing acceptable for the interview setting so that the appearance of the researcher may not "affect the perception of the interviewee" (Ibid, p.330); (e) Beginning the interview by trying "to allay, wherever possible, the interviewee's uncertainties about providing information", and providing assurances about the anonymity and confidentiality of the discussion to increase the researcher's "trustworthiness and reduce the possibility of interviewee or response bias"(Ibid, p.331); and (f) Asking the interview questions "in a neutral tone of voice", and "phrased clearly, so that the interviewee can understand them". "Questions that seek to lead the interviewee or which indicate bias" on the part of the researcher part have been avoided. (Ibid, p.332).

Additionally, the researcher has discussed the "emergent findings with critical friends to ensure that analyses are grounded in the data", or "peer debriefing" (Ibid, p.60). "Critical friends" included the research director and supervisor at Liverpool Business School. The emergent findings have also been presented at the 3rd International Green Workshop & Exhibition held on 4 & 5th October 2016 in Malaysia and organised by The Institution of Engineers Malaysia, as is evidenced by the certificate of appreciation in Appendix C.

The validity of this research was also reinforced through "triangulation" or "the use of two or more independent sources of data or data-collection methods within one study in order to help ensure that the data are telling you what you think they are telling you" (Ibid, p.602):

(1) "Data Triangulation": "Using a variety of data sources" by interviewing different groups of stakeholders - Engineering consulting firms; Government agencies; Power utilities; Biomass/biogas plant management; Research and academic institutions (King & Horrocks, 2010, p. 172). In this research, the criterion adopted as to what is an acceptable level of evidence to warrant triangulation is that there must be at least six (6) references from six (6) different sources within each theme (node) in the final template; and

(2) "Methodological triangulation": Using "a combination of qualitative methods" namely focus group and semi-structured interviews (Ibid, p.172).

4.4.5 ETHICAL CONSIDERATIONS

As emphasised by Saunders, et al. (2009, p. 160), "the general ethical issue here is that the research design should not subject those you are researching (the research population) to embarrassment, harm or any other material disadvantage". To address these ethical concerns, this research was conducted in accordance with the ethical procedures and approval of the academic institution of the researcher (LJMU's Research Ethics Committee Approval under REC reference number:15/LBS/004 dated 29th January 2015). The following steps were taken in compliance with the Research Ethics Committee Approval:

a) Informed and Written Consent:

Interview participants were first invited to participate via the Participant Information Letter, informing them in advance the purpose of the research, how the interview data is kept and used, and their rights. As stated in the letter, if they have any questions they can also contact the researcher by phone or email in the first instance. Should they then decide to participate, they need to sign the Participation Consent Form, consenting in writing to the participation, the audio recording of the interview and the anonymous use of the interview data. Hence, the consent obtained was truly well informed and written;

b) Voluntary Participation:

As stated in the Participant Information Letter, participation is voluntary and that even after consenting in the Participation Consent Form, the participant is still free to withdraw at any time without having to give any reason for it. This is reemphasised in the Participation Consent Form that participation is voluntary and that they are free to withdraw at any time, without giving any reason and that this would not affect their legal rights;

c) Confidentiality and Anonymity**:**

Any personal information collected during the research were anonymised and will remain confidential. No names or identities were disclosed. All the information obtained were handled and kept securely and confidentially, and were used anonymously in accordance with ethical procedures and approval of the academic institution of the researcher. As stated in the Participant Information Letter, the identity of the participants and their conversations are disguised in all publications and presentations. A participant's identity will not be disclosed even if he or she is quoted in any of the publications or presentations. Instead, he or she is referred to as follows:

a) Consultant Engineers/technology provider – Consultant 1, Consultant 2, Consultant 3;
b) Government officials involved in the FiT – Official 1, Official 2, Official 3;
c) Distribution Licensees/Power Utilities – Utility Officer 1, Utility Officer 2, Utility Officer 3;
d) Managers of Biomass/Biogas plant – Manager 1, Manager 2, Manager 3;
e) Researchers and academics – Academic 1, Academic 2, Academic 3.

4.5 SUMMARY

This chapter has established the adoption of an Interpretivist Research Paradigm involving qualitative research using interviews and focus-group discussions, involving small samples. Following on from the Methodological approach, an Exploratory Research Design was adopted, involving semi-structured interviews, focus group discussion, "purposive" sampling, data transcription and analysis using the "template" style of thematic analysis on NVIVO 11, and data and methodological triangulations along with proper emphasis on ethical considerations such as informed consent, voluntary participation, confidentiality and anonymity.

CHAPTER 5.0

DATA FINDINGS

5.1 INTRODUCTION

This Chapter explores the views of the key Malaysian renewable energy stakeholders, namely: 1) Academics; 2) Distribution Licensee – TNB and SESB; 3) Renewable Energy Developers; 4) Project Consultants; and 5) KeTTHA and SEDA, based on the Conceptual Framework to Investigate and Model "Sustainable" and "Successful" Renewable Energy Business Models for Malaysia.

As stated in the previous chapter, the views of the key stakeholders were first elicited through semi-structured interviews and focus group discussions, and then transcribed and analysed using the thematic approach to data analysis. NVIVO 11, a Computer Aided Qualitative Data Analysis Software (CAQDAS), was used to aid the analysis of the interview and discussion transcripts to develop themes - recurrent and distinctive features of participants' accounts, characterising particular perceptions and/or experiences, which the researcher sees as relevant to the research. The template style of thematic analysis was used, involving the construction of a template comprising top-level themes and their sub-themes. The analysis was preceded by defining in advance of the analysis process a priori themes that were identified from the literature review. This chapter begins by presenting the Final Template developed on NVIVO 11. The findings from the template style of thematic analysis are then reported by describing and discussing in detail each of the themes in the Final Template.

This chapter addresses the third research objective:

To collect and analyse the data to investigate and model "Successful" and "Sustainable" FiT-based Renewable Energy Business Models for Malaysia

5.2 TEMPLATE DEVELOPMENT PROCESS

As illustrated in Figure 4.9 , the Initial Template developed after the pilot data analysis of coding the first three (3) interview and one (1) focus group transcripts has seven (7) main themes and twenty-four (24) sub-themes. After coding the fifteen (15) interview transcripts, the nodes in the Initial Template were modified or removed where they did not prove to be useful or appropriate , and new nodes were created where they were appropriate or useful to the data examined, in line with the template style of thematic analysis of King (2014a). After applying, revising and reaaplying the themes and sub-themes , the Initial Template underwent some significant changes as highlighted in the table of comparison below, until the emergence of the Final Template at the point of saturation when no newer themes were identified in the data (Ibid). The Final Template that emerged, as illustrated in Figure 5.1 below, consists of seven (7) main themes and thirty-three (33) sub-themes.

Table 5. 1 Initial Template versus the Final Template

<table>
<tr><th>Initial Template</th><th>Final Template</th></tr>
<tr><td>
Purpose of FiT-based businesses
Value captured
Methane emission reduction incentive
Rural Electrification
Value destroyed
Grid connection costs
Transportation of feedstock
Value missed or wasted
Lack of local expertise and projects
Combined Heat and Power (CHP)
Annual quota
Awareness
Opportunities for new value creation
ENCON type fund
Location-specific bonus tariff
Off-grid FiT
Other International lessons
Time-differentiated tariff system
Centralised biomass power generation
Anaerobic digestate as bio-fertliser
Barriers
Implementation status
Sustainable Energy Development Authority (SEDA)
National Biomass Strategy
Pellets and briquettes
Supply security
Interconnection difficulties
Potential strategies and recommendations for stakeholders
Feedstock ownership and control
Incentives
Green Technology Financing Scheme
Fiscal incentives
</td>
<td>
Purpose of FiT-based businesses
Value captured
Income
Waste management
Pollution and Emission Reduction
Distributed generation
Job and skill creation
Value destroyed
Grid connection cost
Surcharge paid to RE fund
Feedstock price fluctuation
Transportation of feedstock
Value missed or wasted
FiT quotas
Lack of awareness
Lack of local technology and expertise
Combined Heat and Power (CHP)
Opportunities for new value creation
ENCON type fund
Location-specific bonus tariff
Off-grid FiT
Grid connection cost borne by the Utility
Centralised large-scale biomass power generation
Time-differentiated tariff system
Green grid
Bio-fertliser
Promotion of awareness
Promotion of local technology and training
Promotion of CHP
Barriers
Regulatory weaknesses (SEDA)
Adequacy of incentives
Feedstock supply
Impact of National Biomass Strategy
Interconnection difficulties
Potential strategies and recommendations for stakeholders
One-stop centre
Review of incentives
Feedstock ownership
Transparent interconnection requirements
</td></tr>
</table>

For the purpose of data triangulation to enhance the validity of the findings in this research, the criterion used as to what is an acceptable level of evidence to justify a theme necessitates at least 6 references from 6 different sources within each theme (node). Triangulation in this way by “using a variety of data sources” from interviews with different people from different points of views namely Engineering consulting firms, Government agencies, Power utilities, Biomass/biogas plant management, and Research and academic institutions (King & Horrocks, 2010, p. 172) will enable wider and deeper understanding of the research phenomenon. As is apparent from Figure 5.1, there are at least six (6) sources and six (6) references corresponding to each sub-theme, thus meeting the triangulation criterion to justify the adoption of the sub-themes in the Final Template.

5.3 FINAL TEMPLATE

In the Final Template, five (5) main themes are derived from the investigations using the Value Mapping Tool of Bocken, et al. (2013) whilst the remaining two (2) themes are findings based on the approach by the IEA-RETD (2013) to investigate successful Renewable Energy Business Models.

Nodes

Name	Sources	References
Purpose of FiT-based businesses	10	13
Value captured- current value proposition	0	0
Income	10	19
Waste management	8	14
Pollution and Emission Reduction	9	18
Distributed generation	7	22
Job and skill creation	7	13
Value destroyed of current Business Model	0	0
Grid connection cost	8	17
Surcharge paid to RE fund	7	10
Feedstock price fluctuation	6	10
Transportation of feedstock	6	12
Value missed or wasted	0	0
FiT quotas	7	12
Lack of awareness	9	21
Lack of local technology and expertise	10	20
Combined Heat and Power (CHP)	7	11
Opportunities for new value creation for BMFS	0	0
ENCON type fund	12	23
Location-specific bonus tariff	12	27
Off-grid Feed-in Tariff	12	17
Grid connection cost borne by the Utility	12	27
Centralised large-scale biomass power generation	11	20
Time-differentiated tariff system	10	19
Green grid	6	15
Bio-fertiliser	11	20
Promotion of awareness	6	10
Promotion of local technology and expertise	7	25
Promotion of CHP	12	21
Barriers	0	0
Regulatory weaknesses (SEDA)	9	31
Adequacy of incentives	9	20
Feedstock supply	11	28
Impact of National Biomass Strategy	9	21
Interconnection difficulties	11	46

Nodes

Name	Sources	References
Potential strategies and recommendations for stakeholders	0	0
One-stop centre	10	34
Review of incentives	10	34
Feedstock ownership	12	24
Transparent interconnection requirements	8	27

Figure 5. 1 Final Template

5.4 FINDINGS FROM THEMATIC ANALYSIS

The findings from the template style of thematic analysis are reported by describing and discussing each of the themes in turn, referring to examples from the data and using direct quotes to show how the findings have cast light upon the topic at hand (King & Horrocks, 2010). Not every constituent code within each theme is illustrated but only those that most strongly illustrate what the theme is covering and which most effectively address the research objectives (Ibid).

The detailed illustrations for each theme are presented in the following sections and grouped under the 7 main themes:

(1) Purpose of FiT-based businesses
(2) Value captured – current value proposition
(3) Value destroyed of current Business Model
(4) Value missed or wasted by current Business Model
(5) Opportunities for new value creation for Business Model for Sustainability(BMFS)
(6) Business Model Challenges
(7) Potential Strategies and recommendations for stakeholders

5.4.1 PURPOSE OF FiT-based BUSINESSES

The triangulated evidence showed that the majority of the participants agreed that the "primary reason for the existence of the business" is to manage palm oil milling wastes to convert them into green energy for export to the grid to generate income, comply with environmental regulations and mitigate pollution.

As Manager 2 described it, "……*to export the power that we generate……. for a revenue for the company and ……also to be sustainable in the power generation, to use the biomass or the waste…".* Another respondent commented, *"…one is biogas capture and the second part is the waste water management and waste water treatment. One is dealing with power generation and the second part is dealing with compliance to*

Department of Environment in Malaysia" (Manager 3). According to Utility Officer 1, the purpose was to "*reduce the Green House Gas emission, air pollution, at the same time, you generate revenue from clean energy which was fed into the utility system".*

This was echoed by Official 1, "*So the reason why we have this biomass and biogas is because there is so much of waste. Palm oil mill effluent is releasing methane gas into the atmosphere, which is worse than carbon dioxide actually, as far as greenhouse gas is concerned. And biomass is also piling up at the mills, you know, and then of course causing a lot of … also releasing all these gasses and problem. So rather than becoming a problem to the millers and also to the plantation owners, the whole idea was to have, this has become a source for renewable energy".*

Another purpose relates to the long-term security of energy supply through energy diversification to include oil palm renewable energy. *"...you want to diversify the energy.... In the long-term energy security. Energy security is important for you to have diverse…".* (Academic 2). Likewise, Official 3 said, "*First of all, to increase the local energy security. Secondly, to increase the biomass value. The local biomass value. Thirdly, to increase the local career opportunities".*

The triangulated evidence on the "Purpose of FiT-based businesses" is summarised in Table B.1 in Appendix B.

5.4.2 VALUE CAPTURED – CURRENT VALUE PROPOSITION

This research found five (5) sub-themes in respect of "what value is created for the different types of stakeholders". Four (4) sub-themes are related to "what positive value is created", namely:

(1) Income
(2) Waste management
(3) Distributed generation
(4) Job and skill creation

The remaining sub-theme relates to "what negative values" are mitigated, namely:

(5) Pollution and emission reduction

The detailed illustrations for each sub-theme are presented one by one in the following sections.

5.4.2.1 Income

As stated by Academic 2, "*You get a good income…So from this you can create more wealth from your biomass and biogas".* He further stated, *"we have a way to get value for this power i.e. the FiT."* Consultant 2 also expressed this, *"…they can sell energy to TNB, then they can earn some profit from this FiT".* In the words of Manager 2, *"...what we benefit is basically we are able not just getting rid of this so-called by-product of* *waste but now it is also a source of income, revenue as well".* Likewise, Utility Officer 3 described this as "*a form of revenue".*

Consultant 3 considered this as a value created for the Renewable Energy Developer, "*….you get back some return in term of your investment. So, this is the best for the stakeholder."*

Some interviewees referred to the fiscal incentives and described these as part of the positive value created. *"…profit margin is one incentive, the other is a fact that because it is renewable energy, the government gives tax, fiscal incentives"* (Utility Officer 1). "*Pioneer status and tax exemption are very good. So, this actually helps at least when you do the costing, it will actually help you reduce the tax."* (Academic 1).

Table B.2 in Appendix B summarises the triangulated evidence on "Income" as a theme relating to the positive value created.

5.4.2.2 Waste Management

The triangulated evidence showed waste management as a positive value created particularly for the palm oil millers who invested in the FiT-based renewable energy businesses.

Palm oil waste posed a problem as Academic 2 and Manager 2 described them. "*They have heaps of the biomass which they have to handle"* (Academic 2). "*So in the past, if with biomass, like empty fruit bunch will be incinerated, create a lot of smoke and problem to the surrounding. Because the wash down of the smoke"* (Manager 2). *"If you go to some of the palm oil mills…you can see a huge mountains of waste, even though they claim it goes back, but in actual fact, it doesn't go… Just burning it openly, you know, and actually affecting the settlers around there"* (Official 1).

It was pointed out that waste management is critical to the palm oil mill, "…*you want to treat it. If not, you will not have the ability to run your palm oil mill. The authorities will shut it down if you can't control it"* (Consultant 1). "*Waste treatment...they need to treat the waste"* (Consultant 2). "…*we are talking about palm oil mill waste, with Environmental Laws becoming stricter now, so whether you like it or not, you have to do something"* (Consultant 3).

Investing in the FiT-based renewable energy businesses will aid palm oil mills to effectively manage their waste as some of the participants have pointed out. *"…waste disposal more efficient and effective…Effectively manage their waste without going into the landfills and dumping."* (Utility Officer 1). "*But now with the biomass boiler, we are able to get rid of this biomass in a very sustainable way…And whereas for biogas, I think we can also see how Palm Oil Mill Effluent, POME… it is getting us closer, easier to comply to the environmental requirements before we discharge the treated water. So, we can be more sustainable in our palm oil milling* (Manager 2). "*…affluent from the mill also is managed to certain extent"* (Utility Officer 3).

In the long run, the cost of managing the waste is reduced. *"…reduce your cost of waste disposal, you get image as well as CSR benefits of creating a clean environment"* (Utility Officer 1). "*Whether it's human resource problem or whether it's environmental problem, to get rid of all this biomass. But now for the plant operator like us, what we benefit is basically we are able not just getting rid of this so- called by-product of waste but now it is also a source of income, revenue as well* (Manager 2).

Table B.3 in Appendix B summarises the triangulated evidence on "Waste Management" as a theme relating to the positive value created.

5.4.2.3 Pollution and Emission Reduction

As the triangulated evidence showed, pollution and emission are negative values that are mitigated in the FiT-based business models. "*So the value is protecting the environment, reducing the carbon footprint. That's the real value"* (Academic 2). Utility Officer 3 stated, it "*helps to mitigate this impact or effect to the environment".* By mitigating these negative values, "*then it becomes even more attractive because then the oil mills who are normally accused of polluting the environment can say we are mitigating the effects. So, it is business profit as well as image"* (Utility Officer 1).

The emission of Greenhouse Gasses (GHG) and pollution of waterways are reduced as Managers 2 and 3 have described it. *"… if we have open ponding system to treat this POME, the methane gas released is causing pollution, greenhouse effect of 21 times more than CO_2. So, with this feed-in tariff for the biogas generation, basically it's cutting down all these greenhouse gases that is damaging to the environment"* (Manager 2). *"…water that comes out after the waste water treatment will be very much improved because of this biogas, new biogas technology…"* (Manager 3).

Manager 3 also pointed out that oil palm renewable energy displaces fossil fuel power generation and reduces the carbon footprint, "…*reduce fossil fuel consumption, because fossil fuel is definitely polluting the air, not renewable energy".* Likewise, Consultant 2 remarked, "*So, you reduce the CO2 emission. Because when you got more this type of plant, then we will burn less fossil fuel in power plant".* And Utility Officer 2 highlighted this mitigative impact particularly for the east coast of Sabah, *"… displaces generation from diesel plant in the east coast of Sabah…. So, in terms of environment, because it displaces diesel. And this one has much more impact….".*

Reducing pollution and emission creates positive values particularly for 2 stakeholders-environment and society. *"…when environment clean indirectly society also because the last time when you bought a house near to the palm oil mill, you can have …dust and also this odour problem but now if this is controlled, then no problem at all"* (Consultant 3). "*Reducing pollution, cutting down in GHGs and helping the community by making the environment cleaner"* (Utility Officer 1).

The triangulated evidence on "Pollution and Emission Reduction" is summarised in Table B.4 in Appendix B.

5.4.2.4 Distributed generation

The triangulated evidence showed that almost all the interviewees recognised distributed power generation as a positive value for the stakeholders, particularly the Utility and society. This is best summed up by Utility Officer 2, *"…the renewable energy plant is distributed generation and if it's located in rural area and it can supply the load in that area, …… the grid doesn't have to send the power all the way to that particular area. Then there is some benefit in terms of savings in energy losses and all that".*

Manager 2 commented, "*For them I see they are having what we call a small power producer that is aiding them, supporting them in providing quality power into a remote area or far end area that is difficult for them to accomplish in the past."* With distributed generation, "*they also need not be so worried about the system stability because local plant can support the area. So, let's say in future, the grid got problem. So, then they can use the local RE plant to support the area"* (Consultant 2). Distributed generation can also "*relieve the cost of generating power to supply to remote areas"* (Manager 3).

In the words of Utility Officer 1, "*these renewable power plants help to support the grid, strengthen the grid and stabilise the power supply. At the same time, we allow the opportunity to extend supply to remote communities".* Hence, society as a stakeholder would benefit from this distributed generation "*in terms of reducing the generation shortfall"* (Utility Officer 2). As Utility Officer 3 has commented,

> *"For those isolated places, like I said, it would be more practical to do what you call this, this like, what to say more of a distribution, real generation and better generation……Because I think, one of the basic necessity of the society is electricity. It would be good that Malaysia would have a… to me the way I look at it, it would help to basically, like I said, improve the penetration of electricity, especially to you know, more remote areas."*

The triangulated evidence on "Distributed generation" is summarised in Table B.5 in Appendix B.

5.4.2.5 Job and skill creation

Another value created for society as a stakeholder is job and skill creation, as Consultant 2 has stated, "*I think society near the area will actually have more job opportunities for them. Because it creates job for them".* Utility Officer 1 pointed out, *"Not just for the construction, but operation, maintenance. And the people living in the vicinity have an opportunity for jobs in those areas because they are fairly remote".*

Utility Officer 1 added that it was "*not just the direct job creation"* but also "*cottage and service industries"* such as "*transport, other services, repairs and maintenance".* Academic 3 also pointed out that "*it has created also a business in biomass fuel. Not only those projects are using the fuel to generate power to the grid, but there are also* *businesses who are now buying biomass, selling biomass….So there is a business that is created plus also jobs".*

This can *"provide opportunities to all the youth in the remote areas"* (Manager 3). With these new job, skills are also being created for society. Accordingly, those communities living around the area where the FiT renewable energy businesses are based will experience a positive transformation, as Manager 2 has described it,

> *"…a transformation for the rural area as well, because we are talking about household benefitting from it because it's a job creation for them and not just job creation at the lower level but this is a skill level. Because those who are required to do the job are people who need to be trained to operate million dollar machineries. So, it's a new skill that they have to learn, moving from plantation or agriculture now to industry".*

However, Consultant 3 opined that the number of jobs created might not be as many as an industrial factory, "*In terms of numbers, it is not like, factory, where you can have 200, 300 people".*

Table B.6 in Appendix B summarises the triangulated evidence on "Job and skill creation" as a theme.

5.4.3 VALUE DESTROYED OF CURRENT BUSINESS MODEL

With regard to "the value destroyed" or "negative outcomes for any of the stakeholders", four (4) sub-themes were identified from the triangulated evidence. They are:

(1) Grid connection cost
(2) Surcharge paid to RE fund
(3) Feedstock price fluctuation
(4) Transportation of feedstock

5.4.3.1 Grid connection cost

A significant value destroyed or negative outcome for the renewable energy developer as a stakeholder is the grid connection cost. Academic 2 recounted, "*I heard a lot of people complaining that the connection cost is expensive".*

The cost might become prohibitive if the grid is located far away as Manager 1 described it,

> *"Grid interconnection requires the availability of the nearest intake electrical sub-station. This can be a problem as most of the existing substations are situated nearer to towns, which is usually quite a distance from the biomass power plant. The costs of installing long transmission cables becomes prohibitive. Also, the longer the transmission cables, the higher the transmission losses".*

This is shared by Academic 1, *"… you have to bring your own power into the substation which may be a very long distance from your power plant and that can cause a lot of huge capital investment on it. Rule of thumb is 1 km: 1 million".*

Utility Officer 1 expressed the view "*the developer should bear that interconnection cost. But the utilities of the federal government should provide the grid in a close enough place so that it doesn't go more than 10km. In fact, I would say that the interconnection from the power plant to the system grid should be less than 5km".*

Official 1 revealed that "*originally our stand was that the Utility should connect, and the developer will just construct his plant and the connection should be done by the Utility, but of course they protested strongly. So, then when we drafted the Technical and Operational Requirements, it was compromised. So okay the interconnection up to the point of connection, which means to say the nearest sub-station, will be the developer's cost".*

Utility Officer 2 acknowledges that this cost *"is one of the hurdles that you have to go through…..It's very variable and whatever you are getting in FiT …..It doesn't really look into how far ".*

To mitigate this value destroyed for the renewable energy developer, Academic 3 has suggested, "*Because if the cost is really the concern, then there are always options or avenues how to mitigate that…..Probably this other way of doing it is it boils down to the site selection".*

The triangulated evidence on "Grid connection cost" is summarised in Table B.7 in Appendix B.

5.4.3.2 Surcharge paid to RE fund

A value destroyed on the part of society as a stakeholder is the 1.6% surcharge on the electricity bill of consumers to fund the FiT, which Utility Officer 1 described, "*It is cost to society, definitely. Again, I believe that society would not be unwilling to pay that".*

Consultant 2 emphasised that this is a cost or subsidy borne by society, "*….you see now, the renewable energy is actually subsidised by you and me…..The 1.6% where does it come from? Come from our electricity bill. We subsidise the thing".* This is echoed by Utility Officer 2, "*Yes, it's a cost to society".*

Manager 2 pointed out that although this is value *"destroyed in the sense they have to pay more but I think if we compare in the region, I think Malaysian electricity is still cheaper".* Official 1 also commented that this value destroyed to society is not unreasonable,

> "*….1.6%, of course, it is some loss but if you compare with other countries also trying to encourage renewable energy, it is the lowest in the world. The lowest, not one of the lowest, but the 'lowest' in the world. So, we have actually compared to every country around us and in Europe and so on. …..And actually*

> *for residential consumers who are consuming less than 300 units a month, they don't pay 1.6%".*

Utility Officer 3 thought that this is a cost which *"in the beginning, there's bound to be noise coming out"* but *"in the long run, eventually because of grid parity, this will diminish and will be abolished".* By definition, grid parity is the point in time "when the cost of generating electricity from renewable resources is equivalent or cheaper than the cost of generating electricity from conventional fossil fuels" (SEDA, 2016).

Table B.8 in Appendix B summarises the triangulated evidence on "Surcharge paid to RE fund"

5.4.3.3 Feedstock price fluctuation

The triangulated evidence showed that fluctuation in the prices of feedstock had serious negative consequences on the FiT-based renewable energy businesses, as Academic 3 explained:

> "*So you need to do your economic analysis and find out how sensitive is the project to fluctuation in prices, because one thing is that if you have to go out and buy, it may triple the price but that is what you would expect. That could totally damage the project. But if it is from your own sources and you can avoid the cost , so may still not damage your project. So, need to have security of supply of the feedstock"*

According to Academic 1, it is difficult to enter into long-term supply contracts to secure the price, as suppliers are waiting and hoping for better prices in the future:

> "…..*supplying under a long term contract is very difficult. Not many miller are willing to give you a 10 years' contract because as I mentioned just now, everyone is still wait and see. They are trying to wait for the better price of the biomass. So they are eying on the new technology maybe coming in after 5 years, I give you a contract, I sign off today, I might not get the increment, you see?"*

Utility Officer 2 felt that *"the government should step in and probably… I'm not sure whether it's possible or not to control the prices"* and added that "*the bankers also concerned about this one. Because of the risk, so you get higher rates interest".*

Consultant 2 attributed feedstock price uncertainty to the shift from waste to wealth. "*Because last time they are free, how to throw the thing. But when you collect, they see, you must have me, without me you cannot survive. Then it became a problem already. They want RM2.00, RM3.00 per ton. Or RM5.00 per ton or something like that"* (Consultant 2). The extractable oil content in the feedstock has also boosted its value as shared by Consultant 1,

> *"Availability and price of Biomass as feedstock has been affected in particular it has increased in value because of the extractable oil content".*

The price of the feedstock can be very much affected by the competing demand of using the biomass for products other than fuel, such as fibres and organic fertlisers, as Official 3 has pointed out:

> *"…for example, China, they used to buy our Empty Fruit Bunches (EFB) in fibre form for their furniture. Suddenly they don't want to buy…..So suddenly the market affected…..But you will know that now the price increasing, is really increasing because of organic fertiliser. Millers can see the direct money using the low technology, so called lower technology compared to the energy generation. And the demand is increasing. Every half a year the price of organic fertiliser is increasing. Those millers will say we willing to do organic fertiliser compared to the renewable energy."*

Table B.9 in Appendix B summarises the triangulated evidence on "Feedstock price fluctuation".

5.4.3.4 Transportation of feedstock

The triangulated evidence also showed that transportation of biomass feedstock could have negative impacts not only on the renewable energy developer but also on other stakeholders, namely society and the environment. Academic 1 has summed up the impact as follows:

> *"……one of the main issue of biomass is actually the logistic. You consume a lot of energy to logistic your raw material, biomass. If you don't …..have a collection point or the right locations to do the power generation, you might end up wasting more energy than whatever energy you generate".*

As Manager 1 has pointed out, empty fruit bunch (EFB) *"has a low bulk density and requires large trucks to ferry it economically".* The cost might become prohibitive once the transport radius exceeds 50 km as Academic 1 commented,

> "*Once you exceed 50 km radius, very difficult because the logistic cost becomes very high and then you can imagine, because we are transporting, let's say pressed EFB, 40% moisture means 40% you cannot burn. So 1 tonne lorry becomes only 600 kilogram that can be burnt".*

Transportation of feedstock is harmful to the environment and society, particularly the rural communities who live along the transport routes. This value destroyed for society and the environment was highlighted by Consultant 2:

> "*If too far away, it is actually not so green….Also pollution as well. With all the lorries going through the rural area to collect all these kind of things, also create some local issue".*

This concern is echoed by Utility Officer 1, who commented that *"if you have excessive transport of the feedstock, then you are creating some amount of emissions".* Official 3 said, *“we can’t use a clean way to transport the biomass, this is the problem”,* and added:

> *“Even though we claim that this is a clean technology, but the truck is the one that releases the most carbon footprints along the supply chain and in Malaysia nobody is talking about the supply chain optimisation”.*

To mitigate this value destroyed, the location of the biomass plant is critical. *“It should be close to the source of supply….the lorries that delivering it, they are using fuel, for example from one end to the other end, you consume how much fuel for your transport” (Utility Officer 2)*.

The triangulated evidence on “Transportation of feedstock” is summarised in Table B.10 in Appendix B.

5.4.4 VALUE MISSED OR WASTED

Value missed or wasted “represents cases where stakeholders fail to capitalise on existing assets, capabilities and resources” or “are operating below best practice” (Bocken, et al., 2015, p. 71). Four (4) sub-themes were identified from the triangulated evidence:

(1) FiT quotas
(2) Lack of awareness
(3) Lack of local technology and expertise
(4) Combined Heat and Power (CHP)

5.4.4.1 FiT quotas

The triangulated evidence showed that since the FiT quotas are limited, some FiT applicants may not be successful and hence, fail to capitalise on their existing assets, capabilities and resources, resulting in value missed or wasted. Academic 1 has remarked on this value missed or wasted:

> *“Some companies actually can produce more than they’re awarded. So might need some flexibility,…..I mean you have to look at the production capacity instead of you fixing a certain amount… ”*

Consultant 2 has ascribed this value missed or wasted to the lack of FiT quotas particularly for oil palm biogas, *“Those days you open the SEDA website, you can still see the quota for the biogas still there. Wait for you to apply. Now, you know, open, zero…”.* As to why there is a lack of quota, Consultant 2 opined, “*Ask why is the biogas so less …...You see, our fund 1.6% almost finished already. We cannot, unless……… gazette another 1.6%. Then you have more. Then if they go and gazette another 1.6% then you and me going to pay more”.*

Consultant 2 added, *“……I think hydro and solar, solar is quite a lot already,…….. And hydro is also not so good for the environment. Because……., our local economy* *supported by the palm oil. It should be encouraged more……" ;* "*So we better put in more on the biomass and biogas to help our industry also".* Likewise, Utility Officer 1 commented,

> "*Now a lot of this money from this 1.6% has been going to solar. And yet being given exorbitant rates. They should not be given such lucrative rates. And if those rates were more fair, more money will be available for energy efficiency and as well as probably more for the biomass and biogas."*

Consultant 1 also highlighted that it is *"restrictive with the quota system".* Academic 2 posed the question, "*Is it easy for you to get the feed-in tariff? From what I heard it's not easy. There are quotas".* One interviewee felt that the quota system based on first come first serve basis was flawed. "*The current practice of obtaining the approval primarily on the basis of the quota system is defective as it does not take into account the competency of the project developer and the level of completion of the project"* (Manager 1).

Hence, it was advocated by Manager 3 that *"it should be up to the industry"*. He added,

> *"…the renewable energy developer to see how much they can generate and inject into the grid. That would promote renewable energy in a better way rather than restricting us to certain quotas and how much we can put into the grid, inject into the grid. So I would say they should review this fixed quota."*

Table B.11 in Appendix B summarises the triangulated evidence on "FiT quotas".

5.4.4.2 Lack of awareness

The triangulated evidence showed that value is wasted due to lack of awareness. As Academic 1 explained, *"to me, the policy is not reachable to most of the people. It's not very clear. Some people are not aware of this. Some of the financier, some, I would say some, they are still very reluctant to do because they are not aware of that".* This lack of awareness had affected the financing and, consequently, the development of oil palm renewable energy businesses in Malaysia, as Academic 2 had elaborated,

> *"Because the bank is afraid, the way I see it. The bank is afraid or not sure. But who is evaluating at the bank level? Is it someone who very familiar with power generation? If I'm not so familiar with power generation I'm not sure whether the project will succeed. I based on what other people experience but I don't look technically this one is more sound than that one. Both have boilers but boilers have a lot of design. The size, the height whatever the flow, who is telling the bank that this one will have 90% chance of success, that one has less".*

It has also affected investor confidence in oil palm renewable energy businesses. "*So, that's why the biogas starting very slow because they don't know whether can succeed"* (Consultant 2). Consultant 3 thought that nobody seemed to be fully aware of the difficulties and risks before embarking on the business, as he described it *"……. nobody* *knows, I mean if you want to after you said you decided you want to do this, then you know; before that nobody knows……Try first and then only you know, but before that nobody knows; that is the problem".*

Compared to solar, Utility Officer 2 thought that the level of awareness was very low, resulting in lack of interest as he commented, *"I think particularly in the palm oil and biogas sector, I think it's not attracting enough interest. Very low. Compared to the promotion that they put on solar".* This is echoed by Official 1, "…*even though SEDA have done a quite a few stakeholder engagement, especially on Solar PV, but still the common comment is still awareness".* Academic 1 opined that many palm oil millers are not keen as they "*still take a back seat and relax, you know? Because crude palm oil (CPO) is still the main business and it offers a very good price. So they're still enjoying whatever they do".*

One interviewee however differed with the majority on the level of awareness among Malaysian and argued that "*over the last 8 to 10 years, they have become well aware of it"* (Utility Officer 1).

Table B.12 in Appendix B summarises the triangulated evidence on "Lack of awareness"

5.4.4.3 Lack of local technology and expertise

Value is also wasted due to the lack of local technology and expertise as shown by the triangulated evidence. Academic 2 explained,

> "….*you have to make sure your boiler can burn the fuel efficiently and not get into problem. That designing the boiler to suit the fuel was not taken into consideration so much, so they use whatever boiler available and they make it bigger and then you burn it. It doesn't work. And then we see a lot of failures…..So that happens because people don't know how to evaluate. They buy from overseas".*

Official 1 cited an example of a stakeholder failing to capitalise on its assets, capabilities and resources due to the lack of local technology and expertise,

> *"I give you one example. There's a 2 MW plant in Johor. On good days also can only produce 600 kW. Because they use gas engine from China proper, only for 20% efficiency, and then they give you some chemical trouble. You know they need to remove the hydrogen sulphide but here the hydrogen sulphide has gone into the engine and eaten up the engine and so on".*

In addition, the high cost of importing foreign technology is a deterrent as Academic 1 described it,

> "…*there are various palm oil mills that can actually undertake the feed in the tariff, they have the criteria. They don't take it because of the cost, you know things like that. So they actually can do better".*

Official 1 noted that although *"for biogas it's improving"* but for *"biomass, actually apart from one or two",* there are "*still a lot of issues".*

The lack of local expertise was also emphasised by Consultant 2,

> *" I think it's still lack of local expertise. Because like until now,… , if you look engine, we still need the support from manufacturer. Maybe quite a costly thing".*

One interviewee warned that this could have a crippling effect on the oil palm renewable energy businesses in Malaysia. *"You cannot get experienced workers….If you don't have enough of people to run it you are in trouble"* (Consultant 1). This is more so in rural areas as Manager 2 has commented,

> *"….when we have a biomass plant and biogas plant in remote area, the vocational skill or the people, resources is not so easily available….So, it would have been better to have more training, education system to enable the people to be able to operate the machineries".*

Utility Officer 3 thought that *"we are still on a learning curve, because this renewable energy technology is something new in Malaysia. So but I would say maybe, going in the right direction".*

The triangulated evidence on "Lack of local technology and expertise" is summarised in Table B.13 in Appendix B.

5.4.4.4 Combined Heat and Power(CHP)

The triangulated evidence showed that majority of the oil palm renewable energy businesses in Malaysia are operating below best practices in the manner Manager 1 has described it,

> *"Standalone biomass power plants currently operating without CHP in Malaysia is wasteful. There is a lot of potential heat that can be tapped off from the turbine…….. There is also potential to pipe this steam to any nearby process plant. If this is not done, then the process plant will have to purchase another biomass boiler which competes for biomass fuel with the biomass power plant".*

By operating without Combined Heat and Power (CHP), value is missed or wasted. *"It's value wasted basically. If it's right next to the mill, it will be good. Because you can actually use the steam for your process*" (Utility Officer 2). The same was echoed by Utility Officer 3,

> *"…..why they go for combined heat power is because it's more of efficiency, plant efficiency. Basically you are getting, optimising the resources, use of resources. So… so… well, that would be the what you call this value missed , you know"*

Manager 2 asserted," *if we can, of course we prefer to have a Combined Heat and Power (CHP) because that will avoid the redundancy of having a separate boiler to power the palm oil mill".*

However, Consultant 3 has qualified CHP as a value wasted by pointing out that it "*cannot be helped if you are away from other industry. This one is just to help the other industry"* to utilise the heat for their requirements.

One interviewee voiced the absence of any emphasis on CHP in Malaysia's FiT scheme. *"Currently, I don't see much emphasis on this Combined Heat and Power (CHP). To be frank, should be the way to use the energy…"* (Academic 1).

Table B.14 in Appendix B summarises the triangulated evidence on "Combined Heat and Power (CHP)".

5.4.5 OPPORTUNITIES FOR NEW VALUE CREATION FOR BUSINESS MODELS FOR SUSTAINABILITY

This research found eleven (11) sub-themes pertaining to the value opportunities for modelling "Sustainable" FiT-based Renewable Energy Business Models in Malaysia. Two (2) sub-themes are centred on the "possibilities to eliminate value destroyed" (Rana, 2016) as stated below, but only ENCON type fund was found to be conclusive from the triangulated evidence:

(1) ENCON type fund
(2) Grid connection cost borne by the Utility

Three(3) sub-themes related to value missed had emerged from the triangulated evidence:

(3) Promotion of awareness
(4) Promotion of local technology and training
(5) Promotion of CHP

Six (6) sub- themes were identified from the triangulated evidence for "extending the value proposition" or "shifting to higher value added activities" (Ibid). However, this research found that Off-grid Feed-in Tariff and Centralised large-scale biomass power generation were not supported as value opportunities for innovating the Business Models of renewable energy businesses based on the FiT for oil palm biomass/biogas in Malaysia.

(6) Location-specific bonus tariff
(7) Off-grid Feed-in Tariff
(8) Centralised large-scale biomass power generation
(9) Time-differentiated tariff system
(10) Green grid

(11) Bio-fertiliser

5.4.5.1 ENCON type fund

One possibility to eliminate the Surcharge to the RE fund as a value destroyed is the introduction of an Energy Conservation Promotion Fund (ENCON Fund) in Malaysia similar to Thailand's ENCON Fund, as Manager 1 had suggested,

> *"The ENCON Fund is funded by a levy of USD0.002/L on petroleum sold in Thailand. This is good as it directly discourages the use of fossil fuel, and is a fairer plan than to tax electrical consumers like for example in Malaysia".*

The adoption of this Fund in Malaysia to replace the Surcharge to the RE fund was endorsed by the First Focus Group Meeting ,

> *"Energy conservation and promotion fund in Thailand (ENCON Fund) is an excellent mechanism and should have been established with FiT …… There should be an ENCON type of fund to replace the Renewable Energy Fund as a bigger fund and it can be applied to energy efficiency as well".*

Academic 1 supported the idea of an ENCON type of fund to promote renewable energy in Malaysia,

> *"I do support the idea. If we can have it in Malaysia, that will be very good because one of the main issues, one of the main challenge in a RE project is actually cost. The cost is much higher compared to the conventional system. If you're talking about power generations, RE project is much higher compared to conventional power generation system. Therefore proper subsidy, proper funding available to the investor is always helpful to promote RE project and we have to differentiate bio energy from conventional energy or fossil fuel energy".*

Consultant 3 thought the Fund *"should have been there a long time ago".* Manager 3 commented that the Fund was *"a levy on fossil fuel"* aimed at "*trying to inject more renewable energy and reduce fossil fuel generation*". Manager 2 thought that this levy was fair as it would *"tax the polluter, in this case fossil fuel energy player".* Official 1 argued that it was *"a much better idea than collecting from the people".*

The triangulated evidence on "ENCON type fund" is summarised in Table B.15 in Appendix B.

5.4.5.2 Location-specific bonus tariff

The triangulated evidence showed that location-specific bonus tariff represents a value opportunity for extending the value proposition namely, distributed generation and, pollution and emission reduction particularly for the less developed east coast areas of Sabah.

In section 5.4.2.4, distributed generation was identified as a positive value from the FiT-based renewable energy businesses as these businesses can help support, stabilise and extend the power supply particularly for remote areas. A location-specific bonus tariff or premium can enhance this positive value and also mitigate the pollution and emission from diesel-based power generation, as stated by Manager 1,

> *“I feel this special bonus tariff is good as it encourages the development of renewable energy in rural areas in Malaysia like the state of Sabah which is still heavily relying on high polluting diesel-powered electrical generation. This bonus will also help to offset relative investment risks in this region”.*

Manager 3 suggested that the bonus should be considered for Sabah to promote rural electrification, “*we should consider encouraging investor to invest with a better rate and by doing so, the rural electrification will be satisfied”.* Academic 1 also agreed that the bonus was needed for Sabah to enhance distributed generation in that state,

> *“I do agree with that because in some region, we really need RE project. For example, Sabah… They are the ones who really we should promote RE because one thing is their grid connection is not as well as compared to West Malaysia. So in a lot of area, they are actually still lacking power. And according to the people who are staying there, there are always trips on their power supply compared to West Malaysia which hardly had trips”.*

Furthermore, the cost of diesel-based power generation in Sabah is very high and even with the bonus, there could still be a net saving. “….*actually in Sabah a lot of the power is generated from diesel engine and the price of the diesel engine per kilowatt hour is very high….So even if they give bonus for the FiT , still have a net gain, to me”* (Academic 2). Utility Officer 2 also commented on the high cost of diesel-based power generation especially in the east coast of Sabah and emphasised that a higher FiT rate is needed,

> *“Especially on the east coast of Sabah. West coast, mostly the electricity comes from gas. Whereas on the east coast of Sabah, mostly diesel, we don’t have gas supply over there…They are actually subsidising diesel price….Quite a lot. I mean at the diesel price of RM2.70 for example, the true cost of generation for diesel is about RM1……. Higher rate especially in value-added places such as the east coast of Sabah”.*

Instead of subsidising the diesel, the subsidy saved should be diverted to the renewable energy fund and used for the bonus tariff. “*Because like Sabah for example, when they use less diesel, actually the government actually subsidise less diesel. Actually they can use the subsidy, instead of subsidizing the diesel, you take the subsidy and put in as a bonus”* (Consultant 2).

Official 1 shared that there had been many requests for Sabah to have the bonus and he opined that it should be granted, *“Actually there has been a lot of request for that,…,* *maybe that Sabah should be special case……, my professional opinion, I support that. But the RE Act is written in such a way, we cannot differentiate unless you need to amend the Act".*

The triangulated evidence on "Location-specific bonus tariff" is summarised in Table B.16 in Appendix B.

5.4.5.3 Off-grid Feed-in Tariff

Off-grid FiT was considered as a potential value opportunity for extending the value proposition, income. In section 5.4.2.1, income from the FiT was recognised as a value proposition of the FiT-based renewable energy businesses. As Manager 1 described it, *"by means of this off-grid tariff, the RE generator is still paid the tariff, which encourages them to replace or avoid the use of fossil fuel"* even though the power generated is consumed on-site. Hence, off-grid tariff has the potential to enhance the FiT income as a value proposition of the renewable energy businesses.

However, the triangulated evidence showed that almost all the interviewees thought that off-grid FiT was not sustainable as an initiative to extend the income of the renewable energy businesses. As the First Focus Group meeting has pointed out, if the biogas plant is integrated with a palm oil mill as is the norm in Malaysia, there might not be enough demand for power on-site unlike the United Kingdom (UK),

> *"In UK self-generation is viable because many of those who do self-generation have a fairly high demand themselves however in Malaysia self-generation may not have enough demand as most palm oil mills already have surplus power even without the biogas plants".*

Furthermore, in Malaysia the renewable energy(RE) fund is limited as highlighted by Official 1,

> *"I think that will be quite difficult to do because RE Fund is limited. So if you want to do that, we actually need to expand the RE Fund, much more….It has been suggested to SEDA before, we should pay for all the generation, and then whatever export should pay additional".*

This was echoed by Utility Officer 3, "*I think, for this initiative to be sustainable, the fund must be available also. Because otherwise, just like what they experienced in Spain, government cannot sustain it, the whole system collapse you know".*

Academic 2 thought, "*I don't think it's much different so even without the incentive the people who can use it internally will use it internally".* Consultant 1 felt that the generator should not be paid if he was not connected to the grid and gave this critical response, ,*"Yeah. How can you get paid? You want to get paid from all angles".*

Although the power generated and consumed on-site was still renewable energy, Utility Officer 2 did not agree that any FiT should be paid for it. "*It's renewable. True, it's renewable. I think should get some tax incentive…Shouldn't be feed in tariff, like that".*

Table B.17 in Appendix B summarises the triangulated evidence on "Off-grid Feed-in Tariff".

5.4.5.4 Grid connection cost borne by the Utility

Getting the Utility to bear the grid connection cost was considered a potential value opportunity to eliminate the value destroyed discussed in section 5.4.3.1, namely Grid Connection Cost.

However the triangulated evidence showed that the responses from the participants were mixed. Three (3) interviewees responded that the cost should be borne entirely by the Utility. "*To me because the utility is buying from us. In fact, the sub-station SSU also should be under them, should be theirs…That means outgoing from our plant is theirs. That should be the way"* (Consultant 3). Consultant 1 thought that it *"should be fair"* but "*basically you should have a situation where the plant is not too far from the grid".* Academic 1 suggested that the Utility should bear all the interconnection costs and recoup them through profit sharing,

> *"For the initial stage, if you want to fully encourage biogas or biomass plant, utility has to bear the cost for the interconnection, maybe at least, for the first 10, 20 % of the plant. Then move on and then probably can share the profit. Profit sharing is one of the model, I would say".*

On the other hand, Utility Officer 1 asserted that "*the developer should bear that interconnection cost. But the utilities should provide the grid in a close enough place so that it doesn't go more than 10km".* Utility Officer 3 also expressed the view that it should be borne by the renewable energy developer,

> "…*my view is it should be borne by the developer. Because, you see, the project is mooted by the developer and interconnection is part and parcel of the cost. And bearing in mind that developer is coming into, what you call this, utility system, so it's only reasonable that the developer should include it as part of their cost".*

Utility Officer 2 argued that *"it is not really fair* as "*we do not allocate for all this ad-hoc added interconnection".*

Other interviewees suggested a middle ground between the two opposite standpoints. Manager 1 suggested that *"grid interconnection costs should be shared on a 50:50 basis because the plant operator has to fork out a lot of money to build the substation and transmission cables which is ultimately handed over to the power utility".* And Manager 2 thought " *it should be shared, you know, because I think for example in our case whereby we invested over Ringgit Malaysia 2.0 million in the switching station, SSU for example. And then after two years, we have to hand over."*

Consultant 2 argued that the Utility should share the cost as they also benefited from the FiT scheme, "*Don't ask the FiT plant to bear everything….I think utility should take portion of it. Because utility also benefit from this scheme…..interconnection cost is shared, utility will consider their investment needs to be done on the interconnection. Or else utility will ask for the sky…..When you need to pay you think about it".*

As discussed above, the triangulated evidence were clearly inconclusive on whether the Utility should bear the grid interconnection cost. Hence, this research found that getting the Utility to bear the grid connection cost is not supported as a value opportunity for innovating the FiT-based Business Models of the oil palm renewable energy businesses in Malaysia towards Business Models for Sustainability.

The triangulated evidence is summarised in Table B.18 in Appendix B.

5.4.5.5 Centralised large-scale biomass power generation

Centralised large-scale biomass power generation was considered a potential value opportunity to extend the value proposition, income. A large-scale plant may possibly accomplish economies of scale resulting in lower cost per unit of electricity produced and hence higher income margin for the renewable energy developer. Academic 1 thought it was a good idea,

> "*I like to have a central utility hub. We call it central utility hub whereby you can collect all the material and centralise the power generation….but when you do a centralised, one of the main issue is actually distance. Cannot be too far because once it become too far, your logistic cost become very, very high".*

However, the triangulated evidence showed that majority of the participants disagreed with centralised large-scale biomass power generation mainly due to the logistical hurdles as summed up by Manager 1,

> *"Large scale biomass power plants are not feasible due to the logistics involved in bringing the feedstock to the power plant. Empty fruit bunch (EFB) has a low bulk density and requires large trucks to ferry it economically. Another problem is the availability of feedstock, it varies considerably between low and high Fresh Fruit Bunch (ffb) seasons".*

Consultant 2 voiced the same view. *"Transport is the main thing, because it is largescale, I think very difficult to get feedstock".* Manager 3 said, "*it's not really viable because the logistic involved, particularly for palm oil mills that are far away from the centralised collection centre".*

Utility Officer 1 did not agree *"because it will mean a lot of transport cost and emissions of transport".* Instead of enhancing the value proposition, centralised large-scale biomass power generation may end up increasing the value destroyed as discussed in section 5.4.3.4, namely Transportation of feedstock, and diminishing the value proposition in section 5.4.2.3 i.e. Pollution and Emission Reduction.

Furthermore, it would defeat the value proposition, distributed generation, as discussed in section 5.4.2.4, as Utility Officer 2 has highlighted, "*Oh no, I don't think so. A bit tough logistically, isn't it?*....*I don't think it's a good idea. It defeats the purpose of distributed generation concept".* Likewise, Utility Officer 3 questioned how distributed generation could be met if centralised large-scale biomass power generation was implemented. "*How can we sort of increase this distributed generation in Sabah? So if you centralise, might not be able to basically meet or realise that".*

Official 1 suggested that the plant should not be too large, preferably about 5 to 6 Megawatts with a comfortable level of feedstock supply,

> *"So if you ask me, it is not a good idea to have these large plants……, rather than having third parties coming in to develop large plants and so on, 30 MW plants, the palm oil miller should be the one actually doing the biogas and also biomass. Whatever feedstock he can secure, comfortably, that means its own; sure to get some from some friendly party. Only that, 5-6 MW. Because if you keep on going for these large ones, definitely will get into problems".*

Hence, this research found that centralised large-scale biomass power generation is not supported as a value opportunity for innovating the Business Models of renewable energy businesses based on the FiT for oil palm biomass in Malaysia.

The triangulated evidence is summarised in Table B.19 in Appendix B.

5.4.5.6 Time-differentiated tariff system

Academic 1 supported the introduction of a time-differentiated tariff scheme described as follows:

> *"…in the day time there is always the higher power consumption. So we should encourage the generation in the day time and they can run down at night time. So you should have a different tariff".*

Time-differentiated tariff system could constitute a value opportunity to extend the value proposition, particularly pollution and emission reduction. As discussed in section 5.4.2.3, oil palm renewable energy displaces fossil-based power generation. By encouraging the generation of renewable electricity in the day time with higher tariffs to meet the peak power demand, less fossil fuel would be burnt in the power plants, thereby reducing the carbon emissions. This is echoed by Utility Officer 1, "*…it should be on time-differentiated tariff so that the feed stock is used most efficiently to produce highest amount of power when the feed demand is there".*

Consultant 3 thought that this is fair since the Utilities "*are charging the consumer this way, so why not they do the same"* with the renewable energy developer. Utility Officer 2 said, *"it's a good idea. In the future when the infrastructure is ready, I think that will be the way".*

However, some of the participants disagreed. Consultant 2 thought that it would be unfair to the renewable energy developer,

> *"If let's say at the off-peak, they want to pay lower, I think the FIT plant will have problem. Because they are not a big scale plant, you know ; because their capital investment, then they will have longer payback, this may kill off the industry, they don't want to invest already".*

Manager 2 also voiced the view that this is *"not good for plant operator"* and said, "*I think, because our investment is based on the, what do you call that, installed capacity. We must be running up to the full capacity".* Utility Officer 3 felt, *"probably, it is too early for Malaysia. Because this may need further study or evaluation whether it's conducive or is it a right time to implement in this country".*

Manager 3 opined that the time-differentiated tariff system would diminish the value proposition i.e. pollution and emission reduction rather than extending it as a value opportunity. "*So, in my opinion, I do not quite agree with these peak and off-peak rates. Why I say, because is, we should encourage all the renewable energy plants, whether it's biogas or biomass, to generate to its maximum in fulfilling what we call to reduce the air pollution…So by doing off-peak rate, you are not encouraging renewable energy power to be generated".*

As can be seen from the triangulated evidence, there are as many opponents as there are the proponents of the time-differentiated tariff system. Hence, the evidence is inconclusive as to whether the time-differentiated tariff system can constitute a value opportunity to innovate the Business Models of the renewable energy businesses based on the FiT for oil palm biomass/biogas in Malaysia.

Table B.20 in Appendix B summarises the triangulated evidence discussed above.

5.4.5.7 Green grid

The triangulated evidence revealed a proposal by the Government to develop a green grid, which is a network of collector sub-stations to be constructed close to clusters of palm oil mills. As Official 1 explained, the *"collector station will be the interconnection point, but it will step up from 11kV to 132kV, and the Government will actually construct this collector station and also the 132 kV line to the existing grid. That is the proposal".* The proposed green grid will facilitate the participation of palm oil mills in FiT-based renewable energy businesses by enabling them to connect to the respective collector sub-stations, rather than connecting all the way to the main grid.

As discussed in section 5.4.2.4, distributed generation was recognised as a value proposition of FiT-based oil palm renewable energy businesses, as their renewable energy plants can help to support the grid, strengthen the grid, stabilise the power supply and extend supply to remote communities for rural electrification. Distributed generation was recognised as a positive value for the stakeholders, particularly society and the Utilities.

Official 1 commented on how the green grid could boost distributed generation particularly for remote areas,

> "*Federal Government spends a lot of money extending the grid or doing this solar hybrid projects for these isolated villages. But this solar hybrid has very limited power. So people can just have some lighting basically but you cannot have air-con or cannot have cottage industry, you know, cannot have all these. And if you extend the grid, sometime at the end there, the voltage is so low you cannot even light the bulb properly. So, under the green grid proposal, we identify which are the clusters of oil mills, plantations and so on, and we negotiate with them whether they are willing to do a biomass plant and also biogas. If they agree, then the Government will fund the green grid. Under the green grid, we have collector stations. That means the biomass plant or the biogas plant will extend 11kV only up to this collector station, rather than all the way to the grid. So this collector station is somewhere near them. So they only construct the 11kV up to this point".*

Likewise Utility Officer 3 said that the idea of the green grid was *"basically to enhance further the development of renewable energy generation, especially in those remote areas".*

By facilitating the interconnection of biomass and biogas plants particularly in the rural areas, the green grid can actually enhance distributed generation as a value proposition and thus, it constitutes a value opportunity for renewable energy businesses based on the FiT for oil palm biomass/biogas in Malaysia.

Official 3 said it is important to optimise the location of the collector sub-stations:

> *"They have to enhance it with the proper location selections. All these is about the optimisation. So where is the location for this collector substation, so how many mills surrounding them. So everything has to be calculated and the distance back to the main grid and so on. Because or else there is a loss".*

The collector sub-station can serve as *"a centralised injection point"*, making it easier for the Utilities to control if there are several plants in an area. "*So, maybe with too many plants injecting, maybe difficult for the utilities to control. If let's say the area got many plants, should consider a centralised injection point"* (Consultant 2).

Utility Officer 1 argued that instead of introducing a location-specific bonus tariff as discussed in section 5.4.5.2, *"what is more important and desirable for Sabah is extension of the grid to enable these plants to feed into the grid".* In other words, in the opinion of Utility Officer 1, a green grid of collector sub-stations built by the Government to facilitate the grid interconnection of biomass and biogas plants in Sabah should be the value opportunity instead of a location-specific bonus tariff.

However, Utility Officer 2 mentioned that the authorities were *"talking about the green grid for some time already"* but it was still *"in the very early stage".*

Table B.21 in Appendix B summarises the triangulated evidence on “Green grid”.

5.4.5.8 Bio-fertiliser

The triangulated evidence showed the conversion of biogas and biomass residues into bio-fertiliser as a higher value added activity that could constitute a value opportunity for oil palm renewable energy businesses based on the FiT for biomass/biogas, particularly for the environment and renewable energy developers.

Belt press and dewatering press cakes are residues from the biogas plant that can be recycled back to the oil palm estates as they are a good source of plant nutrients. Boiler ash, a residue from the biomass plant, is also a good source of some of the palm nutrients , and blending the cakes and ash together can convert them into bio-fertiliser as a value-added product, as said by Manager 2. “*In biogas plant for example, the belt press and dewatering press cake can still be used as, what do you call this, fertiliser. And likewise for biomass plant, the boiler ash, in fact, we have started to sell our boiler ash now. And we are also considering how to blend this ash and cake so that it gives a better fertiliser”.*

Academic 2 agreed, *“to me it is definitely a good bio- fertiliser. This is part and parcel of what I say recycling everything…They contain a lot of micronutrients that effect the fertility of the soil long term. So you want to do biogas the cakes must be put back to the estate”.* Likewise, Manager 3 said, *“using biogas residues as bio-friendly fertiliser is actually a very good thing…..so I think we need to promote that it is bio-friendly”.*

Consultant 2 also opined on the biogas residues, “*you may have to mix with other thing to become better fertiliser…process it and mix it with certain type of chemical”.*

Academic 1 lauded the sustainability of recycling the residues back to the oil palm estates as bio-fertiliser,

> *“If you can, it’s very good because eventually…… transforming the entire palm oil into zero waste discharge from the mill and bio fertiliser is one of the good product that can actually help us to mitigate a lot of our ways and it’s actually close the cycle where because of the fertiliser, we can send back to the plantations where you can return the nutrient back”.*

Academic 1 added that producing bio-fertiliser as a value-added product in addition to renewable power generation was in line with the concept of bio-refinery which he described as follows,

> *“the concept of bio-refinery where you can produce multiple products. So how it works is, because when you have multiple products, that means your system will be more robust. When collapse in one project or one product, you can alternate your system to produce another product where you still retain your ROI or your profit margin. So if you are relying only on power generation, it might be a risk, high risk investment because what if SEDA said “No more extension after 16 years”, then what happens? You might be uncertain”.*

Manager 1 supported the idea of granting a bonus tariff for bio-fertiliser in the Malaysian FiT scheme. "*A new bonus tariff for converting the by-product of the biogas plant into eco-friendly bio-fertilizer should be welcomed as it will encourage the increase in production of such fertilizers which in turn reduce our dependence on chemical fertilizers".* But Official 1 felt, "*I don't think we need a bonus for that"* although he agreed by saying *"yes, definitely"* to bio-fertiliser as a value opportunity.

Utility Officer 2 cautioned the need to *"look at the economic perspective first. Or cost-benefit to the owner whether there's sufficient ROI for them to extract the fertiliser and make profit from there itself without the need of subsidy".*

Table B.22 in Appendix B summarises the triangulated evidence on "Bio-fertiliser".

5.4.5.9 Promotion of awareness

Earlier in section 5.4.4.2, it was noted from the triangulated evidence that value is squandered due to lack of awareness. Value is squandered or missed because stakeholders, particularly renewable energy developers, fail to capitalise on existing assets, capabilities and resources due to lack of awareness. Hence, new positive values can be created for the stakeholders, if various activities and collaborations to promote awareness are introduced as highlighted by the triangulated evidence. As Official 3 has pointed out, "*it involves the awareness of the policy maker plus the investor"* and "*financier as well".*

Academic 1 pointed out the importance of education in promoting awareness of renewable energy,

> *"….I think European, they already have the awareness, first thing. They are actually willing to pay for eco-friendly product versus the conventional products…..education has to be there to educate people. They are willing to pay more for the bio energy……So education is important. So how do we educate every different sectors, not only the green technology provider, you have to educate the bankers, financing institute so how they look at all these technologies".*

Likewise, Consultant 2 stressed the importance of education to promote green energy. "*Because everything you must educate from young, only in future they know about green energy. If they know about green energy and how green energy is important then easier to convince them".*

As palm oil millers are those who have the best capabilities and resources to invest in the FiT-based renewable energy businesses, the promotional activities including workshops should target them. In this regard, Official 1 revealed that more effort is needed,

> *"That's why we have been trying to have workshops, where we get the stakeholders to come. Unfortunately those who come are normally the*

entrepreneurs or the service providers in biogas industry. Rather than the oil millers. Oil millers are so difficult to turn up".

Consultant 2 felt that the website of SEDA was an important platform to promote awareness, particularly on the incentives available for renewable energy businesses. "*Can make it more simple and publicise it in the SEDA's website, then let people know what type of incentive they can get from government. Just put in point form. Because SEDA's website also didn't state clearly .Highlight very clearly and put in point form what incentive you can get. Then for detail, they can go and check whatever".*

Manager 3 also thought that the website was an important tool to promote awareness among stakeholders and suggested, *"..as time goes, they should improve their website so that it will be not only renewable energy investors but even ordinary people can go into it and see".*

The promotion of awareness should be done continuously as Utility Officer 3 has advocated. "*It would be good to have continuous promotion of awareness program, if the government really wants to realise the target".*

Table B.23 in Appendix B summarises the triangulated evidence on "Promotion of awareness".

5.4.5.10 Promotion of local technology and expertise

As shown by the triangulated evidence in section 5.4.4.3, value is squandered due to lack of local technology and expertise. Hence, if various activities and collaborations are undertaken to promote local technology and expertise in the manner some of the interviewees have suggested , as can be seen from the triangulated evidence, then new positive values can be created for the stakeholders through regaining the values missed.

Manager 2 emphasised more training and education as the way forward to boost local technology and expertise,

> "*So, it would have been better to have more training and education to enable the people to operate the machineries and the power plants*…*There should have been more encouragement and then more incentive to teach and learn English because you would be surprised that many people unable to read a multimillion dollar machinery manual. So if people are not able to read the manual, then they are not able to maintain or operate well".*

The need to have more training was recognised by SEDA (Sustainable Energy Development Authority), as shared by Official 1,

> "*one of the things that actually SEDA has done is to train people…What we have done so far is sporadic , you know, only once a while but actually now, we want to have a proper training. We are planning to joint venture probably with a local university, UNITEN."*

Consultant 2 raised the idea of a Human Resource Training Fund for existing plant operators to train the recruits of other new biogas or biomass plant.

> "*HR training fund. Let's say others want to operate this type of plant, then they can send new employees to the existing running biomass or biogas plant. The existing plant let them train, then get some subsidy from HR fund".*

He suggested that a training centre could be set up for this purpose,

> *"Actually you can build an education centre to train students from outside, educate them and you want to charge some fee. Maybe this fee is not 100% borne by the student but with some incentive from the government. This training centre set up by the operator because they have an existing running plant. Then they can train others and can also get some training fees, because if free training, nobody wants to offer it".*

Utility Officer 2 agreed that there should be more promotion of local technology and expertise. "*I think should promote more".*

As discussed in section 2.3, the FiT scheme for biogas also offers an additional bonus of RM 0.05 for the "use of locally manufactured or assembled gas engine technology" (see Table 2.1). However, it was noted earlier that what constitutes "local assembly" is not clearly defined.

Utility Officer 1 supported the incentive as a way to promote local technology, which was also good for the nation's economy. "*Local manufacture or local assembly.... because we need to encourage that additional industry for the national base. It is good because once you have local industry built up with these incentives, they also have the opportunity to market their products in the region. So from a national economic perspective, it's better".*

On whether this additional bonus for local assembly of RM0.05 can actually promote the development of the local gas engine technology in Malaysia, Official 1 acknowledged that currently the scope was quite limited. "*At present the manufacturers of these engines are not willing to send the parts to be assembled here, you know, they send a whole block. So basically what can be done locally is just the radiator, the exhaust and then the housing and so on".*

Nevertheless, Official 1 believed that the local assembly bonus was a step in the right direction and it had motivated an established international gas engine company to consider doing "*some real assembly"* in Malaysia,

> "…*but same time we don't want to be just a user of technology, you know, over the long run. We have had recent discussions with a supplier of Austrian made gas engines. Off course they were very adamant, they didn't want to do any local assembly and so on. But now they have come to see us. They are more serious than Caterpillar or MTU. They want to do some real assembly here".*

And in the words of Official 1: "*We think over the long run the local assembly bonus will contribute to the advancement of local technology, because actually people have come to see us and wanted to come up with a totally Malaysian engine, but we don't know how far".*

Consultant 2 thought otherwise and argued that the bonus would create a *"monopoly"* for the two (2) gas engines currently qualified for the bonus by having been certified as "locally assembled" engines by SEDA.

> "..*local assembly bonus for RM 0.05, actually do you know it creates like a monopoly business. Because now, you know, Caterpillar and MTU are the two "locally assembled" engines. Of course, they will sell their engines at a higher price. They sell at higher price and it's like sharing with you the bonus of RM 0.05 because they are the only engines that can get the local assembly bonus. So they kill all the other engine suppliers. You cannot say the other engines cannot work. It's just because they are not "locally assembled". This "local assembly" bonus is, you know, very vague".*

Academic 3 thought "*there should be more promotion because we have not seen much development or more efficient types of biomass plants and biogas plants over the past 10 years or so".* However, on the local assembly bonus, Academic 3 argued that this was a different kind of incentive which has nothing to do with the FiT:

> *"Local assembly should have been another kind of incentive. That should be a business development incentive by the Ministry of International Trade and Industry (MITI) or its agency, Malaysian Investment Development Authority (MIDA)…So under MIDA there can be incentives to grow certain businesses within Malaysia…..But I don't think the feed in tariff has something to do with that".*

Table B.24 in Appendix B summarises the triangulated evidence on "Promotion of local technology and expertise".

5.4.5.11 Promotion of CHP

In section 5.4.4.4, Combined Heat and Power (CHP) was recognised as a value missed or wasted by majority of the renewable energy businesses based on the FiT for oil palm biomass in Malaysia. As was discussed, currently there is no emphasis at all on CHP in Malaysia's FiT scheme.

CHP can create new positive value for oil palm renewable energy businesses as Manager 1 pointed out,

> "*Combined heat and power is a more efficient way to utilise energy. Most process plants like palm oil mills use a combination of both heat and electrical power. If a CHP plant is situated next to such processing plants, it will be able to*

> *sell both heat and power and get higher returns. However, the design of the energy balance must match the needs of the process plant".*

Manager 3 agreed that this value missed could be converted into new value to be captured by oil palm renewable energy businesses in Malaysia. "*Combined heat and power definitely because, in fact, we are tapping almost the full energy of it. With the combined heat and power, we will be able to reduce the fuel consumption for other processes. In this case the heat from the exhaust fume of the gas engine can be captured for other purposes".*

Utility Officer 3 commented that CHP should be the way forward. "..*if we are to optimise the resources, country resources, that would be the way to go".* Utility Officer 1 said that palm oil mills should be integrated with oil palm renewable energy plants in order to utilise CHP as a value missed,

> "*Now if that was done, you would have all the renewable energy power plants linked with the mills. And the mills, who are currently operating at very low efficiency just to dispose their waste, can operate at higher efficiency. Their steam requirements, their electricity requirements and their waste disposal becomes more effective and more efficient and you get ideal quantity of electricity as well as opportunities for thermal energy for anybody who needs it there".*

Utility Officer 2 agreed with the integration. "*I think it should be incorporated with palm oil mills. So that the palm oil mills can use the steam".*

Official 1 shared that SEDA had in fact proposed a bonus tariff for CHP but the utility was very much against it. *"Actually that is one the things that SEDA will really like to promote. CHP, Combined Heat and Power……But the utility is very much against it….We really don't quite understand their rationale. They say if power, power alone only. Shouldn't be … it makes no sense at all, why should they bother, isn't it?*....*We proposed to have a FiT rate for CHP. For CHP basically".*

Academic 1 thought that CHP should be promoted as a value opportunity for oil palm renewable energy businesses but "*CHP should be economically driven also and not only by added incentive".* Utility Officer 2 thought the bonus tariff was not necessary to promote CHP . "*I don't think CHP bonus tariff is necessary. Because the power plant owners will get additional value from there already".* In other words, even without the bonus incentive, CHP could still create new positive value based on economic considerations.

Utility Officer 3 felt that SEDA should decide on the bonus tariff. "*But then again is, at the end of the day is up to SEDA, whether they want to go on that route or not".* Although the triangulated evidence clearly supported CHP as a value opportunity for oil palm renewable energy businesses based on the FiT for biomass/biogas, it is less than clear whether a bonus tariff for CHP should be offered in the FiT scheme for Malaysia.

The triangulated evidence on “Promotion of CHP” is summarised in Table B.25 in Appendix B.

5.4.6 BARRIERS

This research has found five (5) sub-themes in respect of the barriers for the realisation of oil palm renewable energy in Malaysia. Barriers refer to “the obstacles or hindrances” to the development and usage of renewable energy (Sen & Ganguly, 2016, p. 5). The sub-themes are:

(1) Regulatory weaknesses (SEDA)
(2) Adequacy of incentives
(3) Feedstock supply
(4) Impact of National Biomass Strategy
(5) Interconnection difficulties

The following sections will present each sub-theme in turn and illustrate the barriers as expressed by the research participants.

5.4.6.1 Regulatory weaknesses (SEDA)

The triangulated evidence showed that majority of the research participants viewed regulatory weaknesses as significant barriers to the deployment of oil palm renewable energy in Malaysia. Several participants cited weaknesses of the regulatory body as their major concerns. Consultant 1 was very critical,

> *“…. sad to say, there is nothing new about SEDA, the same people who started the Small Renewable Energy Programme (SREP) and then later on converted to PTM, Pusat Tenaga Malaysia……and then finally now they settled down as FiT regulator”.*

Manager 1 described the regulatory body as not having “enough clout”,

> *“SEDA does not seem to have enough clout to steer the boat. Our experience with SEDA, when we refer our issues with Utility to SEDA, most of the time they are not able to resolve for us…... As an authority empowered to spearhead Malaysia’s quest into the development of RE , I find SEDA failing to meet even the 5% target”.*

Likewise, Academic 2 said that the regulatory body *“is not doing enough”,*

> *“Status of implementation I think is not satisfactory. So who is responsible for that incentive is not doing enough. It’s not just waiting for people to submit proposal and then we process. They have to know why the thing didn’t take off. They have to check why the project is not moving. What are the barriers and then once knowing the barriers also they have to find ways of overcoming it and focus on that until everything is smooth”.*

Lack of promotion on oil palm renewable energy by the regulatory body was highlighted as another weakness. *"SEDA should be stronger in promoting biomass and biogas rather than promoting solar so much…..And in fact …….recently, I've made the joke that SEDA is not really a sustainable authority but a Solar Energy Development Authority"* (Utility Officer 1). Utility Officer 2 said, *"Or I think in terms of the incentive. Or promotion. They should do more. Facilitate the growth….For potential biomass generation in Sabah. But we could probably have at least 200MW….. Until now we only have 40MW".*

Consultant 2 touched on the lack of effective regulatory enforcement. *"…commissioned ones and whatever SEDA approved are very far away, you know, for the biogas and biomass….Whoever not commission, let's say already due for at least one year or more, and they didn't do anything, should cancel their approval".*

However, official 1 disagreed and argued "*if without SEDA, we would never have gone so far",* and added,

> *"For biogas, I would say it's satisfactory because, one, quota is not there. Second, those people who have taken the quota, almost all of them are now under construction……But biomass, I would say still not satisfactory because not fully taken up and for those which have been taken up also, many of the plants have not started construction at all, still after two years….".*

The triangulated evidence on "Regulatory weaknesses (SEDA)" is summarised in Table B.26 in Appendix B.

5.4.6.2 Adequacy of incentives

The triangulated evidence showed that majority of the interviewees felt that tariff and financing incentives offered for oil palm renewable energy in Malaysia were inadequate, particularly for biomass, and they regarded this inadequacy as a barrier for the realisation of oil palm renewable energy in Malaysia. Academic 1 commented,

> *"Incentives should be higher….biogas and biomass are much lower as compared to solar photovoltaic (PV) although I understand that solar photovoltaic (PV) is higher capital investment but still, you want to attract the investors".*

Consultant 2 felt that it was unfair that the tariff rate was fixed for the entire FiT duration of 16 years,

> *"…..these rates going to be fixed for 16 years, maybe not fair, I feel. Because, you know our electricity rate is going up,……..Two, three years they go up but you think, then under this FiT they enjoy the same kind of tariff……., let's say for the future overhaul all the spare parts, also with the price will increase also……Because they sell at the same rates. But then the spare part, the price increases. They need to bear so it's not fair for them".*

Manager 2 thought that "*the incentives could have been better"*, whilst Manager 3 responded, *"I think, from the business point of view, it would be better if it's slightly higher, I would say it's better, slightly higher with a bonus".*

Two (2) other interviewees thought that the biogas tariffs were adequate but the rates for biomass were *"not that attractive".* Utility Officer 2 said,

> *"Based on what I'm hearing from the owners, I gather that biomass rates are not that attractive as compared to biogas. Biogas, we got a lot of interest……Biomass rates could be better…..I think biogas the investors would be able to have less worries about feedstock and all that,….And the rates are quite attractive"*.

Official 1 voiced the same opinion. *"Biogas rates are adequate. The only one they might need to review is the biomass. Biomass still a bit slow, although nowadays the take-up is quite fast, but those people who have taken-up, that was not constructed".*

On the financing incentive i.e. the Green Technology Financing Scheme (GTFS), one interviewee pointed out that it was not so effective. *"The green technology financing scheme is in my opinion less effective because the developers, if they are credible businesses, will not need that facilities. The people who need that facility are those who come up with shell companies and even if GTFS approves them, the banks don't approve"* (Utility Officer 1). In addition, during the First Focus Group Meeting, it was highlighted that "*if you have a long track record, the bank will give a better rate than GTFS".*

The triangulated evidence on "Adequacy of incentives" is summarised in Table B.27 in Appendix B.

5.4.6.3 Feedstock supply

As can be seen from the triangulated evidence, the difficulties faced in securing long-term feedstock supply were considered as obstacles to the development of oil palm renewable energy businesses in Malaysia, as Academic 1 described it,

> *"It's a challenge. It's totally a challenge. Only with companies or larger company, they have the mills, have the plantations themselves, then, they have easier access to the biomass feedstock. Then, it's easier to operate a power plant themselves".*

Security of feedstock supply is critical to the survival of biomass renewable energy businesses as Consultant 1 has pointed out. *"If you don't have the feedstock you are just dancing with the devil, asking for problems that you don't need'.* Without long-term security of feedstock supply, the renewable energy developer would also face difficulties in securing project financing from financial institutions. *"Even the banks now, it's one of the things they are looking at, very important before they approve any loan, they are seeing whether you got long-term contract…Because no long-term feedstock contract, the banks will not consider"* (Official 1).

Manager 3 thought that feedstock supply was one of the biggest challenges. *"I think the biggest challenges are feedstock and interconnection. These are the biggest challenges that we face, so far. Other than that, if you can resolve these two issues, I think the biomass industry will be very interesting industry".*

Most of the research participants considered competition from other uses of the oil palm biomass as a major factor affecting the security of feedstock supply. *"…there is now a growing trend to convert biomass feedstock especially empty fruit bunch (EFB) into value added products. This will eventually put pressure on the availability of oil palm biomass for power generation"* (Manager 1). *"Shell, even the empty fruit bunch (EFB) because we have competition from long fibre, short fibre use as well……I think it's going to be a challenge"* (Manager 2). *"Competition is affecting the industry itself. Meaning that you've got pellets and long fibre and others…Shell today has become a very, very important commodity…."* (Consultant 1). One interviewee even questioned the rationale of using oil palm biomass as feedstock (fuel) for the biomass plant when it could be pelletised and sold at a higher value overseas. *"And once you start pelletising, the overseas market pays better. So why burn locally?"* (Utility Officer 1).

Utility Officer 3 discussed how fluctuation in palm oil prices could affect the availability of biomass feedstock. *"To a certain extent I think usually when the palm oil price is not good, there is always this tendency to slow down in terms of , what you call this, the mill production itself. That would to certain extent affect feedstock, you know".* Hence, it is a challenge as feedstock supply can be *"unpredictable",* in the opinion of Utility Officer 2.

Table B.28 in Appendix B summarises the triangulated evidence on "Feedstock supply".

5.4.6.4 Impact of National Biomass Strategy

Majority of the research participants regarded the National Biomass Strategy 2020 policy as an obstacle to the growth of oil palm biomass renewable energy businesses in Malaysia, as shown by the triangulated evidence discussed below.

The majority viewed the policy as having negative impacts. Manager 1 said that the policy would impact feedstock prices to the detriment of biomass renewable energy developers. *"The National Biomass Strategy focuses on the higher value added-uses of biomass. As such, this will cause a heavy demand for biomass , thereby driving prices of feedstock upwards".*

As discussed in section 2.4.3, the Strategy aims to create "waste-to-wealth" from oil palm biomass through higher-value downstream uses such as pellets (bioenergy), bioethanol (biofuel) and bio-based chemicals. However, as Utility Officer 1 noted, "*because of the National Biomass Strategy, a lot of those who do not have a direct investment in the renewable energy plant have taken advantage of the situation to overvalue their waste. When you overvalue the waste, the chance of the projects being viable reduces".* Utility Officer 1 added that the strategy would have a negative impact on the long-term supply of feedstock as fuel for the biomass plants. "*I believe that a number of palm oil mills who would have been willing to sell their waste at a reasonable price to* *developers for renewable energy power plant are now holding back on the value part of it because they want to leverage it against the high tech value. But nobody as far as I know, has indicated how much is required for the high tech value and how much should be burnt for the renewable energy".*

Academic 1 disputed the quantity of oil palm biomass available for utilisation under the National Biomass Strategy. "*The Strategy actually claimed there are plenty of biomass that are unutilised. Unfortunately, I would say those biomass are controlled by certain agencies or companies. So some of them, they are not willing to share or they have their own strategy. They are not committed to or not following the same national strategy. So that's why biomass power plant, they face the issue of getting the biomass or constant supply biomass".* As such, the quantity of biomass available as feedstock for oil palm renewable energy businesses might not be as amply available as anticipated under the National Biomass Strategy.

Hence, the Strategy might result in intense competition for biomass as Manager 2 had cautioned, *"I think, if we don't control it, then it will be suddenly after one to two years another industry comes up that will also compete with you for the same feedstock".* This is echoed by Consultant 2 who said,

> "*In fact there will be, I think, fighting for the feedstock. So this is something the Government has to look at. Because they already asked this biomass power plant to invest so much of money, now you change to another scheme. This affects their business".*

Consultant 3 stressed that oil palm renewable energy businesses should be viewed as an extension or affiliation of the palm oil mills and thus, he disagreed with the utilisation of the milling wastes for other businesses or industry as set out in the National Biomass Strategy. *"We should concentrate on the palm oil mill and related business rather than come up with another business which is away from it".*

One interviewee, however, felt that the impact of the Strategy was minimal. *"I think it has a minor effect because in my frank opinion, the National Biomass Strategy won't work. Oleo chemical and all that, not going to happen....Because the cost is still so high"* (Official 1).

The triangulated evidence on "Impact of National Biomass Strategy" is summarised in Table B.29 in Appendix B.

5.4.6.5 Interconnection difficulties

The triangulated evidence showed that interconnection difficulties were regarded by most of the research participants as major barriers to the deployment of oil palm renewable energy in Malaysia. Many attributed these difficulties to the manner in which the Utilities handled grid interconnection. "*In general, they are very firm and their point is - ' It's my expectations regardless of whatever. You need to fulfil. If you can, you do it. If* *you cannot, leave it.' They are very firm on their certain specs. So it's a challenge for the renewable energy developer"* (Academic 1).

Consultant 3 remarked that the Utilities appeared to be reluctant to accept renewable energy,

> *"Is very far away from what we expected……because I find out the way they talk when we are talking to them. Looks like they are reluctant to accept our biogas or biomass…..whether with their intention or not but they make it slow to accept our commissioning…..Looks like they don't want to take it…..Because they consider you part of competitor because they are in this line so why are you coming here to disturb them?"*

Consultant 1 said they acted according to their *"whims and fancies"* and cited the *"switch room"* as an example,

> *"Whims and fancies so that they can change, example switch room…..Why all the gas cylinders for firefighting inside? It must be outside, so you can reach it. Earlier it was outside, somebody came around and said you must put it inside. Now the boss come and say you must put it outside. So we have changed the positon on the cylinders three times. Unnecessary costs".*

Other interviewees commented that the interconnection requirements were unreasonable, vague, brand-specific and overly bureaucratic. Manager 1 was unhappy with the *unnecessary demands"* and *"unnecessary delays"*,

> *"..unnecessary demands by the power Utility company. This has caused delays….The decision making process to approve certain tests is slow due to the frequent changes and transfer of manpower and engineers involved in the project. This causes unnecessary delays in the project…The level of cooperation is considered low…..We have complained to the heads of departments who are usually not competent enough to make the decisions and would still rely on subordinates".*

Manager 2 thought the requirements were vague. **"***I think it is still vague ……I see more like negotiation between the consultant and the Utility and …. I think it would have been better if everything is spelt out up front…So I know what is my cost. Otherwise, I will have overrun my cost".* And Manager 3 thought that the process was overly bureaucratic. *"I think grid interconnection now, we have to deal with too many departments within the Utility…. As it is now, we are going in and we are looking at, what you call that, responding to various departments, requirements".*

According to Consultant 2, *"whatever that we supply for interconnection to the Utility, the specs is actually higher than the Utility's…..More expensive one. Let's say, got other brand which can use. But they also don't accept".*

The triangulated evidence on “Interconnection difficulties” is summarised in Table B.30 in Appendix B.

5.4.7 POTENTIAL STRATEGIES AND RECOMMENDATIONS FOR STAKEHOLDERS

This section deals with the potential strategies to overcome at least to some degree the barriers to the realisation of oil palm renewable energy in Malaysia, as expressed by the research participants. This section also highlights the recommendations put forward by the research participants for the stakeholders including policy makers and investors. From the triangulated evidence, four (4) sub-themes were identified:

(1) One-stop centre
(2) Review incentives
(3) Feedstock ownership
(4) Transparent interconnection requirements

5.4.7.1 One-stop centre

One-stop centre was suggested as a potential strategy to overcome some of the regulatory and interconnection hurdles, as can be seen from the triangulated evidence. Manager 2 suggested a one-stop centre to communicate and disseminate all the regulatory requirements,

> *“I think there also many departments here to deal with, you see. So, I think it will have been better if all these associated regulatory requirements are being centralised, that means……You know, one stop centre, then all this information disseminated and developers are able to comprehend what is required of them. And so that at the end of the day to ensure that the thing goes on as scheduled. Number one, number two, is that the costs don't overrun”.*

One interviewee said that there seemed to be some overlapping functions performed by the regulatory agencies. *“A lot of overlapping in a certain area and it becomes grey area whereby who is actually leading the thing? And then so, it becomes uncertain and the investor not clear who should I go to, you see?”* (Academic 1).

Manager 1 suggested, *“I feel a one stop department be set up to coordinate the processing of the many licenses and submissions that a project developer has to carryout. This department should have the power and expertise to guide and assist the project developer. This will make renewable energy (RE) power an attractive investment opportunity to foreign investors”.*

According to Consultant 1, *“project developers, technocrats, financial instructions, Government agencies and SEDA are within the policy framework. However their efforts are not in harmony”.* Consultant 2 cited the Power System Study (PSS) as an example of the disharmony,

> “*But actually, SEDA need to do more, they need to actually work more with the TNB or SESB. Especially certain thing, like now, all the renewable energy (RE) plant, they’re going to TNB to get the Power System Study (PSS) injection point.*

Then after they got the PSS report, don't have the quota. Then no point for the industry to go to TNB first to pay for the PSS study and after getting the report, go to SEDA and SEDA then say no quota".

Having the one-stop centre as a coordinator can overcome at least to some degree the disharmony between the stakeholders. Academic 1 said, *"centralised means someone has to direct from the top and oversee the Utility, the relevant party to work together and stay together. That is the key".*

There should also be a one-stop centre within the Utility to handle grid interconnection as Manager 3 suggested. *" I think grid interconnection now, we have to deal with too many departments within TNB or SESB.....For example projects, production, transmission, all that. So rather than that, I hope that SESB or TNB can have a separate department, just to cater for all these. Another one stop agency".*

The triangulated evidence on "One-stop centre" is summarised in Table B.31 in Appendix B.

5.4.7.2 Review of incentives

As the triangulated evidence has shown, majority of the participants recommended that the incentives should be reviewed or extended to overcome at least to some degree the inadequacy of the incentives as a barrier to the realisation of oil palm renewable energy in Malaysia . Manager 1 suggested the *"incentives should be reviewed from year to year"*. Academic 1 proposed more incentives to promote oil palm renewable energy businesses,

> *"More incentives can be given as been discussed previously, so to help promote renewable energy (RE). We should encourage all palm oil millers to take up the RE project but again back to the dollar and cents issue, we have to see whatever we can subsidise or what are the subsidies, the tariff and things like that, to promote the industry to move on".*

Utility Officer 2 suggested that the subsidy for fossil fuel should be withdrawn gradually and then diverted to the renewable energy fund to provide more incentives. *"Withdraw the subsidy slowly…..As you reduce your subsidy…..some of that subsidy can go into the renewable energy fund" (Utility Officer 2)*

Consultant 3 thought a two or three-stage tariff would be better instead of a fixed tariff for the entire FiT duration of 16 years,

> "*I think having a two or three-stage rate is better. First five year, we give you better rate, so at least you can recover your money first. Then second, third, is just maintenance and then cheaper rate doesn't matter, actually it is just to pay your maintenance cost and the floating cost then a little bit on the profit, that is all. Instead of putting lump sum from day 1 until 16 years with the same rate".*

It was suggested that the biomass tariff should be reviewed as many Feed-in Approval Holders of biomass have yet to commence construction. *"So we know something is wrong, you know, they have not constructed. So biomass, I would say we should have a review"* (Official 1). Utility Officer 2 said "*because of that feedstock risk, I think….biomass power plants should be given extra compensation for that risk".*

Manager 1 recommended that the "*fiscal incentives should be extended beyond 2015 so that more players in the renewable energy sector can participate".* Likewise, Consultant 2 said, *"investment tax allowance, they need to extend, let the industry will be more matured".* Utility Officer 1 also said *"fiscal incentives should be extended"* and Utility Officer 3 agreed "*it would be good to extend, but there must always be some form of cut-off date".* And Official 1 commented,

> *"Actually they are quite good, like Green Technology Financing Scheme (GTFS) subsidising 2% of borrowing cost and then the Investment Tax Allowance (ITA). But the sad thing is that many of these are coming to an end…….should be extended".*

The triangulated evidence on "Review of incentives" is summarised in Table B.32 in Appendix B.

5.4.7.3 Feedstock ownership

As the triangulated evidence has shown, majority of the research participants regarded ownership of part of the feedstock as a critical requirement to participate in biomass renewable energy businesses in Malaysia. The majority recommended at least 50% up to 70% of the feedstock for biomass renewable energy businesses should come from their affiliated palm oil mills in order to overcome at least to some degree the challenges of feedstock supply as discussed in section 5.4.6.3.

This recommendation was best summed up by Academic 1,

> *"If you don't have sufficient feedstock, your operation will be a challenge. If you own yourself, you have your own mill and then you can. I would say at bare minimum, it's 50%.........but if you can up to 70%, that's the best. At least, you can control your own materials and then you can control the entire plant and then you can operate very confidently and consistently".*

Utility Officer 3 said *"at least they should have, you know 50%"* and Manager 3 thought, *"I think at least 50%".* Consultant 2 said, *"If you totally depend on outside, very difficult….50%-50%, I feel is ok".*

Consultant 1 thought it should be at least 70%. *"You should have at least 70% fuel on your own….Basic number one is that I have control over my fuel".* Manager 1 felt *"the biomass plant operator should control and own up to 80% of the feedstock"*, whilst Manager 2 said, *"I think something between 60-70% that will be…. quite comfortable level"*.

Official 1 emphasised a minimum of 50% to 70%,

> *"At the minimum they should have 50%, very minimum, but to be comfortable, would be 70%.....What we should have is, or maybe we should make this as part of the future roles for FiT and so on. Like for example, biogas, the applicant must be either the oil mill owner or he must have some majority share inside there, you know. Rather than third parties come and do".*

To overcome at least to some degree the feedstock price fluctuation as discussed in section 5.4.3.3, Utility Officer 1 suggested that it should be 60% to 70% self-generated,

> *"You see, if you take 40% self-generated, 60% purchase, then your net price depends a lot on the volatility of the purchase price. If you're let's say 60% or 70% self-generated, 20%, 30% or 30-40% bought in, if they ask the price too high, ok, don't buy, you generate less. You are able to control your feed stock price……And then when you don't buy, the other guys have got to dispose of it".*

The triangulated evidence on "Feedstock ownership" is summarised in Table B.33 in Appendix B.

5.4.7.4 Transparent interconnection requirements

The triangulated evidence showed that majority of the research participants thought that if the interconnections requirements were clear and easy to obtain and understand, the barrier of interconnection difficulties as discussed in section 5.4.6.5 could be overcome at least to some degree.

Manager 2 said the requirements should be transparent in the form of a checklist,

> *"I think it should have been shortened and made easy by having everything spelt out and made it into a proper checklist of what is required. Because the renewable energy developers are new and are amateurs, whereas the Utility buyers in this case since independence were already in power production. By right the Utility should have been able to identify what is needed so that when everything is spelt out, I think it's easier for the renewable energy developer to comply".*

Academic 3 emphasised that *"the regulator should make sure that the grid connection is done in a simpler way by actually saying to the Utility this is what is required".* He added that *"by right the developer should not actually negotiate and discuss the technical requirements with the Utility…..It should be the role of the regulator to make sure that it is clear what the rules are….They should create that level playing field for everybody in the power system".* Academic 3 suggested that *"there should be a grid connection code and it should be monitored by the Energy Commission, to whom the developer can complain".*

Utility Officer 3 thought it would not be issue to have interconnection requirements that are clear and easy to understand. "*To be transparent, I don't think that is an issue".*

Consultant 2 thought it would be easier for the renewable energy investors if the interconnection points were predetermined and publicised on the website of Sustainable Energy Development Authority (SEDA).*"SEDA has to work together to determine where is the possible injection point and come out in the SEDA website. Then whoever want to do, they go to website and check".* Academic 3 also thought *"there should be a clear policy on when can people connect to the grid".*

Official 1 pointed out, "*On paper, the procedures are not too bad. It's the Technical and Operational Requirements which SEDA negotiated with TNB and SESB. Of course, would have preferred them to be better than what they are, but that was the best after all these negotiations".*

However, it was the failure to follow the Technical and Operational Requirements that caused some of the interconnection difficulties. "*The Technical and Operational Requirements basically are not too bad, I wouldn't say they are very good, but they are not too bad. But the major problem is the Utility is not following the Technical and Operational Requirements…..So just try to make things more difficult, because they ask you for the best, you know, and then insist on a particular brand, what is the logic, why should you ask for particular brand…You should give technical specification, not specify a brand"* (Official 1).

Utility Officer 2 defended why the utilities required a few particular brands of interconnection equipment,

> *"These are standard requirements. They are not handpicked….But there's a few brands basically. Yes, we've got a few brands that we endorse because we do not want too many brand types of here….. And the stocks or the available replacements are there for these brands".*

Notwithstanding that Utility Officer 2 did agree that the requirements and equipment *" should be publicised"* by reason of transparency.

The triangulated evidence on "Transparent interconnection requirements" is summarised in Table B.34 in Appendix B.

5.5 SUMMARY

This chapter has investigated Business Models of renewable energy businesses based on the FiT for oil palm biomass and biogas in Malaysia, through an analysis of the transcripts of the interviews with key stakeholders of the Malaysian oil palm renewable energy. It has explored the views of the key stakeholders by using NVIVO 11, a Computer Aided Qualitative Data Analysis Software (CAQDAS), to aid in the analysis of the interview and discussion transcripts.

The template style of thematic analysis conducted in this chapter has offered illustrations, based on empirical evidence, of the values captured, destroyed, missed or wasted of oil palm renewable energy businesses in Malaysia as well as new value opportunities for the businesses. The data findings also offer, through empirical evidence, illustrations of the barriers to the realisation of oil palm renewable energy in Malaysia, and the potential strategies to overcome at least to some degree these barriers with recommendations for the stakeholders including policy makers and investors.

The sub-theme, *Grid connection cost borne by the Utility*, was initially considered a potential value opportunity, but the triangulated evidence as presented in section 5.4.5.4 were inconclusive on whether the Utility should bear all or part of the grid connection cost. Hence , it is not supported for adoption in this research as an opportunity for new value creation. The sub-theme, *Off-grid FiT*, based on the “Generation tariffs” payable in the UK for electricity used off-grid (or on-site) as discussed in section 2.2.2, was also initially considered a potential value opportunity for extending the value proposition, income. However, the triangulated evidence as presented in section 5.4.5.3 showed conclusively that off-grid FiT was not sustainable as an initiative to extend the income of oil palm renewable energy businesses. Thus, it is also not supported for adoption in this research as an opportunity for new value creation. Likewise, the sub-theme, *Centralised large-scale biomass power generation*, was initially considered a potential value opportunity as a larger plant might possibly accomplish economies of scale resulting in lower cost per unit of electricity produced and hence higher income margin for the renewable energy developer. However, the triangulated evidence as presented in section 5.4.5.5 showed that majority of the research participants disagreed with centralised large-scale biomass power generation mainly due to the feedstock logistical hurdles. Accordingly , the sub-theme, *Centralised large-scale biomass power generation*, is not supported for adoption in this research as an opportunity for new value creation.

The triangulated evidence as presented in section 5.4.5.6 was inconclusive whether the *Time-differentiated tariff system* can constitute a value opportunity to innovate the Business Models of the renewable energy businesses based on the FiT for oil palm biomass/biogas in Malaysia. It was initially considered a potential value opportunity to extend the value proposition by encouraging the generation of renewable electricity in the day time with higher tariffs to meet the peak power demand, so that less fossil fuel would be burnt in the power plants to reduce the carbon emissions. Hence, as with the other three (3) sub-themes, namely, *Grid connection cost borne by the Utility, Off-grid FiT* and *Centralised large-scale biomass power generation*, the sub-theme, *Time-differentiated tariff system*, is not supported for adoption in this research as an opportunity for new value creation. Only the remaining seven (7) sub-themes pertaining to value opportunity will be evaluated and adopted in the subsequent chapters of this research.

The next chapter will discuss and evaluate all the emergent findings with reference to the literature review.

CHAPTER 6.0

DISCUSSION OF THE DATA FINDINGS

6.1 INTRODUCTION

As outlined in section 3.6, the four components of the Conceptual Framework to investigate and model “Successful” and “Sustainable” FiT-based Renewable Energy Business Models for Malaysia are :

1) Value Mapping Tool (Bocken, et al., 2013)

2) Barriers, Strategies and Recommendations (IEA-RETD, 2013)

3) Normative requirements (Stubbs & Cocklin, 2008 ; Boons & Ludeke-Freund, 2013)

4) Triple Bottom Line Canvas (Osterwalder & Pigneur, 2010)

The data findings from the previous chapter are now discussed pursuant to the first two (2) abovementioned components of the Conceptual Framework, which are the components to *investigate* “Successful” and “Sustainable” FiT-based Renewable Energy Business Models for Malaysia. The remaining two (2) components of the Conceptual Framework will be discussed in the next and final chapter, where the adopted data findings will be incorporated into the Conceptual Framework to *model* “Successful” and “Sustainable” FiT-based Renewable Energy Business Models for Malaysia.

This chapter will evaluate the findings with reference to the literature reviewed in chapters 2.0 and 3.0. It will identify where the findings are consistent or contradictory with the literature. Discussing the primary data findings in the light of the literature is also part of the “Methodological triangulation” procedures to enhance the validity of this research (King & Horrocks, 2010, p. 172).

Thus, this chapter addresses the fourth research objective:

To discuss the data findings pursuant to the Conceptual Framework to investigate “Successful” and “Sustainable” FiT-based Renewable Energy Business Models for Malaysia, and evaluate them with reference to the literature review

6.2 VALUE MAPPING TOOL (Bocken, et al., 2013)

This section will discuss the data findings relating to the Value Mapping Tool of Bocken, et al. (2013). The discussion is organised around the following themes that emerged from the data analysis in the preceding chapter:

- Purpose of FiT-based businesses

- Value captured
    - Income
    - Waste management
    - Distributed generation
    - Job and skill creation
    - Pollution and emission reduction

- Value destroyed
    - Grid connection cost
    - Surcharge paid to RE fund
    - Feedstock price fluctuation
    - Transportation of feedstock

- Value missed or wasted
    - FiT quotas
    - Lack of awareness
    - Lack of local technology and expertise
    - Combined Heat and Power (CHP)

- Opportunities for new value creation
    - ENCON type fund
    - Promotion of awareness
    - Promotion of local technology and training
    - Promotion of CHP
    - Location-specific bonus tariff
    - Green grid
    - Bio-fertliser

6.2.1 Purpose of FiT-based businesses

From the primary data, this research has found that the purposes of oil palm renewable energy businesses based on the FiT for oil palm biomass and biogas are mainly to manage palm oil milling wastes to comply with environmental regulations and mitigate pollution, and to convert them into green energy for export to the grid to generate income.

Another aim of these businesses, as this research has found in section 5.4.1, is the diversification of the supply options for power generation to reduce the dependency on fossil fuel, which can help improve the long-term energy security of Malaysia (Sen & Ganguly, 2016). As IRENA states, the advantages of using biomass instead of fossil fuels for power generation include lower greenhouse gas (GHG) emissions, improved security of supply, and waste management/reduction opportunities (IRENA, 2012).

These findings are consistent with the suggestions in the literature, notably by Hosseini et. al.(2013) that a combination of renewable and sustainable bioenergy strategy and waste treatment should be adopted, and also Lam and Lee (2011) that the treatment of milling wastes to meet the Malaysian environmental regulations should be coupled with the production of green energies as by-products that can alleviate the waste treatment cost. Furthermore, they resonate with the National policies, particularly EPP No. 5 entitled “Build biogas facilities at all mills across Malaysia” as discussed in section 2.4.4, which emphasises the importance of reducing the carbon footprint or Greenhouse Gas emissions so that palm oil products can gain competitive market access to environmentally sensitive markets such as the European Union and the United States.

As stated in section 3.5.1, the Malaysian Stock Exchange now requires every Company listed on the Stock Exchange to disclose their management of material economic, environmental and social risks and opportunities in their annual report (Bursa Malaysia, 2015). The Stock Exchange has issued a Sustainability Reporting Guide (Bursa Malaysia, 2015 a), in which the Exchange has cited as a sustainability initiative, the reduction of Greenhouse Gas Emissions by capturing methane from POME and using the methane to power the palm oil mill and selling the excess electricity to the grid to generate investment revenue. The purposes, as this research has found in section 5.4.1, are also consonant with this sustainability initiative cited by the Malaysian Stock Exchange.

Later in section 6.2.5, the opportunities for new value creation for Renewable Energy Business Models for sustainability will be discussed subject to the bounds of these purposes (Bocken, et al., 2013). However, these purposes of the FiT-based Oil Palm Renewable Energy Businesses may need to be modified later in the light of the subsequent discussions in the following sections (Ibid).

6.2.2 Value captured

As shown in section 5.4.2, this research has found five (5) sub-themes as the values captured or created for the stakeholders, including environment and society, of the Renewable Energy Business Models based on the FiT for oil palm biomass and biogas in Malaysia. The discussion in this section is structured around the five (5) sub-themes:

1) Income
2) Waste management
3) Distributed generation
4) Job and skill creation
5) Pollution and emission reduction

6.2.2.1 Income

In section 5.4.2.1, income was found as one of the values created particularly for the investor or renewable energy developer as a stakeholder. As discussed in the literature review, the FiT scheme offers new revenues for investors from the government incentives offered to renewable energy development (IEA-RETD, 2013). Hence, as the IEA-RETD (2013) has pointed out, it can serve as a stable basis for a business model by guaranteeing access to a predictable and stable long-term stream of income from a credit -worthy counterpart for the duration of the FiT. For this reason, the business models for oil palm renewable energy in this research are rightly referred to as Business Models based on the FiT scheme.

The data, as discussed in section 5.4.2.1, has pointed out that this income is complemented by various fiscal incentives offered by the Government of Malaysia. This is consistent with the literature review, in which it was noted that investors can also combine "the use of a feed-in scheme with other available support mechanisms such as soft loans or fiscal incentives to improve financing conditions" (Ibid, p.69). The Government of Malaysia has established the Green Technology Financing Scheme (GTFS), which is a soft loan supported by the government (Green Tech Malaysia, 2014). Biogas and biomass project developers are eligible to apply for this special financing up to RM 50 million per project for the loan tenure of up to 15 years with the Malaysian Government subsidising 2% of the interest and also guaranteeing 60% of the loan (Yatim, et al., 2016 ; Bong, et al., 2016). Investment Tax Allowance (ITA) has been extended beyond 31st December 2015 by allowing qualifying capital expenditure incurred from 25th October 2013 until the year of assessment 2020 to be "offset against 70% of the statutory income in the year of assessment" and "unutilized allowances can be carried forward until they are fully absorbed" (MIDA, 2016).

6.2.2.2 Waste management

The management of waste was found as another value captured particularly for the renewable energy developers who are also palm oil millers themselves. As the data has shown in section 5.4.2.2, investing in the FiT-based renewable energy businesses will aid the palm oil mills to be more sustainable by making their *"waste disposal more efficient and effective"* (Utility Officer 1) , and *"easier to comply to the environmental requirements"* (Manager 2). In the long run, this will *"reduce their cost of waste disposal"* (Utility Officer 1). These findings are consistent with Lam and Lee (2011, p.126) who support the treatment of POME using wastewater treatment technologies that can meet the standard discharge limits of Malaysian waterways coupled with "simultaneous bio-energies recovery strategy" to harness methane for power generation that can reduce the "wastewater treatment cost by producing green energies as by-products that is also very beneficial towards environmental protection". Likewise, Garcia-Nunez, et al. (2016) have advocated the conversion of palm oil mills into biorefineries comprising, inter-alia, biomass and biogas plants to comply with environmental standards, and also to optimise the use of the available biomass and biogas to improve the economic, social and environmental performance of the industry.

Consistent with the literature, the data also indicate that in the long run, this will create good *"image as well as CSR benefits of creating a clean environment"* for the palm oil industry (Utility Officer 1). As discussed in the literature review, lately there is growing concern about the environmental sustainability of palm oil, including serious claims of loss of biodiversity and increase in greenhouse gas emissions from oil palm cultivation (Sharaai, et al., 2015). Hence, as noted in the literature review, building biogas plants to capture biogas from palm oil mill effluent (POME) is important in order to reduce "the carbon footprint" or greenhouse gas emissions so that palm products can gain "competitive market access" to "environmentally sensitive markets such as the European Union and the United States" (MPOB, 2014, p. 3).

6.2.2.3 Distributed generation

This research has found distributed generation or decentralised power generation as a value captured for the stakeholders, particularly the Utility and society. As the data has indicated in section 5.4.2.4, oil palm renewable energy businesses based on the FiT are embedded within the distribution network in a distributed power generation system, and if it is located in a rural area, it can supply the load in that area without requiring the grid to supply power all the way to that particular area, thereby reducing energy losses (Utility Officer 2). These businesses can benefit the Utility and society by helping to *"support the grid, strengthen the grid and stabilise the power supply"* and at the same time allowing *"the opportunity to extend supply to remote communities"* (Utility Officer 1).

As discussed in the literature review, small scale technologies for harnessing renewable including biomass and biogas are often directly connected to the distribution network or situated in proximity to the points of energy consumption in a distributed generation (DG) system (Theo, et al., 2017). A distributed power generation system can have many technical advantages, including " elevating the voltage of electric power system and facilitating electricity transmission to remote areas" and " minimising power loss via deferment of massive transmission and distribution" (Ibid, p.533). Umar et al. (2014b) have also highlighted that distributed generation can reduce transmission losses in the networking systems. Accordingly, the findings in section 5.4.2.4 are consonant with the literature reviewed.

As noted in the literature review, economic advantages of distributed generation include the "elimination of the need for costly investments on transmission and distribution expansion and upgrading" (Ibid, p.533), which is consistent with the data finding that distributed generation involving oil palm renewable energy businesses can also *"relieve the cost of generating power to supply to remote areas"* (Manager 3).

In the light of the above, the purposes of FiT-based oil palm renewable energy businesses as discussed in section 6.2.1 should be modified to include boosting distributed generation, particularly for rural electrification, as one of the aims.

6.2.2.4 Job and skill creation

Section 5.4.2.5 has found job and skill creation as another value captured for society as a stakeholder of the oil palm renewable energy businesses based on the FiT scheme. As the data has indicated, these businesses provide direct job opportunities for the construction, operation and maintenance of the plants as well as indirect job opportunities in the cottage and service industries such as transport and repairs (Utility Officer 1), especially for the people living in the remote areas (Manager 3). With these new job, skills are also being created for society *"because those who are required to do the job are people who need to be trained to operate million dollar machineries"* (Manager 2).

These findings are consistent with the literature reviewed in chapter 2.0. As the literature has pointed out, in both Germany and Thailand, the FiT has successfully generated more jobs and renewable energy investments (Chua et al., 2011; CCAP, 2012). According to Kumaran, et al. (2016), about 50,000 jobs will be created in Malaysia from the construction, operation and maintenance of power plants related to renewable energy which include oil palm biomass. Furthermore, according to Sen & Ganguly (2016, p.10), "on average, renewable energy technologies create more jobs than fossil fuel technologies".

The data has shown that oil palm renewable energy businesses can create "*a transformation for the rural area"* in Malaysia from *"agriculture now to industry"* (Manager 2). Consistent with this finding, IRENA has stated that one of the many advantages of using biomass instead of fossil fuels for power generation is the creation of local economic development opportunities (IRENA, 2012).

In the light of the above, the purposes of FiT-based oil palm renewable energy businesses as discussed in section 6.2.1 should be modified to include job and skill creation as one of the aims.

6.2.2.5 Pollution and emission reduction

This research has found in section 5.4.2.3 that oil palm renewable energy businesses based on the FiT scheme do mitigate some negative outcomes, namely environmental pollution and greenhouse gas (GHG) emissions. According to Bocken, et al. (2013), this should be treated as a value captured. The data has pointed out that oil palm renewable energy businesses can help reduce greenhouse gas (GHG) emissions by displacing fossil fuel power generation and reducing the carbon footprint. By treating the palm oil mill effluent (POME) and capturing the methane biogas which has a *"greenhouse effect of 21 times more than* CO_2*"*, oil palm biogas plants can cut down the "*greenhouse gases that is damaging to the environment"* (Manager 2). Furthermore, by treating the POME, *"water that comes out after the waste water treatment will be very much improved"* (Manager 3) without polluting the Malaysian waterways.

These data findings are consistent with the literature reviewed in chapter 2.0. According to Lam and Lee (2011), if POME is discharged without proper treatment, the potential damage in 2009 is estimated to equal the waste produced by 75 million people, that is nearly three times the current population in Malaysia. The authors note that "many palm oil mills are still unable to adhere to the wastewater discharge limits and thus resulting to a dramatic increase in the number of polluted rivers" (Ibid, p.125). Hosseini et. al. (2013, p.457) have cautioned that "the global warming potential of methane is 21 times more than CO2". If methane is not captured and escapes directly to the atmosphere, it can cause serious harm to the environment and is reported to have the "highest impact towards the environment (climate change category)" in Malaysia (Lam & Lee, 2011, p. 127).

As noted in the literature review section, agricultural residue such as oil palm biomass could contribute significantly to the national and global effort to reduce GHG emissions by displacing fossil fuel. As stated earlier, IRENA expects "biomass would be the single most important resource to mitigate climate change" (IRENA, 2014a, p. 3) as it could constitute 60% of the total final renewable energy use by the year 2030 with roughly 40% of the biomass originating from agricultural residues and wastes (Ibid).

Reducing pollution and emission can create positive value for society as well, particularly for the people living in the vicinity of the palm oil mills who are often exposed to the *"odour problem, but now if this is controlled, then no problem at all"* (Consultant 3). As discussed in the literature, unpleasant odour can arise from the improper management of oil palm biomass particularly POME (Kumaran, et al., 2016 ; Shukery, et al., 2016).

As with distributed generation and job and skill creation, pollution and emission reduction should be one of the aims of FiT-based oil palm renewable energy businesses in Malaysia.

6.2.3 Value destroyed

In section 5.4.3, this research has found four (4) sub-themes as the values destroyed or negative outcomes for the stakeholders, including environment and society, of the Renewable Energy Business Models based on the FiT for oil palm biomass and biogas in Malaysia. The discussion in this section is structured around these four (4) sub-themes:

1) Grid connection cost
2) Surcharge paid to RE fund
3) Feedstock price fluctuation
4) Transportation of feedstock

6.2.3.1 Grid connection cost

This research has found grid connection cost as a significant value destroyed for the renewable energy developer as a stakeholder. As the data has pointed out, this cost might become prohibitive if the grid is located far away (Manager 1). It is *"very variable"* according to the distance, and is *"one of the hurdles"* to overcome for the renewable energy developer since the FiT scheme offers flat tariff rates regardless of the distance to the connection. An economically viable distance for the renewable energy developer to connect to the grid should not *"go more than 10km"* but ideally it *"should be less than 5km"* (Utility Officer 1).

These findings are consistent with the literature as discussed in chapter 2.0. Kumaran, et al. (2016) note that grid connection cost can override the viability for return on investment, especially where the distance between the renewable energy plant and the grid interconnection point exceeds 10 km. As Umar et al.(2014b) have reported, the cost of connecting to the grid is expensive, and their survey among Malaysian palm oil millers show that this is one of the main barriers to the deployment of grid-connected oil palm renewable energy, causing "53% of respondents to resist investing in grid infrastructure" and 55% to state that they would participate "if the infrastructure cost was borne either by the government or the energy utility" (p.502).

Likewise, Sharaai, et al. (2015, p.36) have highlighted "the lack of infrastructure for feed-in capability into power grids, gridlines availability issue and the long distance between the location of palm oil mills and power grids" as significant challenges.

6.2.3.2 Surcharge paid to RE fund

As this research has found in section 5.4.3.2, one value destroyed for society as a stakeholder of the Renewable Energy Business Models based on the FiT for oil palm biomass and biogas, is the 1.6% surcharge on their electricity bill. "*The renewable energy is actually subsidised by you and me"*, coming *"from our electricity bill"* (Consultant 2). "*It is cost to society, definitely"* (Utility Officer 1).

As noted in the literature review in chapter 2.0, the Distribution Licensee or the Utility collects the 1.6% surcharge from the electricity consumers and remits them to the FiT Renewable Energy Fund, but domestic electricity consumers of less than 300 kWh a month are exempted (Wong, et al., 2015 ; KeTTHA, 2014). Initially, the surcharge was 1% covering only Peninsular Malaysia (or West Malaysia). Later, it was revised to 1.6% effective 1st January 2014 when it was extended to the State of Sabah and the Federal Territory of Labuan, both located in East Malaysia (KeTTHA, 2014).

In contrast to the literature reviewed in chapter 2.0, this research has found that although this is a cost to society, *"society would not be unwilling to pay that"* (Utility Officer 1), and furthermore, it is *"the lowest, not one of the lowest, but the 'lowest' in the world"* (Official 1). As discussed earlier in chapter 2.0, the Association of Water and Energy Research Malaysia (AWER) in their open letter to the Prime Minister of Malaysia dated 16th July 2012 (AWER, 2012), had alleged that the FiT is "stealing from the poor and giving it to the rich". However, as this research has found, even though this is a value destroyed for society *"in the sense they have to pay more"*, it is not unreasonable taking into consideration that *"Malaysian electricity is still cheaper"* in comparison to other countries in the region (Manager 2).

6.2.3.3 Feedstock price fluctuation

In section 5.4.3.3, feedstock price fluctuation was found to have a negative impact on the renewable energy developer. The data has pointed out that feedstock owners prefer to *"wait and see"*, and *"wait for the better price of the biomass"* in the future, rather than committing the supply of their biomass *"under a long term contract"* (Academic 1). As a result, renewable energy businesses largely dependent on third party feedstock suppliers are significantly exposed to long-term feedstock price risk, which can adversely affect the long-term viability of these businesses. Besides, financial institutions concerned about this risk may charge higher interest rates, thereby increasing the negative impact on these businesses (Utility Officer 2). Feedstock price inflation is caused mainly by the shift in value of the feedstock from a milling waste to a renewable fuel (Consultant 2) and also its extractable oil content which has boosted its value (Consultant 1).

The literature discussed in chapter 2.0 are consistent with these findings. As noted in the literature review, IRENA (2012) has emphasised the importance of having a secure and long-term supply of feedstock at a competitive price to ensure the viability of a biomass power plant, as "feedstock costs can represent 40% to 50% of the total cost of electricity produced" (p.27). IRENA recognises the difficulty in negotiating long-term supply contracts designed to reduce feedstock price fluctuation due to many factors, including competing demand for the biomass feedstock. As discussed in chapter 2.0, other than using it as a dry fuel for heat and power generation, the uses and potential uses of biomass in Malaysia include pellets and palm fibres (long or short fibres) (Ng, et al., 2012). Since the biomass can be "utilised for other economically viable co-products other than the energy, which can generate profit in a shorter period" (Kumaran, et al., 2016, p. 938), feedstock supply constraints and price fluctuation are likely to affect renewable energy businesses that are dependent on third party suppliers.

The survey findings of Umar et al. (2014b, p.499) also show that over 61% of their respondent millers "claimed that fuel security and price inflation were amongst the main barriers that need to be removed". According to the authors, "limited boiler fuels such as EFB (empty fruit bunch), kernel shell and mesocarp fibre are likely to affect small developers who depend on third party supply, which is greatly exposed to market price fluctuation" (Ibid, p.499).

6.2.3.4 Transportation of feedstock

In section 5.4.3.4, this research has found that transportation of feedstock can have severe negative impacts on the stakeholders of the Oil Palm Renewable Energy Business Models, particularly the renewable energy developers, environment and society. Excessive transportation of feedstock can generate *"some amount of emissions"* (Utility Officer 1) that is harmful to the environment, and *"also create some local issue"* adverse to society *"with all the lorries going through the rural area to collect all these kind of things"* (Consultant 2). This research has found that the cost of transporting the feedstock might become prohibitive once the transport radius exceeds 50 km (Academic 1).

In chapter 2.0, it is noted that feedstock with a high moisture content such as oil palm biomass poses a problem, as the moisture reduces the energy density of the biomass feedstock, which in turn "increases transportation costs and the fuel cost on an energy basis, as more wet material is required to be transported and provide the equivalent net energy content for combustion" (IRENA, 2012, p. 18). The low energy density of biomass feedstock tends to limit the distance that is economical to transport the feedstock (Ibid), particularly for oil palm empty fruit bunches (EFB). Thus, it is uneconomical to transport the feedstock over long distances exceeding 50 km, as this research has found.

Also, as discussed in the literature review, Chiew, et al. (2011) have highlighted the issues of using oil palm EFB in Malaysia as an energy resource and cited the difficulties in transporting EFB due to its high moisture content and bulkiness. The authors have also described the high cost of transporting feedstock over long distances as unsustainable. Accordingly, the finding of this research that excessive transportation of feedstock can have negative outcomes for the stakeholders , is indeed consistent with the literature.

6.2.4 Value missed or wasted

In section 5.4.4, this research has found four(4) sub-themes relating to value missed or wasted, where stakeholders have failed to capitalise on their existing assets, capabilities and resources, or are operating below best practices. These findings will now be discussed with reference to the literature reviewed in chapter 2.0, with the discussion structured around the four (4) sub-themes:

(1) FiT quotas
(2) Lack of awareness
(3) Lack of local technology and expertise
(4) Combined Heat and Power (CHP)

6.2.4.1 FiT quotas

This research has found in section 5.4.4.1 that value is missed or wasted when some of the applicants of the FiT for oil palm biogas or biomass may not be successful due to the limited FiT quotas and hence, fail to capitalise on their existing assets, capabilities and resources. The data has pointed out that it is *"restrictive with the quota system"* (Consultant 1), and *"rather than restricting"* them, it should be up to *"the renewable energy developer to see how much they can generate and inject into the grid"* (Manager 3).

The literature as discussed in chapter 2.0 are consistent with the finding. According to Chin, et al. (2013) , annual FiT quotas or caps are imposed on the amount of installed capacities avalable under the Malaysian FiT scheme as the funding source for the FiT is limited, and these quotas tend to limit the growth of renewable energy in Malaysia. Other authors have noted that the "FiT is constrained by its limited fund" (Bekhet & Sahid, 2016, p. 1180).

It has also been contended in the literature that the capacity quota allocated to biomass and biogas is relatively low compared to solar (Jamin, 2014), and that the lower FiT rate for biogas is unsatisfactory compared to the higher FiT rate for solar (Kumaran, et al., 2016). Consistent with the literature, this research has also found that FiT rates for solar have been *"exorbitant"* and by right, some of these money should have been made *"available for energy efficiency and as well as probably more for the biomass and biogas."* (Utility Officer 1).

As discussed in the literature review, Germany in its fixed FiT scheme had not imposed caps on the total amount of RE developed and the rate of growth was left up to the market (Couture, et al., 2010). Furthermore, the German scheme, in general, offers a longer support duration of 20 years (Mabee, et al., 2012) in comparison to the duration of 16 years under Malaysian FiT for biomass and biogas. In the UK, no annual quota or cap is imposed on the biogas installed capacity, but the maximum capacity of an installation must not exceed 5 MW. The UK's biogas tariff support duration is also longer at 20 years.

6.2.4.2 Lack of awareness

In section 5.4.4.2, this research has found lack of awareness on oil palm renewable energy in Malaysia as the cause of value being missed or wasted, particularly when it comes to project financing for the renewable energy developer. The data has pointed out that due to lack of awareness, some of the financial institutions are reluctant to provide project financing, leading to the failure to capitalise on existing capabilities and resources (Academics 1 and 2).

This lack of awareness has reduced investor confidence in oil palm renewable energy businesses (Consultant 2), and almost nobody seemed to be fully aware of the difficulties and risks before venturing into the business until you *"try first and then only you know, but before that nobody knows"* (Consultant 3). The data has also pointed out that the level of awareness and promotion on oil palm renewable energy businesses is very low in comparison to solar photovoltaic (Utility Officer 2).

These findings are compatible with the literature reviewed in chapter 2.0. Petinrin & Shaaban (2015, p.979) have cited the lack of confidence among financial institutions to finance renewable energy projects, and Yatim, et al. (2016, p.9) have attributed this lack of confidence to their "lack of knowledge, experience and understanding of risks associated with renewable energy and green technologies". Even with the Green Technology Financing Scheme (GTFS) to facilitate renewable energy financing in Malaysia as discussed in section 2.3, the participation of Malaysian financial institutions is still lacking, which Kumaran, et al. (2016) have attributed to the lack of awareness and experience. Likewise, Embrandiri, et al. (2015) also note that the level of awareness of the potential of oil palm biomass as a renewable energy source is low in Malaysia.

It should be noted that, in the data, there was a dissenting view that over the last 8 to 10 years, Malaysians have become well aware (Utility Officer 1). It is argued that this contradicts the literature, as a study investigating renewable energy technology acceptance in Peninsular Malaysia by Kardooni, et al. (2016, p.7) has found that there is lack of "public awareness of environmentally friendly practices and renewable energy products".

6.2.4.3 Lack of local technology and expertise

As this research has found in section 5.4.4.3, failure to capitalise on existing assets, capabilities and resources have occurred due to the lack of local technology and expertise. The cost of importing foreign technology was found to be a deterrent (Academic 1), and lack of local expertise poses a serious threat to the sustainability of oil palm renewable energy businesses. Reliance on foreign expertise for support was found to be *"quite a costly thing"* (Consultant 2) and if *"you cannot get experienced workers"*, then *"you are in trouble"* (Consultant 1), particularly in rural areas where *"the vocational skill…. is not so easily available"* (Manager 2).

The literature as reviewed in chapter 2.0 are in accord with these findings. As noted in the literature review, Kardooni, et al. (2016, p.7) have reported that "limited capacity in renewable energy technology manufacturing and servicing, and a lack of skilled technicians for the installation and maintenance of technologies impede the introduction of renewable energy technologies in Malaysia". Sharaai, et al. (2015, p.36) have cautioned that "the capital intensive initiative requiring huge costs to cover such imported technologies to the country is unsustainable" , and Kumaran, et al. (2016, p.938) note that the high import cost "demotivates the local biogas plant developers".

Other authors have also reported on the lack of local technology and expertise in Malaysia, as discussed in the literature review chapter. According to Chin, et al. (2013) and Kumaran, et al. (2016), there is a shortage of local expertise for operation and maintenance to ensure the stability of the biogas system to cope with the seasonal fluctuation. Similarly, Bong, et al. (2016, p.7) have cited "the inexperience and unfamiliarity in the anaerobic digestion process, its design and operation, maximisation of biogas yield" as some of the main challenges facing biogas renewable energy businesses in Malaysia. The authors have also highlighted the shortage of skilful engineers and technicians in Malaysia to operate and maintain biogas plants (Ibid).

6.2.4.4 Combined Heat and Power (CHP)

Section 5.4.4.4 has found that most biomass renewable energy businesses in Malaysia are performing below best practices by operating without Combined Heat and Power (CHP), and thus value is missed or wasted, particularly for *"standalone biomass power plants currently operating without CHP in Malaysia* . With CHP, the businesses are *"optimising the resources"* and their *"plant efficiency"* (Utility Officer 3). It was also found that there is no emphasis at all on CHP in the Malaysian FiT scheme (Academic 1).

These findings are consistent with the literature. As discussed in chapter 2.0, CHP allows 75% to 80% of fuel inputs, and up to 90% in the most efficient plants, to be converted to useful energy" (IEA, 2011, p. 6). In contrast, a dedicated power-only biomass plant has a very much lower overall efficiency of around 20% , and in fact, the biomass FiT scheme in Malaysia explicitly acknowledges this low efficiency level by offering a bonus tariff of RM0.01 per kWh for "use of steam-based electricity generating systems with overall efficiency of above 20%" (SEDA, 2014a). Hence, as noted in the literature review, IRENA has pointed out the potential of biomass CHP in Malaysia to replace biomass combustion “in rather ***inefficient boilers*** *(emphasis added)* or ***only in power producing*** *(emphasis added)* plants” (IRENA, 2014a, p. 24).

As shown in Table 2.1 under section 2.3, there appears to be no emphasis at all on CHP in Malaysia’s FiT scheme and instead, standalone biomass plants generating power only without any usable heat recovery are being promoted (SEDA, 2014a).

However, it has been pointed out that CHP as a value wasted “*cannot be helped if you are away from other industry”* who can utilise the heat for their requirements (Consultant 3). As highlighted earlier in the literature review, “unlike electricity, heat cannot be transported efficiently over large distances” and thus, it must be produced close to where the heat or steam is needed (IEA, 2011, p. 27).

6.2.5 Opportunities for new value creation

This research has found, in chapter 5.0, eight (8) sub-themes pertaining to value opportunities for innovating the FiT -based Oil Palm Renewable Energy Business Models towards Business Models for sustainability. This section will now discuss the findings with reference to the literature review. The discussion is centred around the following seven (7) sub-themes:

(1) ENCON type fund
(2) Promotion of awareness
(3) Promotion of local technology and training
(4) Promotion of CHP
(5) Location-specific bonus tariff
(6) Green grid
(7) Bio-fertiliser

6.2.5.1 ENCON type fund

In section 5.4.5.1, this research has found the introduction of an Energy Conservation Promotion Fund (ENCON Fund) in Malaysia, akin to Thailand’s ENCON Fund, as a value opportunity that can eliminate the 1.6% surcharge paid to the RE fund – a value destroyed for society as a stakeholder. As the data has pointed out, the ENCON Fund is *“a much better idea than collecting from the people”* (Official 1). The Fund is in fact *“a levy on fossil fuel”* aimed at “*trying to inject more renewable energy and reduce fossil fuel generation*” (Manager 3). It *“should have been there a long time ago”* (Consultant 3).

These findings are supported by the literature reviewed in chapter 2.0. As noted earlier, Thailand established the ENCON Fund in 1992, funded through a tax on all petroleum sold in the country, to provide financial incentives to promote energy conservation, energy efficiency and renewable energy (IEA - Thailand, 2013b). With the availability of financial support from the ENCON Fund, it has driven the growth of the biogas industry in Thailand, and as reported, about 50% of the large-scale starch plants and most of the palm oil mills in Thailand have already been fitted with biogas plants (Jue, et al., 2012). Accordingly, Malaysia can consider the introduction of an ENCON Fund to be funded through a tax on all petroleum sold in the country, to fund the FiT . The proposed Fund can replace the renewable energy fund currently funded by the 1.6% surcharge on the electricity bills of consumers.

The data has also pointed out this levy is fair as it would *"tax the polluter, in this case fossil fuel energy player"* (Manager 2). The effectiveness of this levy is noted in the literature review , as Lau, et al. (2016, p.79) have pointed out that carbon taxes are environmentally effective in countries such as Sweden, Denmark, Finland, Belgium, Germany and Norway, and suggested that "if a similar measure is implemented in Malaysia, it will likely be in favour of Malaysia's commitment for reducing carbon footprint".

One of the purposes of FiT-based businesses, as this research has concluded in section 6.2.1, is the diversification of the supply options for power generation to reduce the dependency on fossil fuel, which can help improve the long-term energy security of Malaysia. Hence, it is argued that the introduction of an ENCON Fund as a value opportunity is fit for purpose, as the ENCON Fund will encourage renewables as alternative sources of fuel whilst the levy will discourage fossil fuel-based power generation.

6.2.5.2 Promotion of awareness

This research has found, in section 5.4.5.9, that the introduction of various activities and collaborations to promote awareness of oil palm renewable energy can create new positive values for the stakeholders by enabling existing assets, capabilities and resources to be capitalised, which otherwise would have been missed or wasted due to lack of awareness. As the data has pointed out, it is important to *"educate from young"* so that *"only in future they know about green energy"*, and *"if they know about green energy and how green energy is important then easier to convince them"* (Consultant 2). The data has also pointed out that there should be *"continuous promotion of awareness"* (Utility Officer 3) through *"workshops"* (Official 1) , and using the website of the Sustainable Energy Development Authority (SEDA) to disseminate information on oil palm renewable energy by making "*it more simple and publicise it"* (Consultant 2).

These findings are compatible with the literature. As discussed in section 2.5.2, Kardooni, et al. (2016, p.5) have suggested "introducing environmental and technology curriculum at all levels of school, improving environmental campaigns and the portrayal of green technology in mass media and social media, and introducing a one-stop centre/agency to disseminate information on green technology". Bong, et al. (2016, p.9) have stressed the need to organise "seminars, talks and demonstrations" to increase "social awareness and acceptance towards green technology".

Earlier, it is noted that even with the Green Technology Financing Scheme (GTFS) to promote renewable energy, the participation of Malaysian financial institutions is still lacking due to their lack of awareness and experience related to renewable energy (Kumaran, et al., 2016). As the data has indicated, "*it involves the awareness of the policy maker plus the investor"* and "*financier as well"* (Official 3). Hence, cooperation among the government, financial institutions and renewable energy investors is important to overcome “any misunderstanding and lack of communications” (Sharaai, et al., 2015, p. 36).

The introduction of various activities and collaborations to promote awareness of oil palm renewable energy will encourage the deployment of oil palm renewable energy, thereby reducing the dependency on fossil fuel and helping to improve the long-term energy security of Malaysia. Hence, it is argued that the promotion of awareness as a value opportunity is fit for purpose, as it is within the bounds of the purposes of the FiT-based businesses defined in section 6.2.1 (Bocken, et al., 2013).

6.2.5.3 Promotion of local technology and expertise

As this research has found in section 5.4.5.10, undertaking various activities and collaborations to promote local technology and expertise related to oil palm renewable energy can create new positive values for the stakeholders, by enabling them to capitalise on existing assets, capabilities and resources which they had missed or wasted due to lack of local technology and expertise. As the data has pointed out, there should be *“more training and education to enable the people to operate the machineries and the power plants”* ,and in this regard, there should be *“more incentive to teach and learn English because you would be surprised that many people unable to read a multimillion dollar machinery manual”* (Manager 2).

The data has also pointed out that “*there should be more promotion because we have not seen much development or more efficient types of biomass plants and biogas plants over the past 10 years or so”* (Academic 3). However, the data was inconclusive on whether the additional bonus of RM 0.05 for the “use of locally manufactured or assembled gas engine technology” (see Table 2.1) was appropriate. On one hand, it was pointed out that *“over the long run the local assembly bonus will contribute to the advancement of local technology”* (Official 1). On the other hand, it was suggested that the local assembly bonus has created a *“monopoly”* for the two (2) gas engines currently qualified for that bonus and as a result, *“they kill all the other engine suppliers”* (Consultant 2).

These findings are supported by the literature. As discussed in section 2.5.2, Aghamohammadi, et al. (2016, p.10) have advocated the promotion of local technology and expertise by suggesting that “Malaysia should use foreign knowledge and technologies and start to increase the number of local technology manufacturers and skilled workers” to reduce the high cost of technology and maintenance. Kumaran, et al. (2016) have advocated the development of local expertise by proposing that the government should collaborate with educational institutions to impart skill trainings and knowledge. Likewise, Bong, et al. (2016, p.7) have suggested “a need to improve technical know-how” through “trainings and workshops” on operation and maintenance.

The promotion of local technology and expertise will lead to the development and usage of more local technology and expertise. As Umar et al. (2013) and Aghamohammadi, et al. (2016) have pointed out, the usage of more local technology can reduce the reliance on foreign technologies and hopefully lower the technology costs. Sharaai, et al. (2015, p.36) have already warned that "the capital intensive initiative requiring huge costs to cover such imported technologies to the country is unsustainable".

The introduction of various activities and collaborations to promote local technology and expertise related to oil palm renewable energy will encourage the deployment of oil palm biomass-based power generation, thereby reducing the dependency on fossil fuel and helping improve the long-term energy security of Malaysia. Hence, it is argued that the promotion of local technology and expertise as a value opportunity is fit for purpose, as it is within the bounds of the purposes of the FiT-based businesses as defined in section 6.2.1 (Bocken, et al., 2013).

6.2.5.4 Promotion of CHP

This research has found in section 5.4.5.11 that Combined Heat and Power (CHP) can create new positive values for renewable energy developers by enabling them to capitalise on *"both heat and power"* as *" a more efficient way to utilise energy"* (Manager 1). CHP is noted as a value missed or wasted in section 6.2.4.4, and the heat from CHP can be utilised "*to reduce the fuel consumption for other processes"* (Manager 3), particularly through the integration of the renewable energy plants with palm oil mills *"so that the palm oil mills can use the steam"* (Utility Officer 2).

As the data has pointed out, CHP should be promoted in order to generate "*ideal quantity of electricity as well as opportunities for thermal energy for anybody who needs it there"* (Utility Officer 1) and also *"to optimise the resources, country resources"* (Utility Officer 3). Hence, this value missed could be converted into new value to be captured by oil palm renewable energy businesses in Malaysia.

These findings are consistent with the review of the literature in chapter 2.0. As noted in section 2.5.6, biomass CHP systems have higher overall efficiencies and are economically very attractive with the sale or opportunity value of the heat produced especially where the low-cost agricultural residues as feedstock and the process heat needs are located together (IRENA, 2012, p. 41). From this standpoint, the best location to site a biomass power plant should be inside or somewhere in the vicinity of a palm oil mill, where palm oil wastes are available as low-cost feedstock for the power plant, and various process heating needs of the palm oil mill can be met using the heat produced from the biomass CHP system. The CHP biomass plant can be integrated with the oil mill either as an extension or upgrade to the oil mill. Garcia-Nunez, et al. (2016) have also advocated the conversion of palm oil mills into biorefineries complete with biomass and biogas plants.

Chua et al. (2011, p.709) note that most of the existing biomass combustion systems in Malaysia utilise "low efficiency low-pressure boilers with combined heat and power efficiency of less than 40%". Upgrading the low pressure boilers to higher pressure CHP systems , as Umar, et al. (2014b) have suggested, can generate more electricity (Garcia-Nunez, et al., 2016) and allow the surplus to be exported to the grid.

As noted in section 2.5.6, the IEA has proposed technology development, incentives and awareness as some of the initiatives to promote CHP (IEA, 2011). IRENA has also advocated the adoption of "strategies to grow industrial CHP use" (IRENA, 2014a, p. 59). As discussed in section 2.2.2, CHP has been and is strongly promoted in the UK from the RO scheme which offers "Dedicated Biomass with CHP" more RO support than "Dedicated Biomass" alone to the FiT with CFD (CFD) which are only available for biomass plants with CHP but not electricity-only biomass power plants. The Department of Energy & Climate Change (DECC) actively promotes and supports the development of CHP schemes in the UK (DECC, 2015) and various government incentives are available for CHP schemes (DECC, 2008a). There is also an "adder" or bonus tariff for CHP in Germany's EEG law (Mabee, et al., 2012, p. 486). However, as this research has found in section 5.4.5.11, it is less than clear whether a bonus tariff should be offered for CHP in Malaysia, with two opposing views. On one hand, "*I don't think CHP bonus tariff is necessary"* (Utility Officer 2), and on the hand, there should be *"a FiT rate for CHP. For CHP basically"* (Official 1).

CHP enables *" a more efficient way to utilise energy"* (Manager 1) to generate an "*ideal quantity of electricity"* (Utility Officer 1) to be exported to the grid. Hence, it is argued that the promotion of CHP as a value opportunity is fit for purpose, as it is within the bounds of the purposes of the FiT-based businesses as discussed in section 6.2.1 (Bocken, et al., 2013).

6.2.5.5 Location-specific bonus tariff

In section 5.4.5.2, this research has found location-specific bonus tariff as a value opportunity, particularly for the State of Sabah in East Malaysia, that can enhance distributed generation and mitigate pollution and emission, thereby extending the value propositions of FiT-based renewable energy businesses. As the data has pointed out, *"it encourages the development of renewable energy in rural areas in Malaysia like the state of Sabah which is still heavily relying on high polluting diesel-powered electrical generation"* (Manager 1). Furthermore, *"their grid connection is not as well as compared to West Malaysia. So in a lot of area, they are actually still lacking power"* (Academic 1).

The literature reviewed in chapter 2.0 supports these findings. As noted in section 2.2.3, special Adders or higher tariffs are paid in Thailand for "Three Southernmost Provinces" and for "Diesel Replacement" in off-grid areas relying on diesel plants for electricity (Tongsopit & Greacen, 2013, p. 442). Special Adders or bonus tariff for rural areas such as Sabah in East Malaysia, that still rely heavily on diesel-powered electricity generation, can help promote the deployment of renewable energy in these less developed areas to displace the use of expensive and environmentally polluting diesel fuel. Sharaai, et al. (2015, p.36) have highlighted "the lack of infrastructure for feed-in capability into power grids, gridlines availability issue and the long distance between the location of palm oil mills and power grids" as significant challenges and suggested that the biogas industry players in Sabah should be given greater attention and funding. Likewise, Chin, et al. (2013) have suggested a higher allocation of quota for the State of Sabah in East

Malaysia as new power generation plants are more urgently needed there to meet power shortages.

The data has also indicated that the true cost of diesel-based power generation in Sabah is as high as RM1.00 per kWh and the authorities *"are actually subsidising diesel price"* by *"quite a lot"*(Utility Officer 2), in contrast to the maximum biogas tariff of only RM0.4669 per kWh as shown in Table 2.1. It has been suggested that *"instead of subsidising the diesel, you take the subsidy and put in as a bonus"* to promote renewable energy to displace diesel-based power generation (Consultant 2). Kardooni, et al. (2016, p.6) have pointed out that "Malaysia is among the nations with the highest fossil fuel subsidies", which distort the market, and make renewable energy technologies relatively more expensive and difficult to compete economically with fossil fuel, leading some to suggest that this subsidy should be gradually eliminated and transferred to renewable energy resources (Petinrin & Shaaban, 2015 ; Kumaran, et al., 2016).

Location-specific bonus tariff for Sabah can extend the value propositions of FiT-based renewable energy businesses by enhancing distributed generation, and mitigating pollution and emission through the displacement of diesel-based power generation in Sabah. Hence, it is argued that the introduction of location-specific bonus tariff as a value opportunity is fit for purpose, as it is within the bounds of the purposes of FiT-based businesses as discussed in section 6.2.2.5 (Bocken, et al., 2013).

6.2.5.6 Green grid

This research has found in section 5.4.5.7 that the development of a green grid in the rural areas, comprising a network of collector sub-stations constructed close to clusters of palm oil mills, can facilitate the participation of palm oil mills in FiT-based renewable energy businesses by enabling them to connect to the respective collector sub-stations of the green grid, instead of extending their connection all the way to the main grid. The *"collector station will be the interconnection point"* instead of the existing main grid, and *"the Government will actually construct this collector station and also the 132 kV line to the existing grid"* (Official 1). As the data has pointed out, the green grid can enhance distributed generation as a value proposition as noted earlier in section 6.2.2.3, and thus, it represents a value opportunity that can *"enhance further the development of renewable energy generation, especially in those remote areas"* (Utility Officer 3).

The literature reviewed earlier in this research is supportive of these findings. Bong, et al. (2016, p.7) have suggested that the government should construct "infrastructure to access to the national grid" so that renewable energy businesses can have access to the predictable and long-term revenue stream of the FiT scheme. Chin, et al. (2013, p.724) have proposed connecting the palm oil mills located close to each other in rural areas for rural electrification, especially in Sabah. In this regard, the collector sub-station can serve as *"a centralised injection point"* (Consultant 2) for the cluster of palm oil mills.

As noted in section 2.5.3, Ahmed, et al. (2017, p. 1427) have considered four (4) types of policies for allocating grid connection costs by referring to the figure below, and concluded that, among these policies, the semi-shallow connection cost policy is sustainable and "is economically viable for renewable generators" (Ibid, p.1427). The green grid as a network of collector sub-stations built close to clusters of biomass and biogas plants is akin to a semi-shallow connection cost policy.

The figure originally presented here cannot be made freely available via LJMU E-Theses Collection because of copyright. The figure was sourced at Ahmed, et al. (2017, p.1427).

Figure 6. 1 Connection costs allocation policies (Ibid, p.1427)

The green grid can enhance distributed generation particularly in the rural areas and hence, it is argued that the introduction of the green grid is a value opportunity that is fit for purpose, as it is within the bounds of the modified purposes of the FiT-based businesses as discussed in section 6.2.2.3 (Bocken, et al., 2013).

6.2.5.7 Bio-fertliser

As this research has found in section 5.4.5.8, the residues of the biogas plant, namely belt press and dewatering press cakes, can be recycled back to the oil palm estates as bio-fertiliser, and this value-added product constitutes a value opportunity for renewable energy businesses based on the FiT for oil palm biomass/biogas in Malaysia. Boiler ash, a residue from the biomass plant, can also be converted into bio-fertiliser as a value-added product (Manager 2). The sustainability of recycling the biogas and biomass residues back to the estates was commended as it helps in "*transforming the entire palm oil into zero waste discharge from the mill"* (Academic 1).

These findings are consistent with the review of the literature in chapter 2.0. Garcia-Nunez, et al. (2016) and Kumaran, et al. (2016) have reported that the anaerobic process also produces a residue digestate that can be used as a bio-fertiliser. According to Bong, et al. (2016, p.8), it is "rich in nutrient and can be used to fertilise crops".

According to Shukery, et al. (2016, p.2121), “a sustainable and integrated bio-refinery concept” can generate higher value-added products such as bio-fertiliser and “also benefit the surrounding community” including “electricity generation for the community”. Producing bio-fertiliser in addition to power generation is consonant with *“the concept of bio-refinery where you can produce multiple products. So how it works is, because when you have multiple products, that means your system will be more robust”* (Academic 1).

One of the purposes of FiT-based businesses as discussed in section 6.2.1 is to manage palm oil milling wastes to comply with environmental regulations and mitigate pollution. Bio-fertiliser constitutes a value opportunity that can help in transforming palm oil milling into a zero-waste discharge process and hence it is within the bounds of the purposes of the FiT-based businesses as defined in section 6.2.1 (Bocken, et al., 2013).

6.3 BARRIERS, STRATEGIES AND RECOMMENDATIONS (IEA-RETD, 2013)

This section deals with the data findings relating to the barriers, strategies and recommendations on the realisation of oil palm renewable energy in Malaysia. The discussion is organised around the following themes that emerged from the preceding chapter:

- Barriers to the realisation of oil palm renewable energy in Malaysia
    - Regulatory weaknesses (SEDA)
    - Adequacy of incentives
    - Feedstock supply
    - Impact of National Biomass Strategy
    - Interconnection difficulties

- Strategies and recommendations
    - One-stop centre
    - Review incentives
    - Feedstock ownership
    - Transparent interconnection requirements

6.3.1 Barriers to the realisation of oil palm renewable energy in Malaysia

In respect of the barriers to the realisation of oil palm renewable energy in Malaysia, this research has found, in section 5.4.6, five (5) sub-themes. These findings will now be discussed with reference to the literature reviewed in chapter 2.0, with the discussion structured around the following five (5) sub-themes:

(1) Regulatory weaknesses (SEDA)
(2) Adequacy of incentives
(3) Feedstock supply

(4) Impact of National Biomass Strategy
(5) Interconnection difficulties

6.3.1.1 Regulatory weaknesses (SEDA)

In section 5.4.6.1, this research has found regulatory weaknesses as part of the barriers to the deployment of oil palm renewable energy in Malaysia. As the data has pointed out, Sustainable Energy Development Authority (SEDA) lacks the clout *"to spearhead Malaysia's quest into the development of renewable energy"* especially on *"issues with Utility"* (Manager 1). It has also been pointed out that the *"status of implementation"* of biomass and biogas *"is not satisfactory"*, and SEDA should check *"what are the barriers and then …..find ways of overcoming"* them (Academic 2).

These findings are supported by the literature reviewed in chapter 2.0. As noted in section 2.5, the Cumulative Installed Capacity of Biomass Plants as at 1st September 2016 has reached only 68.40 MW (SEDA, 2016). At least 30 MW or less than half are capacities previously installed under the SREP (the predecessor to the FiT) and migrated to the FiT scheme (SEDA, 2012). The Cumulative Installed Capacity for Biogas (Landfill / Agri Waste) until September 2016 is only 18.88 MW. These achieved capacities are far off the 2015 targets set in the Tenth Malaysian Plan (2011 -2015), namely 330 MW of biomass renewable energy (including other solid wastes) and 100 MW of biogas renewable energy (landfill/agricultural waste/other biogas). Thus, Kumaran, et al. (2016, p.937) have also concluded that "the growth of biogas plant installation is still at the nascent stage in Malaysia".

Muhammad-Sukki, et al.(2014) have reviewed the impact of the FiT scheme on renewable energy as a whole in Malaysia one year after its implementation, and concluded that the FiT application was dominated by solar photovoltaic and had fewer applications from other types of renewable energy including biomass and biogas. This is echoed by Adham, et al., (2014, p.257) who "find Photovoltaic has shown good progress while the developments of other RE sources are under-performed". As the data has suggested, *"SEDA should be stronger in promoting biomass and biogas rather than promoting solar so much",* otherwise *"SEDA is not really a sustainable authority but a Solar Energy Development Authority"* (Utility Officer 1).

6.3.1.2 Adequacy of incentives

In section 5.4.6.2, it is found that tariffs offered for oil palm renewable energy in Malaysia are inadequate, particularly for biomass, and this inadequacy poses a barrier to the realisation of oil palm renewable energy in Malaysia. As pointed out, "*the incentives could have been better"* (Manager 2). *"Biomass rates are not that attractive as compared to biogas"*, and *"biomass rates could be better"* (Utility Officer 2).

The data has pointed out that the rates for *"biogas and biomass are much lower as compared to solar photovoltaic (PV)"* (Academic 1), consistent with the literature reviewed in chapter 2.0. Kumaran, et al. (2016) have highlighted that the lower FiT rate for biogas is unsatisfactory compared to the higher FiT rate for solar.

According to Bong, et al. (2016, p. 9), "the government must ensure that a reasonable profit can be obtained through the FiT rates over a certain period of time" to ensure the success of the FiT scheme. Hence, as the data has suggested, there is a *"need to review"* the biomass rates as many *"people who have taken-up"* the quota have still *"not constructed"* (Official 1). It was also indicated that having a tariff rate that is fixed for the FiT duration of 16 years *"maybe not fair"* since *"for the future overhaul all the spare parts….price will increase also"* (Consultant 2).

6.3.1.3 Feedstock supply

This research has found in section 5.4.6.3 that it is difficult to secure long-term supply of biomass feedstock, which represents a barrier to the realisation of oil palm renewable energy in Malaysia. As pointed out, without "*long-term feedstock contract, the banks will not consider"* (Official 1) and thus, the renewable energy developer would face difficulties in securing project financing. Feedstock supply is one of the biggest challenges (Manager 3) , and *"if you don't have the feedstock you are just dancing with the devil, asking for problems that you don't need"* (Consultant 1).

These findings are supported by the literature. As discussed earlier in chapter 2.0, Aghamohammadi, et al. (2016, p.7) have emphasised that "the continuous supply of palm biomass is one of the fundamental elements of sustainable power generation from palm biomass". Petinrin & Shaaban (2015, p.979) have highlighted that "fuel suppliers are not committed to having a long-term agreement with the renewable energy project developers". As noted in section 2.5.1, failure to secure long-term feedstock supply agreement may result in the financing of the project not being approved (Sharaai, et al., 2015; Yatim, et al., 2016; Kumaran, et al. ,2016).

The data has also pointed out that *"there is now a growing trend to convert biomass feedstock especially empty fruit bunch (EFB) into value added products. This will eventually put pressure on the availability of oil palm biomass for power generation"* (Manager 1). The uses of biomass include pellets and palm fibres (long or short fibres) and hence, there is *"competition from long fibre, short fibre use as well"* (Manager 2). And, if *"the overseas market pays better. So why burn locally?"* (Utility Officer 1). As discussed in the literature review in section 2.5.1, competition on biomass use also affects the feedstock supply and cost as the wastes can be "utilised for other economically viable co-products other than the energy, which can generate profit in a shorter period" (Kumaran, et al., 2016, p. 938).

6.3.1.4 Impact of National Biomass Strategy

This research has found in section 5.4.6.4 that the National Biomass Strategy 2020 can pose a barrier to the growth of oil palm renewable energy businesses in Malaysia. The Strategy aims to create "waste-to-wealth" from oil palm biomass through higher-value downstream uses such as pellets (bioenergy), bioethanol (biofuel) and bio-based chemicals (Agensi Inovasi Malaysia, 2013, p. 18; see also Yatim, et al., 2016).

As the data has pointed out, the policy can have a negative impact by *"driving prices of feedstock upwards"* (Manager 1), as suppliers may take *"advantage of the situation to* *overvalue their waste"* , thereby affecting the viability of oil palm renewable energy businesses that buy a significant proportion of third party feedstock (Utility Officer 1). It should be noted that some of the higher-value downstream uses such as bioethanol (biofuel) and bio-based chemicals are still uncertain, as the data has suggested that *"oleo chemical and all that, not going to happen....Because the cost is still so high"* (Official 1). However, the uncertainties in the downstream uses can create a wait and see situation on the part of feedstock suppliers who may now be *"holding back on the value part of it because they want to leverage it against the high tech value"* envisioned by the strategy (Utility Officer 1). These findings are in line with the literature. As discussed in the literature review in section 2.4.2, uncertainties in the Empty Fruit Bunch (EFB) downstream market can create a wait and see situation that can reduce the availability of EFB for power generation and drive up the cost (Chiew, et al., 2011).

The data has also indicated that the policy may result in intense competition for biomass which can be detrimental to oil palm renewable energy businesses in Malaysia. *"If we don't control it, then it will be suddenly after one to two years, another industry comes up that will also compete with you for the same feedstock"* (Manager 2). Hence, "*this is something the Government has to look at. Because they already asked this biomass power plant to invest so much of money, now you change to another scheme. This affects their business"* (Consultant 2). As discussed in section 2.4.3 of the literature review, "government policies that complement each other are more likely to be successful" (Sen & Ganguly, 2016, p. 10). To ensure the success of the FiT scheme, the National Biomass Strategy 2020 should complement it instead of hindering it.

6.3.1.5 Interconnection difficulties

In section 5.4.6.5, this research has found that interconnection difficulties represent major barriers to the deployment of oil palm renewable energy in Malaysia. As the data has pointed out, these difficulties have arisen mainly due the way the Utilities are handling grid interconnection, which *"looks like they are reluctant to accept our biogas or biomass"* (Consultant 3). It was found that these difficulties include *"unnecessary demands by the power utility company"*, *"the decision making process to approve certain tests is slow"* , *"unnecessary delays in the project"* and *"the level of cooperation is considered low"* (Manager 1).

Other difficulties include *"whims and fancies so that they can change"* (Consultant 1) , having *"to deal with too many departments within the utility"* (Manager 3), and *"vague"* requirements (Manager 2). The data has also pointed out that the Utilities *"are very firm on their certain specs"* (Academic 1), and often *"the specs is actually higher than the utility's"* own equipment and also *"more expensive"* (Consultant 2).

These findings are consistent with the literature reviewed in chapter 2.0. As noted in section 2.5.3, Theo, et al. (2017) have highlighted that "institutional barrier could exist in the form of strict criterions for distributed generation (DG) interconnection into power grid" (Ibid, p. 536). Borhanazad, et al. (2013, p.217) have also reported on the "onerous requirements for small power producer set by utility" in Malaysia. At a workshop organised by IEA in collaboration with IRENA and FAO, one speaker has also highlighted the uncertain and difficult interconnection requirements, and the request for special equipment by the power utility, as some of the interconnection difficulties faced by oil palm renewable energy businesses in Malaysia (Jamin, 2014). Petinrin & Shaaban (2015, p.979) have cited the "long negotiation periods" for the Renewable Energy Purchase Agreement (REPPA) to be concluded with the Utilities. The longer it takes, "the more expenses the development will incur", and if the "company does not have staying power, it will simply abandon" the initiative.

As discussed in the literature review, the electricity supply industry in Malaysia is still largely regulated and remains "a single-buyer model with a competitive generation market but vertically integrated monopolistic transmission, distribution, and supply market in three geographic regions" (Pacudan, 2013, p. 285). Sen & Ganguly (2016, p.6) have rightly stated that policies that protect the monopoly or near-monopoly transmission and distribution of the Utilities would make "the way of renewable energy very difficult", as the barriers highlighted in this section have shown.

6.3.2 Strategies and recommendations

This research has found, in section 5.4.7, four (4) sub-themes pertaining to potential strategies to overcome at least to some degree the barriers to the realisation of oil palm renewable energy in Malaysia, and the recommendations for the stakeholders including policy makers and investors. This section will now discuss the findings with reference to the literature review. The discussion is centred around the following four (4) sub-themes:

(1) One-stop centre
(2) Review incentives
(3) Feedstock ownership
(4) Transparent interconnection requirements

6.3.2.1 One-stop centre

As this research has found in section 5.4.7.1, having a one-stop centre can be a potential strategy to overcome at least to some degree some of the regulatory and interconnection barriers. It was found that a one-stop centre can communicate better all the relevant requirements and information, and hence, can provide more clarity and certainty to renewable energy investors. As the data has indicated, there are *"many departments here to deal with"*, and through a one-stop centre, *"all these associated regulatory requirements are being centralised"* so that *"all this information disseminated and developers are able to comprehend what is required of them"* (Manager 2). It was pointed out that there is *"a lot of overlapping in a certain area"* and *"so, it becomes uncertain and the investor not clear who should I go to"*. (Academic 1).

This research has found that the one-stop centre can also coordinate the processing of all the applications for licensing, planning, building and environmental approvals by the various regulatory departments. With so many departments to deal with, the one -stop centre can *"coordinate the processing of the many licenses and submissions that a* *project developer has to carry out"* (Manager 1). It is important that the one-stop centre *"should have the power and expertise to guide and assist the project developer"* (Manager 1). It *"has to direct from the top and oversee the utility, the relevant party to work together and stay together. That is the key"* (Academic 1). There should also be a one-stop centre within the Utility to handle the Renewable Energy Power Purchase Agreement (REPPA) and grid interconnection as the data has suggested, instead of having *"to deal with too many departments within TNB or SESB…. Another one stop agency"* (Manager 3).

The data findings are not at variance with the literature review. As noted earlier, Kardooni, et al. (2016, p.5) have suggested "introducing a one-stop center/agency to disseminate information on green technology". According to Yatim, et al. (2016, p.9), there is some overlapping functions performed by SEDA and the Energy Commission, and "this conflicting responsibility may cause confusion for stakeholders of the industry". Bong, et al. (2016, p.8) have also highlighted that "fragmented implementation" in the legal and regulatory framework has led to "overlapping function and unclear responsibilities".

As discussed earlier in the literature review, the FiT policy is formulated at the federal level of government but policy implementation "requires state and local authorities to issue land conversion approvals, planning permissions, and access to land use", which reportedly "tend to be lengthy" with "inconsistent" requirements (Yatim, et al., 2016). Hence, there should be a one-stop centre to coordinate among the various institutions, which is "vital to ensure unfettered development" of renewable energy (Sen & Ganguly, 2016, p. 9).

6.3.2.2 Review of incentives

This research has found in section 5.4.7.2 that reviewing and extending the incentives can overcome at least to some degree the inadequacy of the incentives, which this research has found as a barrier to the realisation of oil palm renewable energy in Malaysia. As the data has pointed out, the *"incentives should be reviewed from year to year"* (Manager 1), and *"more incentives can be given"* (Academic 1) to promote oil palm renewable energy businesses in Malaysia. In order to provide more incentives, it was suggested that the Government should *"withdraw the subsidy slowly"* for fossil fuel and *"some of that subsidy can go into the renewable energy fund"* (Utility Officer 2). The data has indicated that *"because of that feedstock risk,…..biomass power plants should be given extra compensation for that risk"* (Utility Officer 2).

The data findings are consonant with the literature review. As discussed in section 2.2.2, the generation and export tariff rates of United Kingdom's FiT are linked to the Retail Price Index and are adjusted annually to increase or decrease with inflation (Ofgem, 2015). Tariff levels in the UK have been calculated to offer at least 5-8% return on investment (IEA - UK, 2014a). As Bong, et al. (2016, p. 9) have suggested, "the government must ensure that a reasonable profit can be obtained through the FiT rates over a certain period of time" to ensure the success of the FiT scheme. Umar, et al.

(2014 a, p.45) have suggested identifying "other alternatives to financing renewable technologies" including "transferring some of the conventional energy subsidy to promote the renewable market". As discussed in the literature review, the "enormous and massive support" for fossil fuel has been cited as a key hindrance to the deployment of renewable energy in Malaysia (Foo, 2015, p. 1495).

As noted in section 2.3, Pioneer Status, ITA and Import Duty Exemption were available until 31st December 2015 (SEDA, 2015b). However, Investment Tax Allowance has been extended beyond 31st December 2015 by allowing qualifying capital expenditure incurred from 25th October 2013 until the year of assessment 2020 to be "offset against 70% of the statutory income in the year of assessment", and "unutilized allowances can be carried forward until they are fully absorbed" (MIDA, 2016). The data has pointed out that some of the "*fiscal incentives should be extended beyond 2015 so that more players in the renewable energy sector can participate"* (Manager 1). This is compatible with the suggestion in the literature that the "government should provide special incentives and tax reduction" to "palm oil mills to assist them with the high capital investment of the biogas power generation plant" (Chin, et al., 2013, p. 724). Bong, et al. (2016, p.7) have also suggested "more tax exemption on anaerobic digestion technology due to its high capital and operational cost". Furthermore, as noted earlier, in most developing countries such as Malaysia, "there is usually no economic incentive to develop waste-free processes" and, "a cleaner production is therefore limited unless it is subsidised, externalities are factored in, products are successfully designed for commercial reuse and, most importantly, the government takes the initiative in legislating for a sustainable industrial development" (Wu, et al., 2009, p. 50).

6.3.2.3 Feedstock ownership

As this research has found in section 5.4.7.3, it is critical to own or control part of the feedstock in order for biomass renewable energy businesses in Malaysia to overcome at least to some degree the challenges of feedstock supply as discussed in section 5.4.6.3. As the data has pointed out, *"at the minimum they should have 50%, very minimum, but to be comfortable, would be 70%"* (Official 1).

The data indicates that *"if you don't have sufficient feedstock, your operation will be a challenge. If you own yourself, you have your own mill and then you can. I would say at bare minimum, it's 50%....but if you can up to 70%, that's the best"* (Academic 1). In this regard, it was suggested that to qualify for the FiT scheme, *"the applicant must be either the oil mill owner or he must have some majority share inside there, you know. Rather than third parties come and do"* (Official 1).

These findings are in line with the literature review. As noted in chapter 2.0, IRENA stresses the importance of "a secure, long-term supply of an appropriate biomass feedstock" to the viability of a biomass power plant (IRENA, 2012, p. 27), and it emphasises the fact that "many biomass power projects, particularly for CHP, are promoted by the industry which controls the process that produces the wastes and residues" (Ibid, p.26). The bio-refinery concept as Garcia-Nunez, et al. (2016) and

Shukery, et al. (2016) have advocated, where the biomass plant is integrated with a palm oil mill, can most likely satisfy this requirement of feedstock ownership as there is significant amount of biomass available at a single location and produced all year round. Hence, *"you can control your own materials and then you can control the entire plant and then you can operate very confidently and consistently"* (Academic 1).

6.3.2.4 Transparent interconnection requirements

This research has found in section 5.4.7.4. that clear interconnection requirements, which are easily available and understood, can overcome at least to some degree the interconnection barriers as discussed in section 6.3.1.5. As the data has indicated, the requirements should have been *"made easy by having everything spelt out and made into a proper checklist of what is required"* (Manager 2). The requirements *"should be publicised"* (Utility Officer 2), and "*to be transparent, I don't think that is an issue"* (Utility Officer 3).

The data has pointed out that *"it should be the role of the regulator to make sure that it is clear what the rules are"* and then *"it should be monitored by the Energy Commission, to whom the developer can complain"* (Academic 3). As indicated by the data, the Renewable Energy (Technical and Operational Requirements) Rules 2011 and the Renewable Energy (Technical and Operational Requirements) (Amendments) Rules 2014 (SEDA, 2016) issued by the Sustainable Energy Development Authority (SEDA) do provide some degree of transparency. However, interconnection difficulties can arise where "*the Utility is not following the Technical and Operational Requirements"* (Official 1).

These findings are not at variance with the literature review. As discussed in section 2.5.3, "clear and transparent grid interconnection rules are key for a fast uptake of the renewable energy market in Malaysia" as the FiT participants are generally "not used to dealing with complex administrative and technical requirements" as the big independent power producers (Jacobs, 2010, p. 10). Likewise, Sen & Ganguly (2016, p. 9) have emphasised that "transparent and streamlined procedures can reduce transaction costs". For FiT-based oil palm renewable energy businesses to be successful in Malaysia, it is argued that the key factors ensuring the success of Germany's FiT should be emulated, particularly priority grid connection and guaranteed purchase obligations which oblige the power utilities "to purchase renewable based electricity and feed into their grids on a priority basis" (Rahman, et al., 2016, p. 3). Other success factors of Germany's FiT include ensuring "grid access without delay and bureaucratic hassles, which minimizes transaction costs" (Ibid, p.3) by "simplifying legal, technical and financial processes" (Ibid, p.6), and obliging German system operators "to optimize, reinforce and expand the networks in order to accommodate the electricity from renewable resources without delay (Ibid, p.4).

6.5 SUMMARY

The main discussion points in this chapter are highlighted in the Table of summary below.

Table 6. 2 Table summarising the main discussion points in chapter 6.0

Section	Themes	Findings	Refer to section
6.2.1	*Purpose of FiT-based businesses*	Mainly to manage palm oil milling wastes to comply with environmental regulations, to convert them into green energy for export to the grid to generate income, to reduce pollution and greenhouse gas (GHG) emissions, and to diversify the supply options for power generation in Malaysia to reduce the dependency on fossil fuel.	6.2.1
		Also enhancing distributed generation particularly for rural electrification.	6.2.2.3
		And job and skill creation.	6.2.2.4
6.2.2	*Value captured*		
	Waste management	Aid Malaysian palm oil mills to dispose their waste efficiently and effectively to comply with environmental laws and regulations. By reducing the carbon footprint, they can in the long run help to create a good image for the Malaysian oil palm industry to gain competitive market access in the European Union and the United States.	6.2.2.2
	Distributed generation	Distributed generation as a Value Proposition delivered to stakeholders, namely the Utility and society, since FiT-based renewable energy businesses are often connected in a distributed power generation system that can elevate the voltage, facilitate the transmission to remote areas, and reduce transmission losses. It can also eliminate the need for costly investments on transmission and distribution for the Utility.	6.2.2.3
	Job and skill creation	The creation of job opportunities and skills, by oil palm renewable energy businesses, in plant construction, operation and maintenance, and in the supporting services such as transport and repairs.	6.2.2.4

	Pollution and emission reduction	Oil palm renewable energy businesses based on the FiT can mitigate pollution of the waterways by treating the palm oil mill effluent (POME), and reduce greenhouse gas (GHG) emissions by displacing fossil fuel-based power generation and capturing methane from POME which has a global warming potential of 21 times more than CO2.	6.2.2.5
6.2.3	*Value destroyed*		
	Surcharge paid to RE fund	1.6% surcharge on the electricity bill of electricity consumers , other than domestic electricity consumers of less than 300kWh, constitutes a value destroyed for society.	6.2.3.2
	Feedstock price fluctuation	Renewable energy businesses largely dependent on third party feedstock suppliers are significantly exposed to long-term feedstock price fluctuation, which can adversely affect the long-term viability of these businesses, thus having a negative impact on the renewable energy developer.	6.2.3.3
	Transportation of feedstock	Transportation of biomass feedstock can have severe negative impacts on environment and society, as excessive transportation can generate some amount of greenhouse gas (GHG) emissions that is harmful to the environment, and it can be adverse to society, particularly villagers, with all the lorries going through the rural areas. The low energy density of biomass feedstock tends to limit the distance that is economical to transport oil palm empty fruit bunches (EFB), and it was found to be uneconomical to transport feedstock over long distances exceeding 50 km.	6.2.3.4
6.2.4	*Value missed or wasted*		
	FiT quotas	The imposition of FiT quotas or caps on the amount of installed capacities available annually may result in value being missed or wasted when FiT applicants are unsuccessful due to insufficient allocations and thus, fail to capitalise on their existing assets, capabilities and resources. Annual quotas are imposed annually, as the FiT's funding source is limited to the 1.6% surcharge on electricity bill.	6.2.4.1
	Combined Heat and Power	The heat from CHP, as a value wasted, particularly for standalone biomass power	6.2.4.4

		plants currently operating without CHP in Malaysia.	
6.2.5	*Opportunities for new value creation*		
	ENCON type fund	An Energy Conservation Promotion Fund (ENCON Fund) , similar to Thailand's ENCON Fund, should be introduced in Malaysia. The Fund would impose a levy on fossil fuel, and it would be fairer to tax the fossil fuel energy players who are the polluters, rather than collecting the 1.6% surcharge from society.	6.2.5.1
	Promotion of awareness	The introduction of various activities to promote awareness of oil palm renewable energy among renewable energy investors, policy makers, financiers, and society as a whole will enable more existing assets, capabilities and resources of oil palm renewable energy to be capitalised, which otherwise would have been missed or wasted due to lack of awareness. Increasing awareness of renewable energy is beneficial to society and environment as it will increase the deployment of renewable energy in Malaysia, thereby reducing greenhouse gas (GHG) emissions by displacing fossil fuel-based power generation and helping to improve the long-term energy security of Malaysia.	6.2.5.2 And 6.2.4.2
	Promotion of local technology and expertise	The promotion of local technology and expertise can also enable more existing assets, capabilities and resources of oil palm renewable energy to be capitalised, which otherwise would have been missed or wasted due to lack of local technology and expertise.	6.2.5.3 And 6.2.4.3
	Promotion of Combined Heat and Power (CHP)	Combined Heat and Power (CHP) can create new positive values for oil palm renewable energy businesses by enabling them to capitalise on both the heat and power as a more efficient way to utilise energy. The heat from CHP, as a value wasted, can be utilised to reduce the fuel consumption for other processes, particularly through the integration of the renewable energy plants with palm oil mills so that the mills can then use the steam. Thus, the best location to site a biomass power plant should be inside or in the vicinity of an affiliated palm oil mill, where significant quantities of palm oil wastes are available as low-cost feedstock for the	6.2.5.4

		power plant, and various process heating needs of the affiliated palm oil mill can then be met using the heat produced from the biomass CHP system.	
	Location-specific bonus tariff	The introduction of a location-specific bonus tariff for the State of Sabah in East Malaysia can enhance distributed generation, and mitigate pollution and greenhouse (GHG) emissions through the displacement of diesel-based power generation in Sabah.	6.2.5.5
	Green grid	The green grid proposal, consisting of a network of collector sub-stations to be constructed close to clusters of palm oil mills in rural areas, can facilitate grid interconnection. The development of a green grid can facilitate the participation of palm oil mills in FiT-based renewable energy businesses by enabling them to connect to the respective collector sub-stations, rather than connecting all the way to the main grid.	6.2.5.6
	Bio-fertiliser	The residues of the biogas plant, namely belt press and dewatering press cakes, can be recycled back to the oil palm estates as bio-fertiliser. Boiler ash, a residue from the biomass plant, can also be converted into bio-fertiliser. As a value-added product, bio-fertiliser constitutes a value opportunity for oil palm renewable energy businesses based on the FiT in Malaysia.	6.2.5.7
6.3.1	*Barriers to the realisation of oil palm renewable energy in Malaysia*		
	Regulatory weaknesses (SEDA)	The Sustainable Energy Development Authority (SEDA) lacks the clout *“to spearhead Malaysia’s quest into the development of renewable energy”* especially on *“issues with Utility”* (Manager 1).	6.3.1.1
	Feedstock supply	Difficulty in securing long-term supply of biomass feedstock represents a barrier to the realisation of oil palm renewable energy in Malaysia.	6.3.1.3
	Impact of National Biomass	The National Biomass Strategy 2020 can have a negative impact as some of the higher-value downstream uses envisioned by the Strategy such as bioethanol	6.3.1.4

	Strategy	(biofuel) and bio-based chemicals are still uncertain. These uncertainties in the downstream market can create a wait and see situation that can reduce the availability of biomass for power generation and drive up the cost.	
	Interconnection difficulties	Interconnection difficulties represent major barriers to the deployment of oil palm renewable energy in Malaysia. These difficulties have arisen mainly due the way the Utilities are handling grid interconnection, which include *"unnecessary demands by the power utility company"*, *"the decision making process to approve certain tests is slow"* , *"unnecessary delays in the project"* and *"the level of cooperation is considered low"* (Manager 1), and having *"to deal with too many departments within the utility"* (Manager 3).	6.3.1.5
6.3.2	*Strategies and recommendations*		
	One-stop centre	Having a one-stop centre can communicate better all the relevant requirements and information to provide more clarity and certainty to renewable energy investors. The one-stop centre can also coordinate the processing of all the applications for licensing, planning, building and environmental approvals by the various regulatory departments. A one-stop centre can constitute a strategy to overcome at least to some degree some of the regulatory and interconnection barriers, that can lead to an increased deployment of oil palm renewable energy in Malaysia.	6.3.2.1
	Review of incentives	Reviewing and extending some of the incentives can overcome at least to some degree the inadequacy of the incentives offered for oil palm renewable energy in Malaysia. Some of the fiscal incentives should be extended beyond 2015 so that more players can participate in order to increase the deployment of oil palm renewable energy in the country. Thus, Pioneer Status and Import Duty exemption should be extended beyond 31st December 2015. The *"incentives should be reviewed from year to year"* (Manager 1), and *"because of that feedstock risk,….biomass power plants should be given extra compensation for that risk"* (Utility Officer 2).	6.3.2.2 And 6.3.1.2

	Feedstock ownership	At least 50% up to 70% of the feedstock for biomass renewable energy businesses should come from their affiliated palm oil mills.	6.3.2.3
	Transparent interconnection requirements	In order to overcome at least to some degree the interconnection barriers so as to increase the deployment of oil palm renewable energy in Malaysia, there should be clear and transparent grid interconnection rules, which *"should be monitored by the Energy Commission, to whom the developer can complain"* (Academic 3). There is a need for grid interconnection without delay and bureaucratic hassles to minimise transaction costs by simplifying legal, technical and financial processes.	6.3.2.4

This next chapter will conclude by incorporating the data findings into the Conceptual Framework to *model* “Successful” and “Sustainable” FiT-based Renewable Energy Business Models in Malaysia to capture Economic, Environmental and Social value for a wide range of stakeholders, leading to an increased deployment of oil palm renewable energy.

CHAPTER 7.0

CONCLUSIONS AND CONTRIBUTIONS

7.1 INTRODUCTION

This research has explored oil palm renewable energy businesses based on the FiT for biomass and biogas in Malaysia, from the perspective of Business Models. It aims to investigate and model “Successful” and “Sustainable” FiT-based Renewable Energy Business Models in Malaysia to capture Economic, Environmental and Social value for a wide range of stakeholders, and increase the deployment of oil palm renewable energy in the country.

The chapter will summarise the findings and incorporate them into the Conceptual Framework to *model* Sustainable and Successful FiT-based Oil Palm Renewable Energy Businesses for Malaysia. The second and final focus group discussion for this research was held in April 2017 (Second Focus Group Meeting), where the findings were presented and discussed, and the focus group came to the conclusion that the data findings were acceptable, subject to a small number of observations and exceptions, which will be highlighted in summarising the research findings as set out below.

This chapter will also discuss the contributions that this research has made to both knowledge and practice. In short, this research has offered contributions to further the understanding of Renewable Energy Business Models, particularly Sustainable Renewable Energy Business Models of oil palm renewable energy businesses based on the FiT in Malaysia.

Hence, this chapter addresses the fifth and final research objective:

To conclude and model “Successful” and “Sustainable” FiT-based Renewable Energy Business Models for Malaysia with recommendations to the key stakeholders, and discuss the potential contributions of this research

In sections 7.2 and 7.3 below, the Sustainable and Successful FiT-based Renewable Energy Business Models will be modelled by using the remaining two (2) components of the Conceptual Framework:

- Triple Bottom Line Canvas (Osterwalder & Pigneur, 2010)
- Normative requirements (Stubbs & Cocklin, 2008 ; Boons & Ludeke-Freund, 2013)

7.2 TRIPLE BOTTOM LINE CANVAS (Osterwalder & Pigneur, 2010)

This research has shown that the purposes of sustainable oil palm renewable energy businesses based on the FiT for biomass/biogas in Malaysia are mainly to manage palm oil milling wastes to comply with environmental regulations, to convert them into green energy for export to the grid to generate income, to reduce pollution and greenhouse gas (GHG) emissions, and to diversify the supply options for power generation in

Malaysia to reduce the dependency on fossil fuel. As indicated in section 6.2.2.3, enhancing distributed generation particularly for rural electrification is another purpose of these businesses, besides job and skill creation as highlighted in section 6.2.2.4.

As this research has highlighted in section 6.2.2.2, oil palm renewable energy businesses based on the FiT can aid Malaysian palm oil mills to dispose their waste efficiently and effectively to comply with environmental laws and regulations. Furthermore, by reducing the carbon footprint, they can in the long run help to create a good image for the Malaysian oil palm industry. Hence, sustainable oil palm renewable energy businesses based on the FiT can aid "in generating wider sustainability across the full stakeholder network" (Bocken, et al., 2013, p. 485). Thus, the Customer Segments i.e. "for whom are we creating value?" (Osterwalder & Pigneur, 2010, p. 41) would include palm oil mills as the feedstock suppliers. In this regard, the Value Proposition i.e. "which one of our customer's problems are we helping to solve?" (Ibid, pp.43-44) is the management of the palm oil mill's wastes to comply with environmental laws and regulations, and enhance the image of the oil palm industry.

In section 6.2.2.3, this research has highlighted distributed generation as a Value Proposition delivered to stakeholders, namely the Utility and society, since FiT-based renewable energy businesses are often connected in a distributed power generation system that can elevate the voltage, facilitate the transmission to remote areas, and reduce transmission losses. It can also eliminate the need for costly investments on transmission and distribution for the Utility. By stabilising the power supply and allowing the opportunity to extend supply to remote communities, distributed generation constitutes a benefit for society under "the Social and Environmental Benefits of a Business Model (i.e. its positive impact)" (Ibid, p.286). Another "positive impact" for society (Ibid, p.286), as this research has indicated in section 6.2.2.4, is the creation of job opportunities and skills, by oil palm renewable energy businesses, in plant construction, operation and maintenance, and in the supporting services such as transport and repairs.

As highlighted in section 6.2.2.5, oil palm renewable energy businesses based on the FiT can mitigate pollution of the waterways by treating the palm oil mill effluent (POME), and reduce greenhouse gas (GHG) emissions by displacing fossil fuel-based power generation and capturing methane from POME which has a global warming potential of 21 times more than CO2. Reducing pollution and emission constitutes a social and environmental benefit of critical importance, as the Second Focus Group Meeting has emphasised that sustainable oil palm renewable energy businesses should *"address the environmental pollution of air and ground water in the vicinities of palm oil mills and landfills, where unused biomass may be disposed off. Currently villages may exist close to these facilities where the population has no options but to live with the situation".*

This research has indicated in section 6.2.3.2 that the 1.6% surcharge on the electricity bill of electricity consumers, other than domestic electricity consumers of less than 300kWh who are exempted, constitutes a negative outcome for society as a stakeholder.

Thus, it is a cost to society under "the Social and Environmental Costs of a Business Model (i.e. its negative impact)" (Ibid, p.286). In section 6.2.5.1, this research has concluded that an Energy Conservation Promotion Fund (ENCON Fund) , similar to Thailand's ENCON Fund, should be introduced in Malaysia to replace this 1.6% surcharge as a value destroyed for society. As was pointed out, the Fund would impose a levy on fossil fuel, and it would be fairer to tax the fossil fuel energy players who are the polluters, rather than collecting the 1.6% surcharge from society. This ENCON type of fund was initially regarded as a benefit to society but upon deliberation at the Second Focus Group Meeting, it was concluded *"the ENCON type of fund is more a cost to society than a benefit"* as the fossil fuel energy players are expected to pass through the levy to their consumers i.e. society.

It was highlighted in section 6.2.3.4 that transportation of biomass feedstock can also have severe negative impacts on environment and society, as excessive transportation can generate some amount of greenhouse gas (GHG) emissions that is harmful to the environment, and it can be adverse to society, particularly villagers, with all the lorries going through the rural areas. These negative impacts constitute part of "the Social and Environmental Costs of a Business Model (i.e. its negative impact)" (Ibid, p.286).

As the results of this research have indicated in section 6.2.5.2, the introduction of various activities to promote awareness of oil palm renewable energy among renewable energy investors, policy makers, financiers, and society as a whole will enable more existing assets, capabilities and resources of oil palm renewable energy to be capitalised, which otherwise would have been missed or wasted due to lack of awareness. Raising awareness of renewable energy is beneficial to society and environment as it will increase the deployment of renewable energy in Malaysia, thereby reducing greenhouse gas (GHG) emissions by displacing fossil fuel-based power generation and helping to improve the long-term energy security of Malaysia.

This research has highlighted in section 6.2.5.3 that the promotion of local technology and expertise can also enable more existing assets, capabilities and resources of oil palm renewable energy to be capitalised, which otherwise would have been missed or wasted due to lack of local technology and expertise. Hence, successful and sustainable oil palm renewable energy businesses would require operational technology and expertise that are largely local, as one of the Key Resources i.e. "what Key Resources do our Value Propositions require?" (Ibid, pp.55-56).

This research has also shown in section 6.2.5.4 that Combined Heat and Power (CHP) can create new positive values for oil palm renewable energy businesses by enabling them to capitalise on both the heat and power as a more efficient way to utilise energy. The heat from CHP, as a value wasted, can be utilised to reduce the fuel consumption for other processes, particularly through the integration of the renewable energy plants with palm oil mills so that the mills can then use the steam. Thus, CHP should be promoted in Malaysia in order to utilise the heat from CHP as a value wasted to satisfy the customer needs for heat, thereby constituting a new Value Proposition i.e. "which customer needs are we satisfying?”(Ibid, pp.43-44). Accordingly, the “Customer Segments” (Ibid, p.41) of successful and sustainable oil palm renewable energy businesses would include palm oil mills using this heat from CHP, the sale of which would form part of the “Financial Revenue Streams” (Ibid, p.51) of the businesses. The Customer Relationship i.e. “what type of relationship does each of our Customer Segments expect us to establish and maintain with them?” (Ibid, p.49) would be in the form of an agreement between the palm oil mill and the renewable energy plant.

In section 6.2.5.5, this research has shown that the introduction of a location-specific bonus tariff for the State of Sabah in East Malaysia can enhance distributed generation, and mitigate pollution and greenhouse (GHG) emissions through the displacement of diesel-based power generation in Sabah. As it can extend “the Social and Environmental Benefits of a Business Model (i.e. its positive impact)” (Ibid, p.286), the “Financial Revenue Streams” (Ibid, p.51) of sustainable oil palm renewable energy businesses should include a location-specific bonus tariff for Sabah.

This research has highlighted in section 6.2.5.6 that the green grid proposal, consisting of a network of collector sub-stations to be constructed close to clusters of palm oil mills in rural areas, can facilitate grid interconnection. The development of a green grid can facilitate the participation of palm oil mills in FiT-based renewable energy businesses by enabling them to connect to the respective collector sub-stations, rather than connecting all the way to the main grid. Hence, sustainable oil palm renewable energy businesses would require a grid infrastructure that includes the green grid in rural areas as the Channels i.e. “through which Channels do our Customer Segments want to be reached?”; “which ones work best?”; “which ones are most cost-efficient?” (Ibid, pp.47-48).

As this research has indicated in section 6.2.5.7, the residues of the biogas plant, namely belt press and dewatering press cakes, can be recycled back to the oil palm estates as bio-fertiliser. Boiler ash, a residue from the biomass plant, can also be converted into bio-fertiliser. As a value-added product, bio-fertiliser constitutes a value opportunity for oil palm renewable energy businesses based on the FiT in Malaysia. Thus, the Customer Segments i.e. “for whom are we creating value?” (Ibid, p.41) of sustainable oil palm renewable energy businesses would include oil palm plantations as users of the bio-fertiliser. In this regard, the Value Proposition i.e. “what value do we deliver to the customer?” (Ibid, pp.43-44) is the supply of eco-friendly bio-fertiliser to reduce the dependence on chemical fertilisers. The sale of this bio-fertiliser would form part of the “Financial Revenue Streams” (Ibid, p.51) of sustainable oil palm renewable energy businesses. The Customer Relationship i.e. “what type of relationship does each of our Customer Segments expect us to establish and maintain with them?” (Ibid, p.49) would be in the form of an agreement with the oil palm plantations.

This research has highlighted in section 6.3.2.1 that having a one-stop centre can communicate better all the relevant requirements and information to provide more clarity and certainty to renewable energy investors. The one-stop centre can also coordinate the processing of all the applications for licensing, planning, building and environmental approvals by the various regulatory departments. Accordingly, this research has concluded that a one-stop centre can constitute a strategy to overcome at least to some degree some of the regulatory and interconnection barriers, that can lead to an increased deployment of oil palm renewable energy in Malaysia. It was concluded during the Second Focus Group Meeting that the Sustainable Energy Development Authority (SEDA) should be assigned the tasks as the one-stop centre. Hence, the Key Partners i.e. “who are our Key Partners?”; “which Key Activities do partners perform?” (Ibid, pp.59-60) of successful and sustainable oil palm renewable energy businesses in Malaysia would include SEDA as a one-stop centre.

This research has indicated in section 6.3.2.2 that reviewing and extending some of the incentives can overcome at least to some degree the inadequacy of the incentives offered for oil palm renewable energy in Malaysia. As highlighted, some of the fiscal incentives should be extended beyond 2015 so that more players can participate in order to increase the deployment of oil palm renewable energy in the country. Thus, Pioneer Status and Import Duty exemption should be extended beyond 31st December 2015, as part of the “Financial Revenue Streams” (Ibid, p.51) of successful and sustainable oil palm renewable energy businesses in Malaysia.

As this research has shown in section 6.3.2.3, at least 50% up to 70% of the feedstock for biomass renewable energy businesses should come from their affiliated palm oil mills. In section 6.2.3.3, it was highlighted that renewable energy businesses largely dependent on third party feedstock suppliers are significantly exposed to long-term feedstock price fluctuation, which can adversely affect the long-term viability of these businesses. Hence, successful and sustainable FiT-based oil palm renewable energy businesses would require at least 50% of the feedstock supply to be internally generated, as one of the Key Resources i.e. “what Key Resources do our Value Propositions require?” (Ibid, pp.55-56).

For FiT-based oil palm renewable energy businesses to be successful in Malaysia, this research has indicated in section 6.3.2.4 the need for grid interconnection without delay and bureaucratic hassles to minimise transaction costs by simplifying legal, technical and financial processes. Therefore, in order to overcome at least to some degree the interconnection barriers as discussed in section 6.3.1.5 so as to increase the deployment of oil palm renewable energy in Malaysia, the Key Activities i.e. “what Key Activities do our Value Propositions require?” (Ibid, pp.57-58) should involve grid interconnection based on simple, clear and transparent requirements.

7.2.1 “Successful” and “Sustainable” FiT-based Oil Palm Biomass Business Models

The research findings, as summarised above, were incorporated into the Triple Bottom Line Canvas (Osterwalder & Pigneur, 2010) to *model* “Successful” and “Sustainable” FiT-based Renewable Energy Business Models for oil palm biomass in Malaysia to capture Economic, Environmental and Social value for a wide range of stakeholders, leading to an increased deployment of oil palm biomass renewable energy.

As discussed in section 3.6, this research adopts the "business model innovation" approach (Gauthier & Gilomen, 2015, p. 16) to offer a transition towards "Sustainable" and "Successful" FiT-based Business Models. The innovation process leading to the development of "Successful" and "Sustainable" Renewable Energy Business Models is illustrated below. Figure 7.1 shows the FiT-based Oil Palm Biomass Renewable Energy Business Models (*pre-innovation*) as discussed in section 3.4.1.

<table>
<tr>
<td rowspan="2">Key Partners

Distribution Licensees – TNB and SESB

Government Ministries and Agencies – KeTTHA and SEDA

Feedstock suppliers – Palm Oil Mills</td>
<td>Key Activities

Grid interconnection

Transport, handling, storage of Feedstock
Pre-treatment of Feedstock

Feedstock combustion and power generation</td>
<td rowspan="2">Value Propositions

Renewable Electricity generated, exported to the grid and sold to the Utility company</td>
<td>Customer Relationships
Renewable Energy Power Purchase Agreement (REPPA) between the Feed-in Approval Holder (renewable energy developer) and the Distribution Licensee (power Utility) for 16 years</td>
<td rowspan="2">Customer Segments
Distribution Licensee –SESB or TNB</td>
</tr>
<tr>
<td>Key Resources

Feedstock – Empty Fruit Bunches (EFB), Mesocarp Fibres, Palm Kernel Shells

Secure and long-term supply of Feedstock

Operation technology and expertise</td>
<td>Channels

Grid infrastructure</td>
</tr>
<tr>
<td colspan="2">Financial Cost Structure

Grid connection costs

Financing costs

Feedstock costs

Transportation of feedstock

Operational costs</td>
<td colspan="3">Financial Revenue Streams

FiT basic rate

FiT bonus rate for efficiency above 20%

Green Technology Financing Scheme's subsidy of 2% on the interest costs

Investment Tax Allowance allowing qualifying capital expenditure incurred from 25th October 2013 until the year of assessment 2020 to be offset against 70% of the statutory income in the year of assessment</td>
</tr>
</table>

Figure 7. 1 FiT-based Oil Palm Biomass Renewable Energy Business Models (*pre-innovation)*

Following the business model innovation, the "Successful" and "Sustainable" FiT-based Oil Palm Biomass Renewable Energy Business Models (*post-innovation*) is shown in Figure 7.2 below. Substantial innovations in the Business Model components, based on the findings of this research, are highlighted in red.

Key Partners

- Distribution Licensees – TNB and SESB
- Government Ministries and Agencies – KeTTHA and SEDA as a one-stop centre
- Palm Oil Mills - Feedstock suppliers and user of heat from CHP
- Plantations using the bio-fertiliser

Key Activities

- Grid interconnection based on simple, clear and transparent requirements
- Transport, handling, storage of Feedstock
- Pre-treatment of Feedstock
- Feedstock combustion and power generation

Key Resources

- Feedstock – Empty Fruit Bunches (EFB), Mesocarp Fibres, Palm Kernel Shells
- Secure and long-term supply of Feedstock with at least 50% internally generated
- Operation technology and expertise largely based on local technology and skill

Value Propositions

- Renewable Electricity generated, exported to the grid and sold to the Utility company, supporting distributed generation
- Management of Biomass Waste (environmental compliance and enhance the image of the oil palm industry)
- Bio-fertiliser
- Heat from Combined Heat and Power (CHP)

Customer Relationships

- Renewable Energy Power Purchase Agreement (REPPA) between the Feed-in Approval Holder (renewable energy developer) and the Distribution Licensee (power Utility) for 16 years
- Agreements with Palm Oil Mills and Plantations

Channels

- Grid infrastructure including the Green Grid in rural areas

Customer Segments

- Distribution Licensee – SESB or TNB
- Palm Oil Mill disposing its waste
- Plantations using the bio-fertiliser
- Palm Oil Mills using the heat from CHP

Financial Cost Structure

- Grid connection costs
- Financing costs
- Feedstock costs
- Transportation of feedstock
- Operational costs

Financial Revenue Streams

- FiT basic rate
- FiT bonus rate for efficiency above 20%
- Location-specific bonus tariff (Sabah)
- Sale of bio-fertiliser
- Sale of heat from CHP
- Green Technology Financing Scheme's subsidy of 2% on the interest costs
- Investment Tax Allowance extended beyond 31st December 2015 allowing qualifying capital expenditure incurred from 25th October 2013 until the year of assessment 2020 to be offset against 70% of the statutory income in the year of assessment and unutilized allowances can be carried forward until they are fully absorbed
- Pioneer Status and Import Duty exemption extended beyond 31st December 2015

Social and Environmental Costs

- Emissions from the transportation of feedstock
- ENCON type of fund replacing the 1.6% surcharge paid to the RE fund

Social and Environmental Benefits

- Pollution and Emission Reduction
- Distributed power generation and rural electrification
- Job and skill creation
- Awareness of renewable energy
- **Corporate Social Responsibility (CSR) initiatives (see section 7.3)**

Figure 7. 2 "Successful" and "Sustainable" FiT-based Oil Palm Biomass Renewable Energy Business Models (post-innovation)

7.2.2 “Successful” and “Sustainable” FiT-based Oil Palm Biogas Business Models

The research findings, as summarised in section 7.2 above, were then incorporated into the Triple Bottom Line Canvas (Osterwalder & Pigneur, 2010) to *model* “Successful” and “Sustainable” FiT-based Renewable Energy Business Models for oil palm biogas in Malaysia to capture Economic, Environmental and Social value for a wide range of stakeholders, leading to an increased deployment of oil palm biogas renewable energy.

Using the “business model innovation” approach (Gauthier & Gilomen, 2015, p. 16), the results of this research now offers a transition towards “Sustainable” and “Successful” FiT-based Oil Palm Biogas Renewable Energy Business Models, as illustrated below. Figure 7.3 shows the FiT-based Oil Palm Biogas Renewable Energy Business Models (*pre-innovation*) as discussed in section 3.4.2.

<table>
<tr>
<td rowspan="2">Key Partners

Distribution Licensees – TNB and SESB

Government Ministries and Agencies – KeTTHA and SEDA

POME supplier – Palm Oil Mill</td>
<td>Key Activities

Anaerobic digestion process and power generation

Grid interconnection</td>
<td rowspan="2" colspan="2">Value Propositions

Renewable Electricity generated, exported to the grid and sold to the Utility company</td>
<td>Customer Relationships
Renewable Energy Power Purchase Agreement (REPPA) between the Feed-in Approval Holder (renewable energy developer) and the Distribution Licensee (power Utility) for 16 years</td>
<td rowspan="2">Customer Segments
Distribution Licensee –SESB or TNB</td>
</tr>
<tr>
<td>Key Resources

Feedstock – Palm Oil Mill Effluent (POME)

Operation technology and expertise</td>
<td>Channels

Grid infrastructure</td>
</tr>
<tr>
<td colspan="3">Financial Cost Structure

Grid connection costs

Operational costs

Financing costs</td>
<td colspan="3">Financial Revenue Streams

FiT Basic rate

FiT rate for locally assembled technology

Green Technology Financing Scheme’s subsidy of 2% on the interest costs

Investment Tax Allowance allowing qualifying capital expenditure incurred from 25th October 2013 until the year of assessment 2020 to be offset against 70% of the statutory income in the year of assessment</td>
</tr>
</table>

Figure 7. 3 FiT-based Oil Palm Biogas Renewable Energy Business Models (pre-innovation)

Following the business model innovation, the “Successful” and “Sustainable” FiT-based Oil Palm Biogas Renewable Energy Business Models (*post-innovation*) is shown in Figure 7.4 below. Substantial innovations in the Business Model components, based on the findings of this research, are highlighted in red.

Key Partners	Key Activities	Value Propositions	Customer Relationships	Customer Segments
• Distribution Licensees – TNB and SESB • Government Ministries and Agencies – KeTTHA and SEDA as a one-stop centre • POME supplier – Palm Oil Mill • Plantations using the bio-fertiliser	• Anaerobic digestion process and power generation • Grid interconnection based on simple, clear and transparent requirements **Key Resources** • Feedstock – Palm Oil Mill Effluent or POME • Operation technology and expertise largely based on local technology and skill	• Renewable Electricity generated, exported to the grid and sold to the Utility company, supporting distributed generation • Management of POME Waste (environmental compliance and enhance the image of the oil palm industry) • Bio-fertiliser	• Renewable Energy Power Purchase Agreement (REPPA) between the Feed-in Approval Holder (renewable energy developer) and the Distribution Licensee (power Utility) for 16 years • Agreements with Palm Oil Mill and Plantations **Channels** • Grid infrastructure including the Green Grid in rural areas	• Distribution Licensee – SESB or TNB • Palm Oil Mill disposing its waste • Plantations using the bio-fertiliser

Financial Cost Structure	Financial Revenue Streams
• Grid connection costs • Operational costs • Financing costs	• FiT basic rate • Location-specific bonus tariff (Sabah) • FiT rate for locally assembled technology • Sale of bio-fertiliser • Green Technology Financing Scheme's subsidy of 2% on the interest costs • Investment Tax Allowance extended beyond 31st December 2015 allowing qualifying capital expenditure incurred from 25th October 2013 until the year of assessment 2020 to be offset against 70% of the statutory income in the year of assessment and unutilized allowances can be carried forward until they are fully absorbed • Pioneer Status and Import Duty exemption extended beyond 31st December 2015

Social and Environmental Costs	Social and Environmental Benefits
• ENCON type of fund replacing the 1.6% surcharge paid to the RE fund	• Pollution and Emission Reduction • Distributed power generation and rural electrification • Job and skill creation • Awareness of renewable energy • **Corporate Social Responsibility (CSR) initiatives (see section 7.3)**

Figure 7. 4"Successful" and "Sustainable" FiT-based Oil Palm Biogas Renewable Energy Business Models (post-innovation)

7.3 NORMATIVE REQUIREMENTS (Stubbs & Cocklin, 2008;Boons & Ludeke-Freund, 2013)

In the preceding sections 7.2.1 and 7.2.2, this research has modelled, using the Triple Bottom Line Canvas (Osterwalder & Pigneur, 2010), “Successful” and “Sustainable” FiT-based Oil Palm Renewable Energy Business Models for Malaysia. This section will continue with the sustainability modelling process by applying the fourth component of this research’s Conceptual Framework to ensure that the Business Models offered by this research satisfy the basic requirements for sustainability i.e. the Normative requirements (Stubbs & Cocklin, 2008 ; Boons & Ludeke-Freund, 2013).

As discussed in section 3.5.2, “the characteristics and components of a sustainable business model” (Stubbs & Cocklin, 2008, p. 123) should include, firstly, expressing the “purpose, vision and/or mission in terms of social, environmental, and economic outcomes” (Ibid, p.121). This research has concluded at the beginning of section 7.2 that the purposes of “Sustainable” FiT-based oil palm renewable energy businesses in Malaysia are:

- to manage palm oil milling wastes to comply with environmental regulations;
- to convert them into green energy for export to the grid to generate income;
- to reduce pollution and greenhouse gas (GHG) emissions;
- to diversify the supply options for power generation in Malaysia to reduce the dependency on fossil fuel;
- to enhance distributed generation particularly for rural electrification; and
- job and skill creation.

These purposes as stated above are consistent with the first requirement of a sustainable Business Model by Stubbs & Cocklin (2008).

The second requirement for sustainability of Stubbs & Cocklin (2008) requires “social and environmental indicators” to be reported together with “the financial indicators in an annual report” (Ibid, p.122). Hence, “Sustainable” FiT-based oil palm renewable energy businesses in Malaysia should disclose not only their financial performance but also their Social and Environmental Benefits and Costs. For guidance, this research has referred to the list of commonly-used indicators as set out in pages 51 to 68 of the Malaysian Stock Exchange’s Sustainability Reporting Guide (Bursa Malaysia, 2015 a). Accordingly, some of the “social and environmental indicators” (Stubbs & Cocklin, 2008, p. 122) of “Sustainable” FiT-based oil palm renewable energy businesses in Malaysia should include:

- total weight or volume of palm oil wastes managed or treated;

- amount of reduction in greenhouse gas (GHG) achieved from the avoidance of methane emission;
- total renewable energy produced (kWh);
- total renewable energy exported to the grid (kWh);
- amount of reduction in CO2 achieved from the displacement of fossil fuel in power generation;
- number of jobs created;
- average hours of training per annum per employee to develop their skill and knowledge;
- total weight of eco-friendly bio-fertiliser produced;
- negative impacts from the transportation of feedstock including emissions in tonnes of CO2

Reporting these indicators, as part of the requirements of a sustainable Business Model, is also consistent with the Malaysian Stock Exchange Listing Requirements for Companies listed on the Stock Exchange to disclose their "management of material economic, environmental and social risks and opportunities" in their annual report" (Bursa Malaysia, 2015), although these requirements are only applicable to Listed Companies.

The Business Models in sections 7.2.1 and 7.2.2 recognise that the success of the business is "inextricably linked to the success of its stakeholders, including local communities, suppliers, partners, employees, and customers" (Stubbs & Cocklin, 2008, p. 122). By giving proper consideration to the needs of "the relevant stakeholders" (Bursa Malaysia, 2015 a, p. 23), the "Sustainable" FiT-based Oil Palm Renewable Energy Business Models offered in sections 7.2.1 and 7.2.2 do satisfy the third normative requirement of Stubbs & Cocklin (2008). The Models have also acknowledged "nature as a stakeholder", and promote "environmental stewardship" by using renewable resources, minimising waste and pollution, and endeavouring to make "the whole supply chain sustainable" (Ibid, p122). Hence, they also satisfy the fourth normative requirement of Stubbs & Cocklin (2008) as discussed in section 3.5.2.

The fifth requirement of a sustainable Business Model, as Stubbs & Cocklin (2008) have proposed, requires the adoption of "systems perspective as well as the firm-level perspective" by developing "internal structural and cultural capabilities to achieve firm-level sustainability" and collaborating "with key stakeholders to achieve sustainability for the system that the organization is part of", which "requires changes in legislation and regulation", and "collaborative partnerships among stakeholders" (Ibid, p.122). The "Sustainable" FiT-based Oil Palm Renewable Energy Business Models in sections 7.2.1 and 7.2.2 are modelled to achieve "firm-level sustainability" as well as "sustainability for the system" through the proposed introduction of various "collaborative partnerships among stakeholders" and "changes in legislation and regulation", which include the following as summarised in section 7.2:

- the introduction of an Energy Conservation Promotion Fund (ENCON Fund);

- the introduction of various activities to promote awareness of oil palm renewable energy among renewable energy investors, policy makers, financiers, and society as a whole;
- the promotion of local technology and expertise;
- the promotion of Combined Heat and Power (CHP);
- the introduction of a location-specific bonus tariff for the State of Sabah in East Malaysia;
- the proposed development of a green grid;
- the promotion of bio-fertiliser as a value-added product.

These proposed collaborative actions and changes in legislation and regulation in the modelling of the "Sustainable" FiT-based Oil Palm Renewable Energy Business Models in sections 7.2.1 and 7.2.2 are consistent with the fifth normative requirement of Stubbs & Cocklin (2008).

Pursuant to their fifth normative requirement, Stubbs & Cocklin (2008) have also emphasised the need for a "community engagement strategy" to retain and reinvest capital in local communities (Ibid, p.117). This research concurs that in addition to job and skill creation benefiting the local communities, there should be Corporate Social Responsibility (CSR) initiatives in the form of "voluntary contributions made by an organisation to enhance socio-economic benefits and create a positive social impact" (Bursa Malaysia, 2015 a, p. 51). The "social and environmental indicators" (Stubbs & Cocklin, 2008, p. 122) of "Sustainable" FiT-based oil palm renewable energy businesses in Malaysia should include "total amount invested in the community" as part of the CSR initiatives (Bursa Malaysia, 2015 a, p. 51). Accordingly, the "Social and Environmental Benefits" of the "Sustainable" FiT-based Business Models in sections 7.2.1 and 7.2.2 should include Corporate Social Responsibility (CSR) initiatives to retain and reinvest capital in local communities, which is highlighted in green. During the presentation of the emergent findings at the 3rd International Green Workshop & Exhibition held on 4 & 5th October 2016 in Malaysia and organised by The Institution of Engineers Malaysia, the need for a community engagement strategy to retain and reinvest capital in local communities, as a component of "Sustainable" Renewable Energy Business Models, was well received by the audience.

As noted above, the "Sustainable" FiT-based Business Models in sections 7.2.1 and 7.2.2 provide "Social and Environmental Benefits" as well as "Financial Revenue Streams" and "Financial Cost Structure". Hence, the "Sustainable" FiT-based Business Models "provide both ecological or social and economic value through offering products and services" (Schaltegger, et al., 2015, p. 4), consistent with the model of sustainability of Boons and Ludeke-Freund (2013).

Boons and Ludeke-Freund (2013) have pointed out that in a sustainable Business Model, "the business infrastructure must be rooted in principles of sustainable supply chain management" (Schaltegger, et al., 2015, p. 4). As noted in section 7.2, the

"Sustainable" FiT-based Business Models in sections 7.2.1 and 7.2.2 can aid in generating wider sustainability across the full stakeholder network, particularly for palm oil mills as the feedstock suppliers by assisting them to dispose their milling waste efficiently and effectively to comply with environmental laws and regulations, and reducing their carbon footprint which in the long run will help to create a good image for the Malaysian palm oil industry. By doing so, it could help to enhance the sustainability of the feedstock supply chain. Furthermore, the "Sustainable" FiT-based Business Models acknowledge that excessive transportation of biomass feedstock can have severe negative impacts on environment and society as part of "the Social and Environmental Costs of a Business Model (i.e. its negative impact)" (Osterwalder & Pigneur, 2010, p. 286). To mitigate this negative impact in the supply chain, the "Sustainable" FiT-based Business Models in sections 7.2.1 require at least 50% of the feedstock for biomass renewable energy businesses to come from their affiliated palm oil mills, and as discussed in section 6.2.5.4, the best location to site a biomass power plant should be inside or in the vicinity of the affiliated palm oil mill, where significant quantities of palm oil wastes are available as low-cost feedstock for the power plant, and various process heating needs of the affiliated palm oil mill can be met using the heat produced from the biomass CHP system. Having at least 50% of the feedstock supply internally generated can also mitigate the exposure to long-term feedstock price fluctuation. Hence, this research argues that the "Sustainable" FiT-based Business Models are well "rooted in principles of sustainable supply chain management", in accordance with the model of sustainability of Boons and Ludeke-Freund (2013) (Schaltegger, et al., 2015, p. 4).

7.4 CONTRIBUTIONS TO KNOWLEDGE

This section discusses the contributions to knowledge that this research has offered. This research has made a further contribution to the knowledge of Renewable Energy Business Models, particularly Renewable Energy Business Models based on the FiT for oil palm renewable energy in Malaysia, by adopting and justifying the adoption of Osterwalder's Business Model Canvas (Osterwalder & Pigneur, 2010) as the framework to investigate and model FiT-based oil palm renewable energy businesses in Malaysia. This research has argued in section 3.3 that the Business Model Canvas approach is compatible with the adoption in this research of the IEA-RETD's definition of a Renewable Energy Business Model as "a strategy to invest in renewable energy technologies, which creates value and leads to an increased penetration of renewable energy technologies" (IEA-RETD, 2013, p. 15).

The literature search on Business Models has revealed that the number of publications on Business Models for renewable energy is very limited. Apart from Wustenhagen and Boehnke (2006), APEC Energy Working Group (2009), Okkonen and Suhonen (2010), Aslani and Mohaghar (2013), Richter (2013), and IEA-RETD (2013), nothing has yet been found on Renewable Energy Business Models. In fact, there is hardly anything yet on Renewable Energy Business Models based on the FiT for oil palm biomass and biogas in Malaysia or anywhere else. Hence, this research has offered a further contribution to the existing limited body of knowledge on Renewable Energy Business

Models by enhancing the understanding of Renewable Energy Business Models based on the FiT, particularly the FiT for oil palm biomass and biogas in Malaysia.

As the discussion in chapter 3.0 has shown, Economic, Environmental and Social sustainability is critical to the Malaysian oil palm renewable energy businesses based on the FiT, as sustainability efforts can increase productivity and lead to cost efficiencies, provide increased access to capital, locally and globally, and enhance brand value and reputation of palm oil producers who are linked to the sustainable oil palm renewable energy businesses. As discussed in section 3.5, the concept of sustainability has gained significant momentum over the recent years, with an increasing body of literature emerging on Business Models for Sustainability. However, as the literature search has revealed, an unequivocally supported approach to conceptualise Business Models for Sustainability is still missing.

This research has further contributed to this discourse on Business Models for Sustainability by offering a combination of multiple conceptualisation approaches, derived from a critical review of the current literature. It has combined in section 3.6 the normative requirements of Stubbs & Cocklin (2008) and Boons and Ludeke-Freund (2013), the Value Mapping Tool of Bocken, et al. (2013) and the Triple Bottom Line Business Model Canvas of Osterwalder & Pigneur (2010, p. 285) to develop a Conceptual Framework to investigate and model "Sustainable" Renewable Energy Business Models based on the FiT for oil palm biomass and biogas in Malaysia. In justifying the adoption of these multiple approaches, this research has argued that the System dynamics-based Business Models for Sustainability (Abdelkafi & Tauscher, 2015) relying on the values-beliefs-norms (VBN) theory, and the Strongly Sustainable Business Model Canvas (Jones & Upward, 2014) are not practical for business modelling due to their complexity. The Conceptual Framework was then extended to incorporate the IEA-RETD (2013, p.36) approach to "successful business models", resulting in a Conceptual Framework to investigate and model "Successful" and "Sustainable" FiT-based Oil Palm Renewable Energy Business Models for Malaysia that can capture Economic, Environmental and Social value for a wide range of stakeholders, leading to an increased deployment of oil palm renewable energy.

This research argues that the Conceptual Framework has generated Business Models which satisfy the universal definition of a Business Model that Roome & Louche (2015) have pointed out. As highlighted in section 3.2.1, there is still no consensus on "What is a Business Model, Really?" (Casadesus-Masanell & Ricart, 2011). Roome & Louche (2015, p.4) have pointed out that "despite this ambiguity, four core characteristics of business models emerge from the literature", namely "*value proposition*, referring to the value embedded in the product/service offered by the firm; *value network*, referring to the relationships with the network including customers, suppliers, and other actors; *value capture*, referring to costs and revenue streams; and *value creation and delivery*, referring to the key activities, resources, channels, technology, and patterns that create value and the way value is then (re)distributed." Clearly, the Business Models generated by the Conceptual Framework, as illustrated in sections 7.2.1 and 7.2.2, do possess the four core characteristics to satisfy the universal definition of a Business Model that Roome & Louche (2015) have pointed out : (1) "*value proposition"* -Value Propositions; (2) "*value network"* – Customer Relationships, Customer Segments, Key Partners; (3) "*value capture"*- Financial Cost Structure, Financial Revenue Stream ; and (4) "*value creation and delivery"*- Key Activities, Key Resources, Channels.

This research also argues that the Conceptual Framework has generated Business Models for Sustainability that satisfy the general concept of sustainable business models as exemplified in the literature. As discussed in the literature review in section 3.5.3, Abdelkafi and Tauscher (2015, p.3) note that although so far no study has offered "sufficient answers to the question what a sustainable business model might be", there is general agreement among researchers on "the creation of customer and social value and on the integration of social, environmental, and business activities". In section 3.5.4, the Strongly Sustainable Business Model Ontology of Upward and Jones (2015) has defined a strongly sustainable firm as "one that creates positive environmental, social, and economic value throughout its value network, thereby sustaining the possibility that human and other life can flourish on this planet forever" (p.7), and reconceptualised the definition of a Business Model "as a systemic model of necessary and sufficient concepts" that "explicitly consider the relationship of a business with the natural environment, society, and economy in which the business is situated and interconnected and on which the business is ultimately dependent, and with all the individuals involved in that business" (Ibid, pp.9-10). In the case of Roome and Louche (2015, p.3), the authors note that "it is also necessary to take account of the question of value destruction". According to them, "a business model that contributes to sustainable development might realistically be expected to mitigate the destruction of value in and on society and its environment", and "knowing what value is being destroyed and taking steps to reduce or mitigate those impacts is as important to a business model for sustainability as the creation of value for the firm and society" (Ibid, p.3). They "add a fifth element to this framework – *value destruction*" (Ibid, p.13).

The Business Models for Sustainability offered by this research in sections 7.2.1 and 7.2.2 have incorporated the fifth element of Roome and Louche (2015): *"value destruction"* - Social and Environmental Costs, and Social and Environmental Benefits. Clearly, the models have created "customer and social value" and integrated "social, environmental, and business activities" (Abdelkafi & Tauscher, 2015, p. 3). The models have created "positive environmental, social, and economic value throughout its value network" (Upward & Jones, 2015, p. 7) and explicitly considered "the relationship of a business with the natural environment, society, and economy in which the business is situated and interconnected and on which the business is ultimately dependent, and with all the individuals involved in that business" (Ibid, pp.9-10). As such, the Conceptual Framework has generated Business Models for Sustainability that satisfy the general concept of sustainable business models which have emerged from the literature.

As illustrated in sections 7.2 and 7.3, the Conceptual Framework to investigate and model "Successful" and "Sustainable" FiT-based Oil Palm Renewable Energy Business

Models for Malaysia, has considerably advanced the knowledge on embedding sustainability in renewable energy businesses and the knowledge for overcoming at least to some degree the barriers facing them, particularly for FiT-based oil palm renewable energy businesses in Malaysia. To embed sustainability in renewable energy businesses as this research has highlighted in section 7.3, the purpose, vision and mission of "Sustainable" FiT-based oil palm renewable energy businesses should not focus solely on income generation from power generation. The purposes as concluded in section 7.2 should include management of wastes, pollution and emission reduction, energy diversity for the nation, enhancement of distributed generation particularly for rural electrification, and job and skill creation. Section 7.3 has emphasised that these businesses should also disclose in their annual report:

- total weight or volume of palm oil wastes managed or treated;
- amount of reduction in greenhouse gas (GHG) achieved from the avoidance of methane emission;
- total renewable energy produced (kWh);
- total renewable energy exported to the grid (kWh);
- amount of reduction in CO2 achieved from the displacement of fossil fuel in power generation;
- number of jobs created;
- average hours of training per annum per employee to develop their skill and knowledge;
- total weight of eco-friendly bio-fertiliser produced;
- negative impacts from the transportation of feedstock including emissions in tonnes of CO2
- total amount invested in the community as part of their CSR initiatives

In section 3.5.1, the concept of "sustainability management" was discussed and defined as "approaches dealing with social, environmental, and economic issues in an integrated manner to transform organizations in a way that they contribute to the sustainable development of the economy and society" (Schaltegger, et al., 2015, p. 2). The "Successful" and "Sustainable" FiT-based Oil Palm Renewable Energy Business Models offered by this research have dealt with the "social, environmental, and economic issues" under the six (6) key sustainability factors identified from the literature review in chapter 2.0, namely sustainability of biomass supply chain, sustainability of renewable energy technology, sustainability of grid network system, sustainability of the FiT scheme for oil palm biomass/biogas, environmental sustainability, and Combined Heat and Power (CHP). As this research has shown in sections 7.2 and 7.3, "Successful" and "Sustainable" FiT-based Oil Palm Renewable Energy Business Models can capture Economic, Environmental and Social value for a wide range of stakeholders and increase the deployment of oil palm renewable energy in Malaysia through:

- the introduction of an Energy Conservation Promotion Fund (ENCON Fund);
- the introduction of activities to promote awareness of oil palm renewable energy;

- the promotion of local technology and expertise;
- the promotion of Combined Heat and Power (CHP);
- the introduction of a location-specific bonus tariff for Sabah in East Malaysia;
- the development of a green grid;
- the promotion of bio-fertiliser as a value-added product;
- a One-stop Centre to coordinate the processing of all the project applications;
- grid interconnection based on simple, clear and transparent requirements;
- having at least 50% of the feedstock supply internally generated.

In this regard, the concept of "sustainability management" of oil palm renewable energy businesses in Malaysia has been enhanced and advanced through this research.

Having at least 50% of the feedstock supply internally generated, as stated above, can also mitigate the exposure to long-term feedstock price fluctuation, as well as mitigating the negative impact from excessive transportation in the feedstock supply chain. Hence, this research has emphasised that "Sustainable" and "Successful" FiT-based oil palm biomass renewable energy businesses should have ownership or control of at least 50% of their biomass feedstock from their affiliated palm oil mills, as a strategy to overcome at least to some degree the barrier of feedstock supply as discussed in section 6.3.1.3. As highlighted in section 5.4.7.3, *"at the minimum, they should have 50%"* and *"maybe we should make this as part of the future roles for FiT"* , and in the case of *"biogas, the applicant must be either the oil mill owner or he must have some majority share inside there…rather than third parties come and do"* (Official 1). In this regard, this research has contributed significantly to the knowledge on how to manage FiT-based oil palm renewable energy businesses "sustainably" and "successfully". However, the Second Focus Group Meeting has cautioned that this requirement *"is not incorporated as a key criterion now"* in the FiT scheme, and *"so will need complex discussions and agreement by the stakeholders involved"* before SEDA imposes it as a requirement to qualify for the FiT.

Another significant contribution to knowledge from this research relates to the transportation of feedstock. As discussed in section 6.2.3.4, the low energy density of biomass feedstock tends to limit the distance that is economical to transport oil palm empty fruit bunches (EFB), and it was found to be uneconomical to transport feedstock over long distances exceeding 50 km. At the Second Focus Group Meeting, it was noted and acknowledged that majority of the participants in this research disagreed with centralised large-scale biomass power generation mainly due to the feedstock logistical hurdles as discussed in section 5.4.5.5. As one focus group member has commented, *"normally centralised large-scale renewable energy plants are unrealistic due to the need for large scale feedstock supply. Transport of such feedstock, without pre-treatment to reduce its volume, is costly and causes high emissions."* Thus, as this research has concluded and contributed to the knowledge of sustainable feedstock management, "Sustainable" and "Successful" oil palm biomass power generation should be decentralised, preferably at locations within 50 km from the source of the feedstock, and centralised large-scale oil palm biomass power generation should be avoided.

As the literature search has revealed, the “Successful” and “Sustainable” FiT-based Oil Palm Renewable Energy Business Models offered at the conclusion of this research in sections 7.2 and 7.3 are the first of its kind using the Business Model approach to study, advance and embed sustainability in oil palm renewable energy businesses based on the FiT. Therefore, this research has contributed significantly to the very limited body of knowledge on Sustainable Business Models for oil palm renewable energy businesses based on the FiT. Although the findings and conclusions of this research are specifically tailored to FiT-based oil palm renewable energy businesses in Malaysia, other types of FiT-based renewable energy businesses in Malaysia may also find the knowledge contributed by this research useful to them for embedding sustainability and for overcoming at least to some degree the barriers facing their businesses. Furthermore, the knowledge contributed by this research will benefit not only Malaysia but also other palm oil producing nations wishing to embark on a similar FiT scheme.

Generalisability or transferability refers to “the degree to which the results of qualitative research can be generalised or transferred to other contexts or settings” (Kumar, 2011, p. 205). It should be noted that the generalisability of the current research findings is limited to the specific Malaysian context, particularly Malaysia’s FiT scheme for biomass and biogas. Other types of FiT-based renewable energy businesses in Malaysia such as solar PV, small hydro and geothermal (SEDA, 2015a) have different circumstances, practices and regulatory requirements, and are subject to different sustainability factors. These contextual differences should be taken into account when trying to apply the “Successful” and “Sustainable” Business Models to other types of FiT-based renewable energy businesses in Malaysia. Likewise, other palm oil producing nations such as Thailand and Indonesia have different circumstances, and different FiT schemes involving different legal and regulatory requirements. Hence, the contextual differences, particularly differences in the sustainability factors as discussed in chapter 2.0, should be taken into consideration when attempting to generalise the results of this research to neighbouring Thailand and Indonesia. The “robustness” of the Business Models offered at the conclusion of this research in sections 7.2 and 7.3 should be tested “by exposing them to other research settings in a follow-up study” (Saunders, et al., 2009, p. 158). In this regard, future research could be directed towards investigating and modelling “Successful” and “Sustainable” oil palm renewable energy businesses based on the FiT in neighbouring Thailand and Indonesia.

According to (Kumar, 2011, p. 205), transferability can be enhanced “if you extensively and thoroughly describe the process you adopted for others to follow and replicate”. This research has set out in detail the process adopted to investigate and model “Successful” and “Sustainable” FiT-based Oil Palm Renewable Energy Business Models for Malaysia. Hence, the generalisability or transferability of the current research findings is greatly enhanced by enabling other researchers to follow and replicate this study. As part of the research process, this study has reviewed the theories of Business Models to develop a

Conceptual Framework in chapter 3.0, and then described the application of this Conceptual Framework to investigate and embed sustainability in chapters 5.0, 6.0 and 7.0. Other researchers can now replicate this process or adopt this Conceptual Framework to investigate and embed sustainability in business. As discussed in section 2.5.5, the oil palm cultivation industry has come under attack over claims of loss of biodiversity and increase in greenhouse gas emissions (Sharaai, et al., 2015). To address these serious concerns on the environmental sustainability of oil palm, this research can and should be replicated to investigate and model “Sustainable” Business Models for oil palm cultivation in Malaysia, Indonesia and Thailand.

In investigating oil palm renewable energy businesses based on the FiT in Malaysia, this research has also focused on Malaysia’s FiT scheme for biomass and biogas. As discussed earlier in chapter 2.0, the Cumulative Installed Capacity of Biomass Plants as at 1st September 2016 has reached only 68.40 MW (SEDA, 2016). The Cumulative Installed Capacity for Biogas (Landfill / Agricultural Waste) until September 2016 is only 18.88 MW. These achieved capacities are already far off the 2015 targets set in the Tenth Malaysian Plan (2011 -2015), namely 330 MW of biomass renewable energy (including other solid wastes) and 100 MW of biogas renewable energy (landfill/agricultural waste/other biogas). Furthermore, under the FiT scheme, biomass is targeted to contribute 800 MW of grid connected electricity by the year 2020 (Umar, et al., 2013). By also investigating the issues and challenges confronting the scheme, leading to conclusions and recommendations for the stakeholders including policy makers and renewable energy developers, this research can help address the huge disparity between the achieved and targeted generation capacities, and hence this research has further contributed to the understanding and advancement of the FiT scheme in Malaysia, as summarised below.

Firstly, to advance the FiT scheme in Malaysia, this research has concluded in section 6.3.2.1 that there should be a one-stop centre in Malaysia to coordinate the processing of the various applications by renewable energy developers to the various regulatory departments for licensing, planning, building and environmental approvals. The Second Focus Group Meeting has suggested that SEDA should be the one-stop centre. SEDA should also function as a one-stop center entrusted with *“the power and expertise to guide and assist the project developer”* (Manager 1) in respect of the various regulatory approvals for the oil palm renewable energy project.

Secondly, as section 6.3.1.1 has indicated, SEDA lacks the clout *“to spearhead Malaysia’s quest into the development of renewable energy”* especially on *“issues with Utility”* (Manager 1). This research has highlighted In section 6.3.2.4 that *“it should be the role of the regulator to make sure that it is clear what the rules are”* (Academic 3). There should be “clear and transparent grid interconnection rules” (Jacobs, 2010, p. 10), which *“should be monitored by the Energy Commission, to whom the developer can complain”* (Academic 3). Sen & Ganguly (2016, p. 9) have emphasised that “transparent and streamlined procedures can reduce transaction costs”. As the authors have rightly pointed out, policies that protect the monopoly or near-monopoly transmission and distribution of the Utilities would make “the way of renewable energy very difficult” (Ibid, p.6). Hence, this research has concluded that there should be simple, clear and transparrent grid interconnection rules to overcome at least to some degree the interconnection barriers as discussed in section 6.3.1.5 and for the regulator *“to direct from the top and oversee the Utility”* (Academic 1).

Thirdly, this research has highlighted in section 6.2.4.1 that the imposition of FiT quotas or caps on the amount of installed capacities available annually may result in value being missed or wasted when FiT applicants are unsuccessful due to insufficient allocations and thus, fail to capitalise on their existing assets, capabilities and resources. Annual quotas are imposed annually as the FiT’s funding source is limited to the 1.6% surcharge on electricity bill. To advance the FiT scheme in Malaysia, this research in section 6.2.5.1 has supported the introduction of an ENCON type of fund to increase the funding and allow more renewable energy developers to participate.

Fourthly, as highlighted in section 6.3.1.4, the National Biomass Strategy 2020 can have a negative impact as some of the higher-value downstream uses envisioned by the Strategy such as bioethanol (biofuel) and bio-based chemicals are still uncertain. These uncertainties in the downstream market can create a wait and see situation that can reduce the availability of biomass for power generation and drive up the cost (Chiew, et al., 2011). To ensure the success of FiT-based oil palm renewable energy businesses in Malaysia, the National Biomass Strategy 2020 should be reviewed to complement the FiT scheme rather than hindering it (Sen & Ganguly, 2016), as this research has concluded in section 6.3.1.4.

Fifthly, to advance the FiT scheme in Malaysia, the *“incentives should be reviewed from year to year”* (Manager 1), and *“because of that feedstock risk,….biomass power plants should be given extra compensation for that risk”* (Utility Officer 2), as this research has highlighted in section 6.3.2.2. Bong, et al. (2016, p. 9) have suggested that “the government must ensure that a reasonable profit can be obtained through the FiT rates over a certain period of time” to ensure the success of the FiT scheme. As this research has concluded in section 6.3.2.2, reviewing and extending some of the incentives can overcome at least to some degree the inadequacy of the incentives offered for oil palm renewable energy in Malaysia, including extending some of the fiscal incentives such as Pioneer Status and Import Duty exemption beyond 31st December 2015.

As the literature review in chapter 2.0 has revealed, the FiT in Malaysia is still fairly new with only a small amount of peer-reviewed literature currently available on its performance, particularly on the FiT for oil palm biomass and biogas. Muhammad Sukki, et al. (2014) have reviewed the Malaysian FiT one (1) year after its implementation, focusing generally on renewable energy in Malaysia as a whole, and Umar, et al. (2014a) have explored some of the key barriers to the deployment of oil palm biomass renewable energy that remain unaddressed by the FiT scheme. Wong, et al. (2015, p.43) have discussed “the latest development of the FiT mechanism in Malaysia” and “its role in stimulating the growth in the renewable energy sector in Malaysia”, but “with the special focus on solar energy sector". Petinrin & Shaaban (2015) have discussed the potential of renewable energy in Malaysia, the initiatives and incentives to promote them, and the challenges to their deployment, focusing on renewable energy in Malaysia as a whole - hydropower, biomass and solar energy, biofuel and biodiesel, and wind generation. Yatim, et al. (2016) have reviewed the evolution of energy policies in Malaysia and highlighted the challenges facing the deployment of renewable energy in general. Sharaai, et al. (2015) have discussed the challenges facing the conversion of palm oil mill effluent (POME) to biogas for power generation in Malaysia and suggested the appropriate measures to promote its development. Guided by the work of Umar, et al. (2014b), Aghamohammadi, et al. (2016) have investigated the sustainability of power generation from oil palm biomass in the State of Sarawak, East Malaysia by conducting a survey among the palm oil millers there. Hence, apart from Umar, et al. (2014a), Umar, et al. (2014b), Sharaai, et al. (2015) and Aghamohammadi, et al. (2016), the availability of existing peer-reviewed literature focusing mainly on the FiT for oil palm biomass and biogas in Malaysia appears to be very limited.

With only a small amount of peer-reviewed literature currently available on the subject, this research, by enhancing the understanding of the FiT scheme to advance it, has clearly contributed to the existing limited body of knowledge on the performance of the FiT in Malaysia, particularly for oil palm biomass and biogas. The contribution to knowledge from this research will benefit not only the government and its regulatory agencies, and renewable energy developers in Malaysia but also key stakeholders in other palm oil producing nations wishing to embark on a similar FiT scheme.

7.5 CONTRIBUTIONS TO PRACTICE

As discussed in section 3.3, identifying, analysing and understanding key features and aspects of Renewable Energy Business Models "can promote commercialization and diffusion of related technologies" in the industry, and help "managers, investors and policy makers to study different aspects of business in the Renewable Energy industry" (Aslani & Mohaghar, 2013, p. 570). This research has investigated the Business Models from the perspectives of its key stakeholders, which include the government and its regulating agency, and renewable energy developers. The "Successful" and "Sustainable" Business Models offered at the conclusion of this research can guide and offer recommendations for these key stakeholders, particularly the government, SEDA and renewable energy developers, to make informed and appropriate policy or business decisions pertaining to the FiT for oil palm renewable energy in Malaysia. Hence, the findings and conclusions from this research, as discussed above, also have important implications for practice for the government, SEDA and renewable energy developers.

Findings from this research which may have important implications for practice include the promotion of biomass Combined Heat and Power (CHP) system. As this research has highlighted in section 6.2.5.4, the best location to site a biomass power plant should be inside or somewhere in the vicinity of an affiliated palm oil mill, where significant quantities of palm oil wastes are available as low-cost feedstock for the power plant, and various process heating needs of the affiliated palm oil mill can then be met using the heat produced from the biomass CHP system. This research has concluded that, instead of operating standalone, a biomass plant should operate on a CHP mode, integrated with the affiliated palm oil mill either as an extension or upgrade to convert the mill into a bio-refinery as Garcia-Nunez, et al. (2016) and Shukery, et al. (2016) have advocated. The Second Focus Group Meeting has also endorsed this bio-refinery concept for palm oil mills in Malaysia through "*the amalgamation of the POME biogas for power generation that can be combined with the biomass generation".*

Another research finding that has important practical implication is the promotion of bio-fertiliser as a value added product. According to Shukery, et al. (2016, p.2121), "a sustainable and integrated bio-refinery" can generate higher value-added products and "also benefit the surrounding community". As the "Successful" and "Sustainable" Business Models in section 7.2 have shown, FiT-based oil palm renewable energy businesses should generate eco-friendly bio-fertiliser as a higher value added product, by blending the biogas belt press and dewatering press cakes with the biomass boiler ash and then recycling them back to the oil palm estates as fertiliser in "*transforming the entire palm oil into zero waste discharge from the mill"* (Academic 1).

7.6 SUMMARY

This chapter has concluded the research and addressed its aim by offering in section 7.2 "Successful" and "Sustainable" FiT-based Oil Palm Renewable Energy Business Models for Malaysia that can capture Economic, Environmental and Social value for a wide range of stakeholders, leading to an increased deployment of oil palm renewable energy. In section 7.3, the characteristics and components of these Business Models have been laid out, followed by the discussion of the contributions that this research has made to both knowledge and practice.

As Petinrin & Shaaban (2015, p.980) have stated, "the prospect and vision of renewable energy is tremendously bright in Malaysia if all the stakeholders cooperate and collaborate synergistically to make the vision a reality". According to Yatim, et al. (2016, p. 9), stakeholders in the Malaysian renewable energy industry "appear to be less organized and under-represented" except for those in the solar photovoltaic industry. An oil palm renewable energy association should therefore be set up in Malaysia to represent and voice the "collective views, interests and concerns" (Ibid, p.9) of its members.

The findings, conclusions and recommendations of this research can facilitate stronger cooperation and collaboration between the key stakeholders in Malaysia to propel the growth of FiT-based oil palm renewable energy businesses in the country. As discussed in section 7.3, the "Successful" and "Sustainable" FiT-based Oil Palm Renewable Energy Business Models in sections 7.2.1 and 7.2.2 are modelled to achieve "firm-level sustainability" as well as "sustainability for the system" through the proposed introduction of various "collaborative partnerships among stakeholders" and "changes in legislation and regulation". Hence, there should be collaborative partnership between the government and other key stakeholders involving the necessary changes in legislation and regulation for the following initiatives that this research has highlighted:

- the introduction of an Energy Conservation Promotion Fund (ENCON Fund);
- the introduction of various activities to promote awareness of oil palm renewable energy among renewable energy investors, policy makers, financiers, and society as a whole;
- the promotion of local technology and expertise;
- the promotion of Combined Heat and Power (CHP);
- the introduction of a location-specific bonus tariff for the State of Sabah in East Malaysia;
- the proposed development of a green grid;
- the promotion of bio-fertiliser as a value-added product.

As stated earlier, the "Successful" and "Sustainable" FiT-based Oil Palm Renewable Energy Business Models offered at the conclusion of this research are the first of its kind using the Business Model approach to study, advance and embed sustainability in oil palm renewable energy businesses based on the FiT. In constructing these models, this research has adopted Osterwalder's Business Model Canvas (Osterwalder & Pigneur, 2010) as the framework to investigate and model FiT-based oil palm renewable energy businesses in Malaysia, and argued that the Business Model Canvas approach is compatible with the adoption in this research of the IEA-RETD's definition of a Renewable Energy Business Model. However, as pointed out earlier, an unequivocally supported approach to conceptualise Business Models for Sustainability is still missing. Upward and Jones (2015, p.18) have contended that, although "the Business Model Canvas has shown to be quite powerful as a tool for formulating profit-normative business models", it "may leave their users exposed to material risks and missed opportunities due to overlooking the inherent ecological, social, and economic entailments of all business models". In this regard, future research on Renewable Energy Business Models for Sustainability should examine the "ecological, social and economic" factors that this research might have overlooked and thus, need further investigation.

It should also be noted that the generalisability of the current research findings is limited to the specific Malaysian context and thus, the contextual differences should be taken into account when trying to apply the "Successful" and "Sustainable" FiT-based Oil Palm Renewable Energy Business Models to other countries. In order to enhance the external validity of the proposed Business Models, future research could be directed towards investigating and modelling oil palm renewable energy businesses based on the FiT in other oil palm producing nations with a FiT scheme similar to Malaysia, such as in neighbouring Thailand and Indonesia.

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APPENDIX A

INTERVIEW GUIDE

1) Briefly describe what you do.

2) Why is the business here in the first place? What is the product or service offered by the company or business unit? What is the primary reason for the existence of the business?

3) What value is created for the different types of stakeholders? What positive value is created and what negative value do all the stakeholders mitigate?
Probe: What value is captured or created for the Customer (SESB/TNB), Network Actors (RE developers/Consultants), Society, Government (KeTTHA/SEDA) and Environment?

   Probe: What are your views on the adequacy of the FiT to mitigate the emission of POME methane, which <u>has a global warming potential of 21 times or more than CO 2?</u>

   Probe: What are your views on the existing financing schemes and fiscal incentives – Green Technology Financing Scheme, Pioneer Status, Investment Tax allowance, and Import Duty and Sales Tax Exemption? <u>Probe: Should these incentives be extended beyond 2016?</u>

4) What is the value destroyed or missed or negative outcomes for any of the stakeholders? Is the business missing an opportunity to capture value, or squandering value in its existing operations? Are assets, capacity and capabilities under-utilised?
Probe: What is the value destroyed for the Customer (SESB/TNB), Network Actors (RE developers/Consultants), Society, Government (KeTTHA/SEDA) and Environment?

   Probe: What is the value missed for the Customer (SESB/TNB), Network Actors (RE developers/Consultants), Society, Government (KeTTHA/SEDA) and Environment?

   Probe: What are your views on the value missed in respect of Combined Heat and Power?

   Probe: What are your views on the value missed in respect of the conversion of by-product from the biogas plant into eco- friendly bio-fertiliser?

5) What new positive value might the network create for its stakeholders through introduction of activities and collaborations?
Probe: What is your view on the Energy Conservation and Promotion Fund (ENCON FUND) of Thailand as a funding mechanism to promote renewable energy? <u>Thailand</u>

*established in 1992 the **ENERGY CONSERVATION PROMOTION FUND (ENCON Fund)**, funded through a tax on all petroleum sold in the country, to provide financial incentives to promote energy conservation, energy efficiency and renewable energy. The ENCON fund supports:*

- *RENEWABLE ENERGY AND RURAL INDUSTRY- The efficient use of renewable technology to displace fossil fuel by providing full operational cost and interest subsidies for rural manufacturing and processing facilities utilizing agro-industrial residues (biomass and biogas) to generate renewable energy. It has been successful in encouraging the deployment of biogas renewable technology in the rural agro-industrial sector.*

- *INDUSTRY LIAISON - The development of the Thai market for energy efficient or renewable energy equipment through technical and financial support.*

- *RESEARCH AND DEVELOPMENT - Research and Development by government agencies and academic institutions to develop new technologies or improving existing technologies with emphasis on small-scale demo projects and dissemination of technical information.*

Probe: What is your view on the bonus tariff for specific regions that are less developed similar to the special "adders" for three (3) southern Thai provinces? In Thailand, tariffs differ by type of technology, installed capacity and locations. Special Adders are paid for three (3) southernmost Thai provinces and for off-grid areas relying on diesel plants for electricity. Special Adders for rural areas that rely on diesel-powered electricity generation can help promote the deployment of renewable electricity in these areas to displace the use of expensive diesel in electricity generation.

Probe: What is your view on the UK FiT for off-grid (consumed on-site) biogas-based power generation? FiT for renewable electricity was only introduced in the United Kingdom in April 2010 to support small-scale renewable electricity generation up to 5 MW. Tariffs are payable for electricity whether used on-site or exported to the grid. However, there is an additional payment or "export tariff" for any power exported to the grid In addition to the "generation tariff".

Probe: What is your view on a system of differentiated tariffs for peak, medium and low periods where the tariffs in the peak period are higher than the off-peak period?

6) What are the barriers for realisation of oil palm renewable energy in Malaysia?
Probe: What are your views on the Sustainable Energy Development Authority (SEDA)?

Probe: What do think about the overall policy framework for biomass and biogas?

Probe: How do you find the current status of implementation in Malaysia?

Probe: What are your views on the long-term availability (supply security and seasonal fluctuation) of biomass feedstock? How much internal feedstock should a biomass plant operator own and control?

Probe: What are your views on using biomass for centralised generation in large scale biomass power plant and what issues do you foresee in doing so?

Probe: How does the National Biomass Strategy affect the availability and pricing of feedstock?

Probe: What are currently the issues and problems with grid interconnection in Malaysia? How should the interconnection costs be shared?

7) What are the potential strategies to overcome- at least to some degree- the barriers for realisation of oil palm renewable energy in Malaysia?

8) What are the recommendations for the stakeholders including policy makers and investors?

Probe: Whether the Malaysian policy and incentives have a reach and a plan that is clear enough for the renewable energy project developers to act on so that they can have sufficient time to actually develop their project and know what kind of incentives they will be entitled to.

APPENDIX B

SUMMARY OF DATA FINDINGS

Table B. 1 Summary of Illustrative Extracts on “Purpose of FiT-based businesses”

ILLUSTRATIVE EXTRACTS	
Manager 2	“*……to export the power that we generate……. for a revenue for the company”.*
Manager 3	*“One is dealing with power generation and the second part is dealing with compliance to Department of Environment in Malaysia”*
Utility Officer 1	“*reduce the Green House Gas emission, air pollution”*
Academic 2	*“…diversify the energy.... In the long-term energy security.”*
Official 1	*“…. there is so much of waste. Palm oil mill effluent is releasing methane gas into the atmosphere…. And biomass is also piling up at the mills…. So rather than becoming a problem to the millers and also to the plantation owners…… this has become a source for renewable energy”.*
Official 3	“*First of all, to increase the local energy security. Secondly, to increase the biomass value. The local biomass value. Thirdly, to increase the local career opportunities”.*

Table B. 2 Summary of illustrative extracts on “Income”

ILLUSTRATIVE EXTRACTS	
Academic 2	“*You get a good income…So from this you can create more wealth from your biomass and biogas”.*
Consultant 2	*“…earn some profit from this FiT”.*
Manager 2	*“…it is also a source of income, revenue as well”*
Consultant 3	“*….you get back some return in term of your investment.”*
Utility Officer 3	*“…a form of revenue”.*
Utility Officer 1	*“…profit margin is one incentive, the other is a fact that because it is renewable energy, the government gives tax, fiscal incentives”.*

Table B. 3 Summary of illustrative extracts on “Waste Management”

ILLUSTRATIVE EXTRACTS	
Academic 2	“*They have heaps of the biomass which they have to handle*”.
Consultant 2	“*Waste treatment...they need to treat the waste*”.
Consultant 3	“*…we are talking about palm oil mill waste, with Environmental Laws becoming stricter now, so whether you like it or not, you have to do something*”.
Utility Officer 1	*“…waste disposal more efficient and effective…Effectively manage their waste without going into the landfills and dumping.” ; “…. reduce your cost of waste disposal, you get image as well as CSR benefits of creating a clean environment”.*
Manager 2	“*But now with the biomass boiler, we are able to get rid of this biomass in a very sustainable way…And whereas for biogas, I think we can also see how Palm Oil Mill Effluent, POME… it is getting us closer, easier to comply to the environmental requirements before we discharge the treated water”.*
Utility Officer 3	“*…affluent from the mill also is managed to certain extent*”.

Table B. 4 Summary of illustrative extracts on “Pollution and Emission Reduction”

ILLUSTRATIVE EXTRACTS	
Academic 2	“*So the value is protecting the environment, reducing the carbon footprint. That’s the real value*”.
Utility Officer 1	“*…then it becomes even more attractive because then the oil mills who are normally accused of polluting the environment can say we are mitigating the effects. So, it is business profit as well as image*”.
Manager 2	*“So, with this feed-in tariff for the biogas generation, basically it’s cutting down all these greenhouse gases that is damaging to environment”.*
Manager 3	*“…water that comes out after the waste water treatment will be very much improved because of this biogas, new biogas technology…”*
Consultant 2	“*So, you reduce the CO2 emission. Because when you got more this type of plant, then we will burn less fossil fuel in power plant”.*
Consultant 3	*“…when environment clean indirectly society also because the last time when you bought a house near to the palm oil mill, you can have …dust and also this odour problem but now if this is controlled, then no problem at all”*.

Table B. 5 Summary of illustrative extracts on "Distributed Generation"

ILLUSTRATIVE EXTRACTS	
Utility Officer 2	*"…the renewable energy plant is distributed generation and if it's located in rural area and it can supply the load in that area, …… the grid doesn't have to send the power all the way to that particular area."* *"Social, in terms of reducing the generation shortfall".*
Utility Officer 3	*"For those isolated places, like I said, it would be more practical to do what you call this, this like, what to say more of a distribution, real generation and better generation…Because I think, one of the basic necessity of the society is electricity."*
Manager 2	"*…having what we call a small power producer that is aiding them, supporting them in providing quality power into a remote area."*
Consultant 2	*"So, let's say in future, the grid got problem. So, then they can use the local RE plant to support the area".*
Utility Officer 1	"*these renewable power plants help to support the grid, strengthen the grid and stabilise the power supply. At the same time, we allow the opportunity to extend supply to remote communities".*
Manager 3	"*…relieve the cost of generating power to supply to remote areas".*

Table B. 6 Summary of illustrative extracts on "Job and skill creation"

ILLUSTRATIVE EXTRACTS	
Consultant 2	"*I think society near the area will actually have more job opportunities for them".*
Utility Officer 1	*"Not just the direct job creation, for example, transport, other services, repairs and maintenance. All those go to the society there, in general creating… Well, cottage industries and service industries".*
Academic 3	"*it has created also a business in biomass fuel. Not only those projects are using the fuel to generate power to the grid, but there are also businesses who are now buying biomass, selling biomass….So there is a business that is created plus also jobs".*
Manager 3	*".. provide opportunities to all the youth in the remote areas"*
Manager 2	*"…a transformation for the rural area as well, because we are talking about household benefitting from it because it's a job creation for them and not*

	just job creation at the lower level but this is a skill level".
Consultant 3	"*In terms of numbers, it is not like, factory, where you can have 200, 300 people".* (Note: Consultant 3 differs on the significance of this value created)

Table B. 7 Summary of illustrative extracts on "Grid connection cost"

ILLUSTRATIVE EXTRACTS	
Academic 2	"*I heard a lot of people complaining that the connection cost is expensive".*
Manager 1	*"The costs of installing long transmission cables becomes prohibitive".*
Academic 1	*"… you have to bring your own power into the substation which may be a very long distance from your power plant and that can cause a lot of huge capital investment on it".*
Utility Officer 1	"*the developer should bear that interconnection cost. But the utilities of the federal government should provide the grid in a close enough place so that it doesn't go more than 10km. In fact, I would say that the interconnection from the power plant to the system grid should be less than 5km".*
Utility Officer 2	*"is one of the hurdles that you have to go through…..It's very variable"*
Academic 3	"…*if the cost is really the concern….it boils down to the site selection".*

Table B. 8 Summary of illustrative extracts on "Surcharge paid to RE fund"

ILLUSTRATIVE EXTRACTS	
Utility Officer 1	"*It is cost to society, definitely. Again, I believe that society would not be unwilling to pay that".*
Consultant 2	, "*….you see now, the renewable energy is actually subsidised by you and me…..The 1.6% where does it come from? Come from our electricity bill. We subsidise the thing".*
Utility Officer 2	"*Yes, it's a cost to society".*
Manager 2	*"….destroyed in the sense they have to pay more but I think if we compare in the region, I think Malaysian electricity is still cheaper".*
Official 1	"….*1.6%, of course, it is some loss but if you compare with other countries also trying to encourage renewable energy, it is the lowest in the world. The lowest, not one of the lowest, but the 'lowest' in the world".*

Utility Officer 3	*"I think in the long run, eventually because of grid parity, this will diminish and will be abolished*.

Table B. 9 Summary of illustrative extracts on "Feedstock price fluctuation"

ILLUSTRATIVE EXTRACTS	
Academic 3	"*…need to do your economic analysis and find out how sensitive is the project to fluctuation in prices, because one thing is that if you have to go out and buy, it may triple the price….That could totally damage the project. But if it is from your own sources and you can avoid the cost , so may still not damage your project. So, need to have security of supply of the feedstock"*
Academic 1	"…..*supplying under a long term contract is very difficult…everyone is still wait and see. They are trying to wait for the better price of the biomass."*
Consultant 1	*"Availability and price of Biomass as feedstock has been affected in particular it has increased in value because of the extractable oil content".*
Consultant 2	"*Because last time they are free, how to throw the thing. But when you collect, they see, you must have me, without me you cannot survive. Then it became a problem already. They want RM2.00, RM3.00 per ton. Or RM5.00 per ton or something like that"*.
Official 3	*"…for example, China, they used to buy our Empty Fruit Bunches (EFB) in fibre form for their furniture. Suddenly they don't want to buy…..So suddenly the market affected…..But you will know that now the price increasing, is really increasing because of organic fertiliser"*
Utility Officer 2	*"the government should step in and probably… I'm not sure whether it's possible or not to control the prices"*

Table B. 10 Summary of the illustrative extracts on "Transportation of feedstock"

ILLUSTRATIVE EXTRACTS	
Utility Officer 2	*"…the lorries that delivering it, they are using fuel, for example from one end to the other end, you consume how much fuel for your transport"*.
Academic 1	*"You consume a lot of energy to logistic your raw material, biomass".* "*Once you exceed 50 km radius, very difficult because the logistic cost becomes very high"*
Manager 1	Empty fruit bunch (EFB) *"has a low bulk density and requires large trucks to*

	ferry it economically".
Consultant 2	*"Also pollution as well. With all the lorries going through the rural area to collect all these kind of things, also create some local issue".*
Utility Officer 1	*"if you have excessive transport of the feedstock, then you are creating some amount of emissions".*
Official 3	*"Even though we claim that this is a clean technology, but the truck is the one that releases the most carbon footprints along the supply chain and in Malaysia nobody is talking about the supply chain optimisation".*

Table B. 11 Summary of illustrative extracts on "Fit quotas"

ILLUSTRATIVE EXTRACTS	
Academic 1	*"Some companies actually can produce more than they're awarded".*
Academic 2	"*Is it easy for you to get the feed-in tariff? From what I heard it's not easy. There are quotas".*
Consultant 1	*"restrictive with the quota system".*
Manager 1	"*The current practice of obtaining the approval primarily on the basis of the quota system is defective as it does not take into account the competency of the project developer and the level of completion of the project"* .
Utility Officer 1	"*Now a lot of this money from this 1.6% has been going to solar. And yet being given exorbitant rates. They should not be given such lucrative rates. And if those rates were more fair, more money will be available for energy efficiency and as well as probably more for the biomass and biogas."*
Manager 3	*"…see how much they can generate and inject into the grid. That would promote renewable energy in a better way rather than restricting us to certain quotas and how much we can put into the grid, inject into the grid. So I would say they should review this fixed quota."*

Table B. 12 Summary of illustrative extracts on “Lack of awareness”

ILLUSTRATIVE EXTRACTS	
Academic 1	“*It’s not very clear. Some people are not aware of this. Some of the financier, some, I would say some, they are still very reluctant to do because they are not aware of that”.*
Academic 2	“*The bank is afraid or not sure. But who is evaluating at the bank level? Is it someone who very familiar with power generation? If I’m not so familiar with power generation I’m not sure whether the project will succeed”.*
Consultant 3	*“Try first and then only you know, but before that nobody knows; that is the problem”.*
Consultant 2	“*So, that’s why the biogas starting very slow because they don’t know whether can succeed”*.
Official 1	“…*even though SEDA have done a quite a few stakeholder engagement, especially on Solar PV, but still the common comment is still awareness”.*
Utility Officer 1	“*Over the last 8 to 10 years, they have become well aware of it”*[1]

Table B. 13 Summary of illustrative extracts on “Lack of local technology and expertise”

ILLUSTRATIVE EXTRACTS	
Consultant 2	*“ I think it’s still lack of local expertise. Because like until now,… , if you look engine, we still need the support from manufacturer. Maybe quite a costly thing”.*
Academic 2	*“..we see a lot of failures…..So that happens because people don’t know how to evaluate. They buy from overseas”*
Official 1	*“Because they use gas engine from China proper, only for 20% efficiency, and then they give you some chemical trouble. You know they need to remove the hydrogen sulphide but here the hydrogen sulphide has gone into the engine and eaten up the engine and so on”.*
Consultant 1	*“You cannot get experienced workers….If you don’t have enough of people to run it you are in trouble”*.
Manager 2	*“….when we have a biomass plant and biogas plant in remote area, the vocational skill or the people, resources is not so easily available”*
Utility Officer 3	*“we are still on a learning curve, because this renewable energy technology is something new in Malaysia. So but I would say maybe, going in the right direction”.*

[1] Utility Officer 1 differed with the majority over this theme.

Table B. 14 Summary of illustrative extracts on “Combined Heat and Power (CHP)”

ILLUSTRATIVE EXTRACTS	
Manager 1	*“Standalone biomass power plants currently operating without CHP in Malaysia is wasteful. There is a lot of potential heat that can be tapped off from the turbine”*
Utility Officer 3	*“…..why they go for combined heat power is because it’s more of efficiency, plant efficiency. Basically you are getting, optimising the resources, use of resources. So… so… well, that would be the what you call this value missed”*
Manager 2	” *if we can, of course we prefer to have a Combined Heat and Power (CHP) because that will avoid the redundancy of having a separate boiler to power the palm oil mill”.*
Utility Officer 2	*“It’s value wasted basically. If it’s right next to the mill, it will be good. Because you can actually use the steam for your process*”
Consultant 3	“*cannot be helped if you are away from other industry. This one is just to help the other industry”*
Academic 1	*“Currently, I don’t see much emphasis on this Combined Heat and Power (CHP). To be frank, should be the way to use the energy…”*

Table B. 15 Summary of the illustrative extracts on “ENCON type fund”

ILLUSTRATIVE EXTRACTS	
Manager 1	*“The ENCON Fund is funded by a levy of USD0.002/L on petroleum sold in Thailand. This is good as it directly discourages the use of fossil fuel, and is a fairer plan than to tax electrical consumers like for example in Malaysia”.*
Focus Group 1	*“There should be an ENCON type of fund to replace the Renewable Energy Fund as a bigger fund and it can be applied to energy efficiency as well”.*
Academic 1	*“I do support the idea. If we can have it in Malaysia, that will be very good”.*
Manager 3	*“it’s a levy on fossil fuel, because they are trying to inject more renewable energy and reduce fossil fuel generation, you see. I think this should be promoted”.*
Manager 2	“ *it is basically better, I would say to tax the polluter, in this case fossil fuel energy player”.*
Official 1	“*That’s a much better idea than collecting from the people”.*

Table B. 16 Summary of illustrative extracts on “Location-specific bonus tariff”

ILLUSTRATIVE EXTRACTS	
Manager 1	*“I feel this special bonus tariff is good as it encourages the development of renewable energy in rural areas in Malaysia like the state of Sabah which is still heavily relying on high polluting diesel-powered electrical generation”.*
Manager 3	“*we should consider encouraging investor to invest with a better rate and by doing so, the rural electrification will be satisfied”.*
Academic 1	*“Sabah… They are the ones who really we should promote RE because one thing is their grid connection is not as well as compared to West Malaysia. So in a lot of area, they are actually still lacking power”.*
Academic 2	“….*actually in Sabah a lot of the power is generated from diesel engine and the price of the diesel engine per kilowatt hour is very high….So even if they give bonus for the FiT , still have a net gain”*
Utility Officer 2	*“Higher rate especially in value-added places such as the east coast of Sabah”.*
Official 1	*“Actually there has been a lot of request for that,…, maybe that Sabah should be special case……, my professional opinion, I support that”*

Table B. 17 Summary of illustrative extracts on “Off-grid Feed-in Tariff”

ILLUSTRATIVE EXTRACTS	
Manager 1	*“by means of this off-grid tariff, the RE generator is still paid the tariff, which encourages them to replace or avoid the use of fossil fuel”*
Official 1	*“I think that will be quite difficult to do because RE Fund is limited. So if you want to do that, we actually need to expand the RE Fund, much more….It has been suggested to SEDA before, we should pay for all the generation, and then whatever export should pay additional”.*
Focus Group 1	*“In UK self-generation is viable because many of those who do self-generation have a fairly high demand themselves however in Malaysia self-generation may not have enough demand as most palm oil mills already have surplus power even without the biogas plants”.*
Utility Officer 3	“*I think, for this initiative to be sustainable, the fund must be available also”*
Consultant 1	*“Yeah. How can you get paid? You want to get paid from all angles”.*
Utility Officer 2	*I think should get some tax incentive…Shouldn’t be feed in tariff, like that”.*

Table B. 18 Summary of illustrative extracts on “Grid connection cost borne by the Utility”

ILLUSTRATIVE EXTRACTS	
Utility Officer 1	"*the developer should bear that interconnection cost. But the utilities should provide the grid in a close enough place so that it doesn't go more than 10km".*
Utility Officer 3	"*…my view is it should be borne by the developer. Because, you see, the project is mooted by the developer and interconnection is part and parcel of the cost".*
Consultant 3	"*To me because the utility is buying from us. In fact, the sub-station SSU also should be under them, should be theirs…That means outgoing from our plant is theirs. That should be the way".*
Academic 1	*"For the initial stage, if you want to fully encourage biogas or biomass plant, utility has to bear the cost for the interconnection, maybe at least, for the first 10, 20 % of the plant. Then move on and then probably can share the profit".*
Manager 1	*"grid interconnection costs should be shared on a 50:50 basis"*
Consultant 2	"*Don't ask the FiT plant to bear everything….I think utility should take portion of it. Because utility also benefit from this scheme".*

Table B. 19 Summary of illustrative extracts on "Centralised large-scale biomass power generation"

ILLUSTRATIVE EXTRACTS	
Academic 1	"*We call it central utility hub whereby you can collect all the material and centralise the power generation".*
Manager 1	*"Large scale biomass power plants are not feasible due to the logistics involved in bringing the feedstock to the power plant".*
Consultant 2	*"…because it is largescale, I think very difficult to get feedstock".*
Utility Officer 1	*"..it will mean a lot of transport cost and emissions of transport".*
Utility Officer 2	*"I don't think it's a good idea. It defeats the purpose of distributed generation concept".*
Official 1	*"..the palm oil miller should be the one actually doing the biogas and also biomass. Whatever feedstock he can secure, comfortably, that means its own; sure to get some from some friendly party. Only that, 5-6 MW. Because if you keep on going for these large ones, definitely will get into problems".*

Table B. 20 Summary of illustrative extracts on “Time-differentiated tariff system”

ILLUSTRATIVE EXTRACTS	
Academic 1	*“…in the day time there is always the higher power consumption. So we should encourage the generation in the day time and they can run down at night time. So you should have a different tariff”.*
Utility Officer 1	“*…it should be on time-differentiated tariff so that the feed stock is used most efficiently to produce highest amount of power when the feed demand is there”.*
Utility Officer 2	*“it’s a good idea. In the future when the infrastructure is ready, I think that will be the way”.*
Manager 3	*“I do not quite agree with these peak and off-peak rates…we should encourage all the renewable energy plants, whether it’s biogas or biomass, to generate to its maximum in fulfilling what we call to reduce the air pollution”*
Manager 2	*“not good for plant operator”* “*I think, because our investment is based on the, what do you call that, installed capacity. We must be running up to the full capacity”.*
Consultant 2	*“If let’s say at the off-peak, they want to pay lower, I think the FIT plant will have problem. Because they are not a big scale plant, you know ; because their capital investment, then they will have longer payback”*

Table B. 21 Summary of illustrative extracts on “Green grid”

ILLUSTRATIVE EXTRACTS	
Official 1	*“..the Government will fund the green grid. Under the green grid, we have collector stations. That means the biomass plant or the biogas plant will extend 11kV only up to this collector station, rather than all the way to the grid”.*
Utility Officer 3	*“basically to enhance further the development of renewable energy generation, especially in those remote areas”.*
Official 3	*“They have to enhance it with the proper location selections. All these is about the optimisation. So where is the location for this collector substation, so how many mills surrounding them. So everything has to be calculated and the distance back to the main grid and so on”.*
Consultant 2	“*So, maybe with too many plants injecting, maybe difficult for the utilities to control. If let’s say the area got many plants, should consider a centralised*

	injection point".
Utility Officer 1	*"Bonus for Sabah is actually not necessary ….what is more important and desirable for Sabah is extension of the grid to enable these plants to feed into the grid".*
Utility Officer 2	*"talking about the green grid for some time already"* *"…in the very early stage".*

Table B. 22 Summary of illustrative extracts on " Bio-fertiliser"

ILLUSTRATIVE EXTRACTS	
Manager 2	"*In biogas plant for example, the belt press and dewatering press cake can still be used as, what do you call this, fertiliser. And likewise for biomass plant, the boiler ash, in fact, we have started to sell our boiler ash now. And we are also considering how to blend this ash and cake so that it gives a better fertiliser".*
Academic 2	*"to me it is definitely a good bio- fertiliser. This is part and parcel of what I say recycling everything…So you want to do biogas the cakes must be put back to the estate".*
Manager 3	*"using biogas residues as bio-friendly fertiliser is actually a very good thing…..so I think we need to promote that it is bio-friendly".*
Academic 1	*"transforming the entire palm oil into zero waste discharge from the mill and bio fertiliser is one of the good product that can actually help us to mitigate a lot of our ways and it's actually close the cycle where because of the fertiliser, we can send back to the plantations where you can return the nutrient back".* *"the concept of bio-refinery where you can produce multiple products. So how it works is, because when you have multiple products, that means your system will be more robust"*
Manager 1	"*A new bonus tariff for converting the by-product of the biogas plant into eco-friendly bio-fertilizer should be welcomed"*
Official 1	*"yes, definitely"*

Table B. 23 Summary of illustrative extracts on “Promotion of awareness”

ILLUSTRATIVE EXTRACTS	
Official 3	“*…it involves the awareness of the policy maker plus the investor”* and “*financier as well”.*
Academic 1	*“So education is important. So how do we educate every different sectors, not only the green technology provider, you have to educate the bankers, financing institute so how they look at all these technologies”.*
Official 1	*“..we have been trying to have workshops, where we get the stakeholders to come”.*
Consultant 2	*“..make it more simple and publicise it in the SEDA's website, then let people know what type of incentive they can get from government”.*
Manager 3	*“..as time goes, they should improve their website so that it will be not only renewable energy investors but even ordinary people can go into it and see”.*
Utility Officer 3	“*…have continuous promotion of awareness program”.*
Consultant 2	“*Because everything you must educate from young, only in future they know about green energy”.*

Table B. 24 Summary of illustrative extracts on “Promotion of local technology and expertise”

ILLUSTRATIVE EXTRACTS	
Manager 2	*“.. it would have been better to have more training and education to enable the people to operate the machineries and the power plants…There should have been more encouragement and then more incentive to teach and learn English because you would be surprised that many people unable to read a multimillion dollar machinery manual”.*
Consultant 2	“*HR training fund. Let’s say others want to operate this type of plant, then they can send new employees to the existing running biomass or biogas plant. The existing plant let them train, then get some subsidy from HR fund”.*
Utility Officer 2	“*I think should promote more”.*
Official 1	“*one of the things that actually SEDA has done is to train people…What we have done so far is sporadic , you know, only once a while but actually now, we want to have a proper training”*

	"*We think over the long run the local assembly bonus will contribute to the advancement of local technology".*
Utility Officer 1	"*Local manufacture or local assembly.... because we need to encourage that additional industry for the national base. It is good because once you have local industry built up with these incentives, they also have the opportunity to market their products in the region"*
Consultant 2	"..*local assembly bonus for RM 0.05, actually do you know it creates like a monopoly business…..You cannot say the other engines cannot work. It's just because they are not "locally assembled". This "local assembly" bonus is, you know, very vague".*
Academic 3	"*there should be more promotion because we have not seen much development or more efficient types of biomass plants and biogas plants over the past 10 years or so" ; "Local assembly should have been another kind of incentive. That should be a business development incentive by the Ministry of International Trade and Industry (MITI) or its agency, Malaysian Investment Development Authority (MIDA)…So under MIDA there can be incentives to grow certain businesses within Malaysia…..But I don't think the feed in tariff has something to do with that".*

Table B. 25 Summary of illustrative extracts on "Promotion of CHP"

ILLUSTRATIVE EXTRACTS	
Manager 1	"*Combined heat and power is a more efficient way to utilise energy".*
Manager 3	"*Combined heat and power definitely because, in fact, we are tapping almost the full energy of it. With the combined heat and power, we will be able to reduce the fuel consumption for other processes"*
Utility Officer 3	"..*if we are to optimise the resources, country resources, that would be the way to go".*
Utility Officer 1	*"have all the renewable energy power plants linked with the mills. And the mills, who are currently operating at very low efficiency just to dispose their waste, can operate at higher efficiency. Their steam requirements, their electricity requirements and their waste disposal becomes more effective and more efficient and you get ideal quantity of electricity as well as opportunities for thermal energy for anybody who needs it there".*
Utility Officer 2	"*I think it should be incorporated with palm oil mills. So that the palm oil mills can use the steam".;* "*I don't think CHP bonus tariff is necessary. Because the power plant owners will get additional value from there already".*

Official 1	*"Actually that is one the things that SEDA will really like to promote. CHP, Combined Heat and Power".* *"We proposed to have a FiT rate for CHP. For CHP basically".*

Table B. 26 summarises the illustrative extracts on "Regulatory weaknesses (SEDA)"

ILLUSTRATIVE EXTRACTS	
Manager 1	*"SEDA does not seem to have enough clout to steer the boat".*
Academic 2	*"Status of implementation I think is not satisfactory. So who is responsible for that incentive is not doing enough".*
Utility Officer 1	*"I've made the joke that SEDA is not really a sustainable authority but a Solar Energy Development Authority".*
Utility Officer 2	*"They should do more. Facilitate the growth"*
Consultant 2	.*"…commissioned ones and whatever SEDA approved are very far away, you know, for the biogas and biomass".*
Official 1	"*if without SEDA, we would never have gone so far".*

Table B. 27 Summary of illustrative extracts on "Adequacy of incentives"

ILLUSTRATIVE EXTRACTS	
Academic 1	*"Incentives should be higher….biogas and biomass are much lower as compared to solar photovoltaic (PV) although I understand that solar photovoltaic (PV) is higher capital investment but still, you want to attract the investors".*
Manager 2	*"the incentives could have been better"*
Manager 3	*"from the business point of view, it would be better if it's slightly higher"*
Utility Officer 2	*"I gather that biomass rates are not that attractive as compared to biogas…Biomass rates could be better"*
Consultant 2	*"…..these rates going to be fixed for 16 years, maybe not fair…… let's say for the future overhaul all the spare parts…..But then the spare part, the price increases. They need to bear so it's not fair for them".*
Utility Officer 1	*"The green technology financing scheme is in my opinion less effective".*

Table B. 28 Summary of illustrative extracts on “Feedstock supply”

ILLUSTRATIVE EXTRACTS	
Academic 1	*“It’s a challenge. It’s totally a challenge. Only with companies or larger company, they have the mills, have the plantations themselves, then, they have easier access to the biomass feedstock. Then, it’s easier to operate a power plant themselves”.*
Consultant 1	*“If you don’t have the feedstock you are just dancing with the devil, asking for problems that you don’t need’*
Manager 3	*“I think the biggest challenges are feedstock and interconnection. These are the biggest challenges that we face, so far”.*
Manager 1	*“…there is now a growing trend to convert biomass feedstock especially empty fruit bunch (EFB) into value added products. This will eventually put pressure on the availability of oil palm biomass for power generation”.*
Manager 2	*“Shell, even the empty fruit bunch (EFB) because we have competition from long fibre, short fibre use as well……I think it's going to be a challenge”.*
Official 1	*“Because no long-term feedstock contract, the banks will not consider”*

Table 5. 29 Summary of illustrative extracts on “Impact of National Biomass Strategy”

ILLUSTRATIVE EXTRACTS	
Manager 1	. *“The National Biomass Strategy focuses on the higher value added-uses of biomass. As such, this will cause a heavy demand for biomass , thereby driving prices of feedstock upwards”.*
Utility Officer 1	“*because of the National Biomass Strategy, a lot of those who do not have a direct investment in the renewable energy plant have taken advantage of the situation to overvalue their waste. When you overvalue the waste, the chance of the projects being viable reduces”.*
Academic 1	“*The Strategy actually claimed there are plenty of biomass that are unutilised. Unfortunately, I would say those biomass are controlled by certain agencies or companies….So that’s why biomass power plant, they face the issue of getting the biomass or constant supply biomass”.*
Consultant 2	“*In fact there will be, I think, fighting for the feedstock. So this is something the Government has to look at”.*
Consultant 3	*“We should concentrate on the palm oil mill and related business rather than come up with another business which is away from it”.*

Official 1	*"I think it has a minor effect because in my frank opinion, the National Biomass Strategy won't work".*

Table B. 30 Summary of illustrative extracts on "Interconnection difficulties"

ILLUSTRATIVE EXTRACTS	
Manager 1	*"..unnecessary demands by the power utility company. This has caused delays….The decision making process to approve certain tests is slow due to the frequent changes and transfer of manpower and engineers involved in the project. This causes unnecessary delays in the project…The level of cooperation is considered low".*
Manager 3	*"I think grid interconnection now, we have to deal with too many departments within the utility".*
Manager 2	***"**I think it is still vague ……I see more like negotiation between the consultant and the utility"*
Consultant 2	*"whatever that we supply for interconnection to the utility, the specs is actually higher than the utility's"*
Consultant 1	*"Whims and fancies so that they can change"*
Academic 1	*"You need to fulfil. If you can, you do it. If you cannot, leave it. They are very firm on their certain specs. So it's a challenge for the renewable energy developer"*

Table B. 31 Summary of illustrative extracts on "One-stop centre"

ILLUSTRATIVE EXTRACTS	
Manager 2	*"..many departments here to deal with, you see. So,…one stop centre, then all this information disseminated and developers are able to comprehend what is required of them"*
Manager 1	*"I feel a one stop department be set up to coordinate the processing of the many licenses and submissions that a project developer has to carryout".*
Manager 3	*" I think grid interconnection now, we have to deal with too many departments within TNB or SESB.... I hope that SESB or TNB can have a separate department, just to cater for all these. Another one stop agency".*
Consultant 1	*"project developers, technocrats, financial instructions, Government agencies and SEDA are within the policy framework. However their efforts are not in harmony".*

Consultant 2	*"SEDA need to do more, they need to actually work more with the TNB or SESB".*
Academic 1	*"centralised means someone has to direct from the top and oversee the utility, the relevant party to work together and stay together. That is the key".*

Table B. 32 Summary of illustrative extracts on "Review of incentives"

ILLUSTRATIVE EXTRACTS	
Manager 1	*"incentives should be reviewed from year to year"*. "*fiscal incentives should be extended beyond 2015 so that more players in the renewable energy sector can participate".*
Academic 1	*"More incentives can be given as been discussed previously, so to help promote renewable energy (RE)"*
Consultant 3	"*I think having a two or three-stage rate is better. First five year, we give you better rate, so at least you can recover your money first. Then second, third, is just maintenance and then cheaper rate doesn't matter"*
Official 1	*"So we know something is wrong, you know, they have not constructed. So biomass, I would say we should have a review"* *"Actually they are quite good, like Green Technology Financing Scheme (GTFS) subsidising 2% of borrowing cost and then the Investment Tax Allowance (ITA). But the sad thing is that many of these are coming to an end…….should be extended".*
Utility Officer 2	*"…..because of that feedstock risk, I think……biomass power plants should be given extra compensation for that risk"*
Utility Officer 1	*"fiscal incentives should be extended"*

Table B. 33 Summary of illustrative extracts on "Feedstock ownership"

ILLUSTRATIVE EXTRACTS	
Academic 1	*"If you don't have sufficient feedstock, your operation will be a challenge. If you own yourself, you have your own mill and then you can. I would say at bare minimum, it's 50%.........but if you can up to 70%, that's the best. At least, you can control your own materials and then you can control the entire plant and then you can operate very confidently and consistently".*

Official 1	*"At the minimum they should have 50%, very minimum, but to be comfortable, would be 70%"*
Utility Officer 3	*"at least they should have, you know 50%"*
Manager 3	*"I think at least 50%".*
Consultant 1	*"You should have at least 70% fuel on your own….Basic number one is that I have control over my fuel".*
Manager 2	*"I think something between 60-70% that will be…. quite comfortable level"*.

Table B. 34 Summary of illustrative extracts on "Transparent interconnection requirements"

ILLUSTRATIVE EXTRACTS	
Manager 2	*" it should have been shortened and made easy by having everything spelt out and made it into a proper checklist of what is required….By right the Utility should have been able to identify what is needed so that when everything is spelt out, I think it's easier for the renewable energy developer to comply".*
Academic 3	*"by right the developer should not actually negotiate and discuss the technical requirements with the Utility…..It should be the role of the regulator to make sure that it is clear what the rules are….They should create that level playing field for everybody in the power system"* *"there should be a grid connection code and it should be monitored by the Energy Commission, to whom the developer can complain".*
Official 1	"*The Technical and Operational Requirements basically are not too bad, I wouldn't say they are very good, but they are not too bad. But the major problem is the Utility is not following the Technical and Operational Requirements….., and then insist on a particular brand, what is the logic, why should you ask for particular brand…You should give technical specification, not specify a brand"*
Consultant 2	*"SEDA has to work together to determine where is the possible injection point and come out in the SEDA website. Then whoever want to do, they go to website and check".*
Utility Officer 3	"*To be transparent, I don't think that is an issue".*
Utility Officer 2	*" should be publicised"*

APPENDIX C

CERTIFICATE OF APPRECIATION

THE

INSTITUTION OF ENGINEERS

MALAYSIA

Established *May 1959*

THE INSTITUTION OF ENGINEERS MALAYSIA

Certificate of Appreciation

To

TAN SRI DATO' SERI MAH KING THIAM

For delivering the **Keynote Lecture** on

Oil Palm Renewable Energy Businesses in Malaysia: Challenges and Value Opportunities

At the

3rd International Green Workshop & Exhibition
on
GREEN ENERGY AND ENVIRONMENT WITH INNOVATIVE INFRASTRUCTURE AND BUILDING DESIGN

(BEM-Approved CPD/PDP hours = 11)
(Ref. No. IEM16/HQ/414/W)

Held on

4 & 5 October 2016

At

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Ir. Dr. Ooi Teik Aun
Organizing Chairman
IEM CESIG